Vivekanand Education Society's
Institute of Technology

(Affiliated to University of Mumbai, Approved by AICTE & Recognized by Govt. of Maharashtra)

INDEX

1.3.2 Experimental learning through project work/field work/internship as prescribed by the affiliating university / affiliating university curriculum For Year 2020-21

UG-First Year Engineering

Sr. No	Subject Code	Subject Name	Count
1	FEC102,FEL101	Engineering Physics-I,Engineering Physics-I	2
2	FEC103,FEL102	Engineering Chemistry-I,Engineering Chemistry-I	2
3	FEC104,FEL103	Engineering Mechanics,Engineering Mechanics	2
4	FEC105,FEL104	Basic Electrical Engineering,Basic Electrical Engineering	2
5	FEL105	Basic Workshop practice-I	1
6	FEC202,FEL201	Engineering Physics-II,Engineering Physics-II	2
7	FEC203,FEL202	Engineering Chemistry-II,Engineering Chemistry-II	2
8	FEC204,FEL203	Engineering Graphics,Engineering Graphics	2
9	FEC205,FEL204	C programming,C programming	2
10	FEC206,FEL205	Professional Communication and Ethics- I,Professional Communication and Ethics- I	2
11	FEL206	Basic Workshop practice-II	1
		Total	20

AC: Item No. 4.40
Date: 26TH July, 2019

UNIVERSITY OF MUMBAI

Bachelor of Engineering

First Year Engineering (Semester I & II), Revised course

(REV- 2019'C' Scheme) from Academic Year 2019 – 20

(Common for All Branches of Engineering)

Under

FACULTY OF SCIENCE &TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that in the present system, the first year syllabus is heavily loaded and it is of utmost importance that the students entering into the first year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a student to get accustomed to the new environment of a college and to create a bonding between the teacher and a student. In this regard, AICTE has provided a model of Induction Program, which has been accommodated with certain modification and also overall credits proposed by AICTE in their model curriculum.

The present curriculum will be implemented for First Year of Engineering from the academic year 2019-20. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2020-21, for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. Suresh K. Ukarande
Dean (I/C)
Faculty of Science and Technology
Member, Senate Academic Council
Board of Dean's, BOEE, RRC
University of Mumbai, Mumbai

Structure for

Student Induction Program

New students enter an institution with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Transition from school to university/college life is one of the most challenging events in student's life. Therefore, it should be taken seriously, and as something more than the mere orientation program.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

New students be informed that the Induction is mandatory non-credit course for which a certificate will be issued by the institution.

At the start of the induction, the incumbents learn about the institutional policies, processes, practices, culture and values, and their mentor groups are formed. The different activities are:

1. **Orientation**: In the first session of Induction program learners and parents to be oriented about institute policies, processes, practices, culture and values. In addition to this, learners will be educated for 1st year academic program information in terms of academic calendar, Assessment plan, grading information, university ordinances, rules and regulations related to academics.

2. **Mentoring**: Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring process shall be carried out in small groups, group of 10 students to be formed and allocate one senior student from 3rd year of same program in which new students have taken admission, students mentor will continue for two years, till student mentors graduate from the institute. For two (2) such groups one faculty mentor to be allocated from the same department/program, who will remain the mentor till those students graduates from the institute. In the second session of Induction program, groups for mentoring to be formed and student mentors and faculty mentors to be introduced to newly inducted students. Introduction of mentoring system to be given to new students. Minimum one meeting to be

conducted every month during semesters with students group by faculty mentors. For record keeping appropriate formats to be developed and information to be updated regularly by faculty mentors.

3. **Universal Human Values**: Universal Human Values gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

4. **Proficiency Modules**: The induction program period can be used to overcome some critical lacunas that students might have, for example, English, Mathematics, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially.

   A diagnostic test should be conducted on Day 2 itself. Before the test, the students should be informed that the test would not affect their grades, branch change, or any aspect of their admission, placement, study, etc. Purpose of the test is to provide help to those students who need help in English, Mathematics, Computer proficiency etc. Students having more than 80% marks in their qualifying examination in respective subjects need not take the diagnostic test. For those below this cut-off, writing the test is mandatory. Students with weak performance in the test, must attend a non-credit course in Basic English, Basic Mathematics, and Basic Computer Operation etc. Their attending the course is mandatory. There would be no separate fee payable for the course. The classes of Basic courses must start from Day 4 at the latest. Students those who are excluded from basic courses, for them some activity in the domain of creative arts, cultural and literature to be organised.

5. **Physical Activity**: Fitness session, yoga classes, lecture(s) on facing world with sportsman spirit, making young students aware that there is nothing like being failure in the world. The world gives opportunities to all.

   The incoming students must be divided into batches of 50 students maximum, and a qualified coach in physical education/ faculty member should be attached to each batch. The list of available games, sport, or physical activities should be announced in orientation program on Day 1. They should be asked to fill their choice with three preferences, and the game or sport be allotted to them as per their preference. The physical activity should start from Day 3 onwards, wherein the student learns and plays his assigned game during the induction program. It is also important that along with his assigned game the student also practises yoga.

6. **Creative Arts, Cultural and Literary Activity**: Qualified instructors for arts may be hired on contract basis and be paid honorarium as per norms of the institute. Daily 90 to 120 minute sessions may be arranged. The list of available art forms, such as vocal music, instrumental music, folk music, painting, sketching, dance, group dance, clay modelling, pottery, dramatics, etc. should be announced. They should be asked to fill their choice with three preferences, and the art form be allotted to them as per their preference. There should be sufficient number of teachers for each art form. The ratio may be kept as 1 teacher for every 25 students.

   A faculty member interested in literary activity should be assigned for organizing the activity. A list of books which are interesting and educational should be prepared beforehand. Books in Indian languages must be included and even given priority. Students are losing connection with languages in general and their own language, in particular. Students should be assigned a book or other smaller reading material. They should be asked to read and write a critical summary. They should present their summary in front of their group. A literary group may consist of around 30-40 students. Similarly, debating and public speaking activity could also be undertaken. If the college can arrange for a drama workshop where a group of students learn and enact a play it would be very good. Not all the incoming students would do this, but those who wish may be provided the opportunity. Help may be taken from senior students engaged in such extra-curricular activities in the college.

7. **Familiarisation with Institute and Department**: The students admitted in a branch would visit their allotted department or branch. The Head of the department and other associated faculty should address the new student's right on Day 2 or so. Arrangements should be made about the meeting/gathering. The parents of the students should also be welcomed if they accompany their ward. It would be helpful if an alumnus of the Dept. relates his professional experience related to the field of the study to the incoming students.

8. **Lectures /Workshops by Eminent People**: Eminent people from all walks of life may be invited to deliver lectures, namely, from industry, academia, social science (authors, historians), social work, civil society, alumni etc. be identified and invited to come and address the new students. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, S-VYASA university, VivekanandKendras, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops.

9. **Extra-Curricular Activity**: Every college has extra-curricular activities. Most of them are student driven. They are organized by student councils and clubs. The extra-curricular activities going on in the college should be presented to the new students under the guidance of faculty advisors for such activity. The new students should be informed about how they can join the activities. Related facilities should be described to them. Presentation on the activities by the student council should be made.

10. **Feedback and Report on the Program**: A formal feedback at the end of the program should be collected from students by their filling a form in writing or online. Besides the above, each group (of 20 students) should write a report on the Induction Program towards the end of the semester. They would also have to make a presentation of their report. They should be encouraged to use slides while making a presentation. Presentation of the report should be made in the language they are comfortable with, without any insistence that it should be in English. It is more important that they feel comfortable and confident. Each group may make the presentation through 4-5 of its group members or more. In case, the number of new students in a college is large, the presentation should be made by each group in front of 4 other groups besides their own, thus there would be about 100 students (in 5 groups) in the audience in a session. Several such sessions could run in parallel or serially. In each session, their faculty mentors and student guides, if any, should also be in the audience. These sessions would tell you how well the program ran, and what the students are feeling at the end of the program. This would also serve as a grand closure to the program.

    A certificate shall be awarded to all the students, upon successful completion of the induction program based on their report and presentation.

Tentative schedule of 1st Week Induction Program:

Day 1	Session 1	Orientation program
	Session 2	Mentoring (group formation and introduction)
Day 2	Session 3	Diagnostic test (basic English, maths and computer operation)
	Session 4	Familiarisation of Department and Institute (Visits to department, laboratory, Library, Examination cell, office etc)
Day 3	Session 5	Physical Activity (Yoga, sports etc)
	Session 6	Universal human values session
Day 4	Session 7	Proficiency Modules (Short courses on basic maths, English and computer operation etc. for identified students)
	Session 8	Physical Activity (Yoga, sports etc)
Day 5	Session 9	Proficiency Modules (Short courses on basic maths, English and computer operation etc. for identified students)
	Session 10	Creative Arts, Cultural and Literary Activity

A session may be conducted for around 2-3 hours each.

Minimum 12 sessions to be conducted from the following 20 sessions, from 2nd week to last week of academics, throughout the semester.

Session 11	Physical Activity (Yoga, sports etc)- 1
Session 12	Extra-Curricular Activity- 1
Session 13	Physical Activity (Yoga, sports etc)-2
Session 14	Extra-Curricular Activity- 2
Session 15	Physical Activity (Yoga, sports etc)- 3
Session 16	Lectures /Workshops by Eminent People- 1
Session 17	Physical Activity (Yoga, sports etc)- 4
Session 18	Lectures /Workshops by Eminent People- 2
Session 19	Creative Arts, Cultural and Literary Activity- 1
Session 20	Lectures /Workshops by Eminent People- 3
Session 21	Creative Arts, Cultural and Literary Activity- 2
Session 22	Universal Human Values- 1(Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 23	Creative Arts, Cultural and Literary Activity- 3
Session 24	Universal Human Values- 2 (Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 25	Creative Arts, Cultural and Literary Activity- 4
Session 26	Universal Human Values- 3 (Group Discussion among students as per mentoring group on various aspects of life, values, ethics etc.)
Session 27	Creative Arts, Cultural and Literary Activity- 5
Session 28	Physical Activity (Yoga, sports etc)- 5
Session 29	Feedback and Report on the Program- 1
Session 30	Feedback and Report on the Program- 2

For mentoring activity following 4 page format (may be printed as booklet) be adopted by institute for keeping record in detail of students during 4 year tenure by faculty mentor.

NAME OF INSTITUTE

LOGO OF INSTITUTE

Student Mentoring Form

Student's Personal Details	
Name :	Roll No:
Date of Birth:	Male/Female:
Current Address:	
Permanent Address:	
Mobile No:	Email Id:
Father's Name:	
Mobile No.:	Email ID.:
Mother's Name	
Mobile No.:	Email ID.:
Name of The Student Mentor:	
Mobile No.:	Email ID.:
Name of The Faculty Mentor:	
Designation:	Department.:

Student's Attendance Record

Semester	Month / Year :		Month / Year :		Month / Year :	
	Percentage	Signature	Percentage	Signature	Percentage	Signature
I						
II						
III						
IV						
V						
VI						
VII						
VIII						

Student's Academic Performance

Semester	Subject	IA1		IA 2		Prelim		End semester Exam (SGPI)		Signature
I	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
II	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
III	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
IV	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
V	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VI	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VII	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									
VIII	Performance	C	N/C	C	N/C	C	N/C	C	N/C	
	Remark									

Note.:

1. C - Cleared, write percentage or SGPI in Remarks.
2. N/C - write subjects not cleared in Remarks.
3. If students cleared subjects in next academic year kindly circle “N/C” and click On “C”

Student's Co-curricular Activities

Semester	Professional Society	Internship	Papers Published
I			
II			
III			
IV			
V			
VI			
VII			
VIII			

Student Mentor's Feedback Semester wise

Semester I	Semester II	Semester III	Semester IV

Student's Extra-Curricular Activities

Semester	Sports	NSS / Social cell	Competition / Participation / Prize / Awards
I			
II			
III			
IV			
V			
VI			
VII			
VIII			

Placement: - Yes / No If yes get following Details:

Company :-
Package :-

Higher Studies.

Exams	GRE	TOFEL	CAT	GATE
SCORE				

If Admitted:-

University :-
Country :-

Program Structure for First Year Engineering
Semester I & II
UNIVERSITY OF MUMBAI
(With Effect from 2019-2020)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
FEC101	Engineering Mathematics-I	3	--	1*	3	--	1	4
FEC102	Engineering Physics-I	2		--	2		--	2
FEC103	Engineering Chemistry-I	2	--	--	2	--	--	2
FEC104	Engineering Mechanics	3	--	--	3	--	--	3
FEC105	Basic Electrical Engineering	3	--	--	3	--	--	3
FEL101	Engineering Physics-I	--	1	--	--	0.5	--	0.5
FEL102	Engineering Chemistry-I	--	1	--	--	0.5	--	0.5
FEL103	Engineering Mechanics	--	2	--	--	1	--	1
FEL104	Basic Electrical Engineering	--	2	--	--	1	--	1
FEL105	Basic Workshop practice-I	--	2	--	--	1	--	1
Total		**13**	**08**	**01**	**13**	**04**	**01**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC101	Engineering Mathematics-I	20	20	20	80	3	25	--	125
FEC102	Engineering Physics-I	15	15	15	60	2	--	--	75
FEC103	Engineering Chemistry-I	15	15	15	60	2	--	--	75
FEC104	Engineering Mechanics	20	20	20	80	3	--	--	100
FEC105	Basic Electrical Engineering	20	20	20	80	3	--	--	100
FEL101	Engineering Physics-I	--	--	--	--	--	25	--	25
FEL102	Engineering Chemistry-I	--	--	--	--	--	25	--	25
FEL103	Engineering Mechanics	--	--	--	--	--	25	25	50
FEL104	Basic Electrical Engineering	--	--	--	--	--	25	25	50
FEL105	Basic Workshop practice-I	--	--	--	--	--	50	--	50
Total		**--**	**--**	**90**	**360**	**--**	**175**	**50**	**675**

*** Shall be conducted batch-wise**

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
FEC201	Engineering Mathematics-II	3	--	1*	3	--	1	4
FEC202	Engineering Physics-II	2	--	--	2	--	--	2
FEC203	Engineering Chemistry-II	2	--	--	2	--	--	2
FEC204	Engineering Graphics	2	--	--	2	--	--	2
FEC205	C programming	2	--	--	2	--	--	2
FEC206	Professional Communication and Ethics- I	2	--	--	2	--	--	2
FEL201	Engineering Physics-II	--	1	--	--	0.5	--	0.5
FEL202	Engineering Chemistry-II	--	1	--	--	0.5	--	0.5
FEL203	Engineering Graphics	--	4	--	--	2	--	2
FEL204	C programming	--	2	--	--	1	--	1
FEL205	Professional Communication and Ethics- I	--	2	--	--	1	--	1
FEL206	Basic Workshop practice-II	--	2	--	--	1	--	1
Total		**13**	**12**	**01**	**13**	**06**	**01**	**20**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC201	Engineering Mathematics-II	20	20	20	80	3	25	--	125
FEC202	Engineering Physics-II	15	15	15	60	2	--	--	75
FEC203	Engineering Chemistry-II	15	15	15	60	2	--	--	75
FEC204	Engineering Graphics	15	15	15	60	3	--	--	75
FEC205	C programming	15	15	15	60	2	--	--	75
FEC206	Professional Communication and Ethics- I	10	10	10	40	2	--	--	50
FEL201	Engineering Physics-II	--	--	--	--	--	25	--	25
FEL202	Engineering Chemistry-II	--	--	--	--	--	25	--	25
FEL203	Engineering Graphics	--	--	--	--	--	25	50	75
FEL204	C programming	--	--	--	--	--	25	25	50
FEL205	Professional Communication and Ethics- I	--	--	--	--	--	25	--	25
FEL206	Basic Workshop practice-II	--	--	--	--	--	50	--	50
Total		--	--	**90**	**360**	--	**200**	**75**	**725**

*** Shall be conducted batch-wise**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC201	Engineering Mathematics-I	3	--	1*	3	1	--	4

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC201	Engineering Mathematics-I	20	20	20	80	3	25	--	125

Course Objectives: The course is aimed

1. to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.
2. to provide hands on experience using SCILAB software to handle real life problems.

Course Outcomes: Students will be able to

1. Apply the basic concepts of Complex Numbers and will be able to use it for engineering problems.
2. Apply hyperbolic functions and logarithms in the subjects like electrical circuits, Electromagnetic wave theory.
3. Apply the basic concepts of partial differentiation of function of several variables and will be able to use in subjects like Electromagnetic Theory, Heat and Mass Transfer etc.
4. Apply the concept of Maxima, Minima and Successive differentiation and will be able to use it for optimization and tuning the systems.
5. Apply the concept of Matrices and will be able to use it for solving the KVL and KCL in electrical networks.
6. Apply the concept of Numerical Methods for solving the engineering problems with the help of SCILAB software.

Module	Detailed Contents	Hrs.
01	**Complex Numbers** **Pre-requisite:**Review of Complex Numbers-Algebra of Complex Number, Cartesian, polar and exponential form of complex number. 1.1. Statement of **D'Moivre's Theorem**. 1.2. Expansion of $\sin^n\theta$, $\cos^n\theta$ in terms of sines and cosines of multiplesof θ and Expansion of sinnθ, cosnθ in powers of sinθ, cosθ 1.3. Powers and Roots of complex number.	**2** **2** **2**
02	**Hyperbolic function and Logarithm of Complex Numbers** 2.1. Circular functions of complex number and Hyperbolic functions. Inverse Circular and Inverse Hyperbolic functions. Separation of real and imaginary parts of all types of Functions. 2.2 Logarithmic functions, Separation of real and Imaginary parts of Logarithmic Functions. **# Self learning topics:**Applications of complex number in Electrical circuits.	**4** **2**

03	**Partial Differentiation** 3.1 Partial Differentiation: Function of several variables, Partial derivatives of first and higher order. Differentiation of composite function. 3.2.Euler's Theorem on Homogeneous functions with two independent variables (with proof). Deductions from Euler's Theorem. **# Self learning topics:**Total differentials,implicit functions, Euler's Theorem on Homogeneous functions with three independent variables.	**3** **3**
04	**Applications of Partial Differentiation and Successive differentiation.** 4.1 Maxima and Minima of a function of two independent variables, Lagrange's method of undetermined multipliers with one constraint. 4.2 Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems **# Self learning topics:** Jacobian's of two and three independent variables (simple problems)	**3** **3**
05	**Matrices** **Pre-requisite:** Inverse of a matrix, addition, multiplication and transpose of a matrix 5.1.Types of Matrices (symmetric, skew- symmetric, Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices and properties of Matrices). Rank of a Matrix using Echelon forms, reduction to normal form and PAQ form. **5.**2.System of homogeneous and non –homogeneous equations, their consistency and solutions. **# Self learning topics:**Application of inverse of a matrix to coding theory.	**4** **2**
06	**Numerical Solutions of Transcendental Equations and System of Linear Equations and Expansion of Function.** 6.1 Solution of Transcendental Equations: Solution by Newton Raphson method and Regula –Falsi method. 6.2 Solution of system of linear algebraic equations, by (1) Gauss Jacobi Iteration Method, (2) Gauss Seidal Iteration Method. 6.3 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion ofe^x sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x), log(1+x),$\sin^{-1}(x)$,$\cos^{-1}(x)$,$\tan^{-1}(x)$. **# Self learning topics:**Indeterminate forms, L- Hospital Rule, Gauss Elimination Method, Gauss Jordan Method.	**2** **2** **2**

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write at least 4 SCILAB tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on (i) Guass Elimination Method (ii) Guass Seidal Iteration method (iii) Gauss Jacobi Iteration Method (iv) Newton Raphson Method (v) Regula –Falsi method (vi) Maxima and Minima of functions of two variables

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	SCILAB Tutorials	10 marks

Assessment:

Internal Assessment Test:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hoursas mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3. Engineering Mathematics by Srimanta Pal and Subodh,C.Bhunia, Oxford University Press
4. Matrices, Shanti Narayan, .S. Chand publication.
5. Applied Numerical Methods with MATLABfor Engineers and Scientists by Steven Chapra, McGraw Hill
6. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition. John Wiley & Sons,INC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC102	Engineering Physics-I	2	-	-	2	-	-	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC102	Engineering Physics-I	15	15	15	60	2	--	--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai.

The topic distribution is being done in systematic manner and whenever required, prerequisite to the topic are mentioned for frictionless teaching–learning process. In the distribution of topics, core physics and its applied form are given priority. At the same time few modules are introduced over emerging trends in the field of technology.

For the purpose of emphasis on applied part, list of suggestive experiments is added. As per new guidelines of AICTE, a scope is kept in the syllabus for simulation technique and use of information technology to supplement laboratory practices. Further, it is ensured that these modules will cover prerequisites needed for engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects in respective branches.

Objectives

1. To understand basic physics concepts and founding principles of technology.
2. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Outcomes: Learners will be able to…

1. Illustrate the fundamentals of quantum mechanics and its application.
2. Explain peculiar properties of crystal structure and apply them in crystallography using X-ray diffraction techniques.
3. Comprehend the concepts of semiconductor physics and applications of semiconductors in electronic devices.
4. Employ the concept of interference in thin films in measurements.
5. Discuss the properties of Superconductors and Supercapacitors to apply them in novel applications.
6. Compare the properties of engineering materials for their current and futuristic frontier applications.

Module	Detailed Contents	Hrs.
01	**QUANTUM PHYSICS** (**Prerequisites** : Dual nature of radiation, Photoelectric effect Matter waves-wave nature of particles, de-Broglie relation, Davisson-Germer experiment)	07

	De Broglie hypothesis of matter waves; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg uncertainty principle; non existence of electron in nucleus; Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well, Quantum Computing.	
02	**CRYSTALLOGRAPHY** (**Prerequisites** : Crystal Physics (Unit cell, Space lattice, Crystal structure, Simple Cubic, Body Centered Cubic, Face Centered Cubic, Diamond Structure, Production of X-rays) Miller indices; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer;	**03**
03	**SEMICONDUCTOR PHYSICS** (**Prerequisites**: Intrinsic and extrinsic semiconductors, Energy bands in conductors, semiconductors and insulators, Semiconductor diode, I-V characteristics in forward and reverse bias) Direct & indirect band gap semiconductor; Fermi level; Fermi dirac distribution; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; mobility, current density; Hall Effect; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Applications of semiconductors: LED, Zener diode, Photovoltaic cell.	**06**
04	**INTERFERENCE IN THIN FILM** (**Prerequisites** : Wave front and Huygen's principle, reflection and refraction, Interference by division of wave front, Youngs double slit experiment) Interference by division of amplitude, Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film; Newton's rings. Applications of interference - Determination of thickness of very thin wire or foil; determination ofrefractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surfaceflatness; Anti-reflecting films and Highly reflecting film.	**06**
05	**SUPERCONDUCTORS AND SUPERCAPACITORS** (**Prerequisites :** Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical resistivity and conductivity temperature dependence of resistance) Superconductors: Critical temperature, critical magnetic field, Meissner's effect, Type I and Type II and high Tc superconductors; Supercapacitors: Principle, construction, materials and applications, comparison with capacitor and batteries : Energy density, Power density,	**02**
06	**ENGINEERING MATERIALS AND APPLICATIONS** (**Prerequisites:** Paramagnetic materials, diamagnetic materials, ferromagnetic materials, crystal physics, Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance) Liquid crystals: Nematic, Smectic and cholesteric phases, Liquid crystal display. Multiferroics : Type I & Type II multiferroics and applications,	**02**

	Magnetoresistive Oxides: Magnetoresistance, GMR and CMR materials, introduction to spintronics.	

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher
5. Modern Engineering Physics – Vasudeva, S.Chand
6. Concepts of Modern Physics- ArtherBeiser, Tata McGraw Hill
7. A Text Book of Engineering Physics, S. O. Pillai, New Age International Publishers.
8. Introduction to Solid State Physics- C. Kittle, John Wiley& Sons publisher
9. Ultracapacitors: The future of energy storage- R.P Deshpande, McGraw Hill
10. Advanced functional materials – AshutoshTiwari, LokmanUzun, Scrivener Publishing LLC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC103	Engineering Chemistry-I	02	-	-	02	-	-	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC103	Engineering Chemistry-I	15	15	15	60	2	--	--	75

Objectives

1. The concepts developed in this course will aid in quantification as well as understand the applications of several concepts in Chemistry that have been introduced at the 10 + 2 levels in schools.

Outcomes: Learners will be able to…

1. Explain the concept of microscopic chemistry in terms of atomic and molecular orbital theory and relate it to diatomic molecules.
2. Describe the concept of aromaticity and interpret it with relation to specific aromatic systems.
3. Illustrate the knowledge of various types of intermolecular forces and relate it to real gases.
4. Interpret various phase transformations using thermodynamics.
5. Illustrate the knowledge of polymers, fabrication methods, conducting polymers in various industrial fields.
6. Analyze the quality of water and suggest suitable methods of treatment.

Module	Detailed Contents	Hrs.
01	**Atomic and Molecular Structure** Atomic orbitals (s,p,d,f) orbital shapes, Electronic Configuration, Molecular orbital theory (MOT), bonding and anti-bonding orbitals, Molecular orbital diagrams of Homonuclear and Heteronuclear diatomic molecules-Be_2, O_2, CO, NO their bond order and magnetic properties,	**04**
02	**Aromatic systems &their molecular structure** Define Aromaticity, Huckel's rule, Structure and bonding of benzene and pyrrole.	**02**
03	**Intermolecular Forces & Critical Phenomena** Ionic, dipolar and Vander Waal's interactions, Equations of state of real gases and critical phenomena	**03**
04	**Phase Rule-Gibb's Phase Rule** Statement of Gibbs' Phase Rule, Terms involved with examples, One Component System (Water), Reduced Phase Rule, Two Component System (Pb- Ag), Advantages and Limitations of Phase Rule. Numerical problems on Phase Rule.	**05**

05	**Polymers** Introduction: Definition- Polymer, polymerization, Properties of Polymers- Molecular weight (Number average and Weight average), Numerical problems on molecular weight, effect of heat on polymers (glass transition temperature), Viscoelasticity,Conducting Polymers, Classification-Thermoplastic and Thermosetting polymers; Compounding of plastic, Fabrication of plastic by Compression, Injection, Transfer and Extrusion moulding, Preparation, properties and uses of PMMA and Kevlar.	**05**
06	**Water** Introduction - Impurities in water, hardness of water- units (no conversions), types and numerical problems, determination of hardness of water by EDTA method and numerical problems.Softening of water by Ion Exchange process and numerical problems, BOD, COD- definition, significance and Numerical problems. Water purification-membrane technology- Electrodialysis, Reverse osmosis, and Ultra filtration.	**05**

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. Engineering Chemistry - Jain & Jain (DhanpatRai)
2. Engineering Chemistry – Dara &Dara (S Chand)
3. Engineering Chemistry - Wiley India (ISBN – 9788126519880)
4. A Text Book of Engineering Chemistry – ShashiChawla (DhanpatRai)
5. Engineering Chemistry – Payal Joshi &Shashank Deep (Oxford University Press)
6. Concise Inorganic Chemistry – J D LEE
7. Essentials of Physical Chemistry—B S BahlArunBahl G D Tuli.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC104	Engineering Mechanics	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC104	Engineering Mechanics	20	20	20	80	3	--	--	100

Objectives

1. To familiarize the concept of equilibrium and friction
2. To study and analyze motion of moving particles/bodies.

Outcomes: Learners will be able to…

1. Illustrate the concept of force, moment and apply the same along with the concept of equilibrium in two and three dimensional systems with the help of FBD.
2. Demonstrate the understanding of Centroid and its significance and locate the same.
3. Correlate real life application to specific type of friction and estimate required force to overcome friction.
4. Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation
5. Illustrate different types of motions and establish Kinematic relations for a rigid body
6. Analyze particles in motion using force and acceleration, work-energy and impulse-momentum principles

Self-Study/pre-requisites Topics:

Resolution of a forces. Use of trigonometry functions. Parallelogram law of forces. Law of triangle. Polygon law of forces, Lami's theorem. Concepts of Vector Algebra.

Uniformly accelerated motion along straight line, motion under gravity, projectile motion, Time of flight, Horizontal range, Maximum height of a projectile.

Law of conservation of Energy, Law of conservation of Momentum, Collision of Elastic Bodies.

Module	Detailed Contents	Hrs.
01	**1.1 System of Coplanar Forces:** Classification of force systems, Principle of transmissibility, composition and resolution of forces. **1.2 Resultant:** Resultant of coplanar and Non Coplanar (Space Force) force system (Concurrent forces, parallel forces and non-concurrent Non-parallel system of forces). Moment of force about a point, Couples, Varignon's Theorem. Force couple system. Distributed Forces in plane.	**06**
	Centroid: First moment of Area, Centroid of composite plane Laminas	**03**

02	**2.1 Equilibrium of System of Coplanar Forces:** Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non- parallel general forces and Couples. Equilibrium of rigid bodies-free body diagrams. **2.2 Equilibrium of Beams:** Types of beams, simple and compound beams, type of supports and reaction: Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges)	**04** **03**
03	**Friction:** Revision of Static Friction, Dynamic/ Kinetic Friction, Coefficient of Friction, Angle of Friction, Laws of friction. Concept of Cone of friction. Equilibrium of bodies on inclined plane. Application to problems involving wedges and ladders.	**04**
04	**Kinematics of Particle:** Motion of particle with variable acceleration. General curvilinear motion. Tangential& Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). Application of concepts of projectile motion and related numerical.	**04**
05	**Kinematics of Rigid Body:** Translation, Rotation and General Plane motion of Rigid body. The concept of Instantaneous center of rotation (ICR) for the velocity. Location of ICR for 2 link mechanism. Velocity analysis of rigid body using ICR.	**03**
06	**6.1 Kinetics of a Particle:** Force and Acceleration: -Introduction to basic concepts, D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.)	**04**
	6.2 Kinetics of a Particle: Work and Energy: Work Energy principle for a particle in motion. Application of Work – Energy principle to a system consists of connected masses and Springs.	**04**
	6.3 Kinetics of a Particle: Impulse and Momentum: Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	**03**

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. 10 percentage of marks will be asked from the self-study topics.
3. Total 04 questions need to be solved.
4. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
5. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

6. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Engineering Mechanics by R. C.Hibbeler.
2. Engineering Mechanics by Beer &Johnston, Tata McGrawHill
3. Engineering Mechanics by F. L. Singer, Harper& RawPublication
4. Engineering Mechanics by Macklin & Nelson, Tata McGrawHill
5. Engineering Mechanics by ShaumSeries
6. Engineering Mechanics by A K Tayal, UmeshPublication.
7. Engineering Mechanics by Kumar, Tata McGrawHill
8. Engineering Mechanics (Statics) by Meriam and Kraige, WileyBools
9. Engineering Mechanics (Dynamics) by Meriam and Kraige, WileyBools

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC105	Basic Electrical Engineering	3	--	--	3	--	--	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC105	Basic Electrical Engineering	20	20	20	80	3	--	--	100

Objectives

1. To provide knowledge on fundamentals of D.C. circuits and single phase and three phase AC circuits and its applications.
2. To inculcate knowledge on the basic operation and performance of 1-Φ transformer.
3. To provide knowledge on fundamentals of DC and AC machines.

Outcomes: Learner will be able to…

1. Apply various network theorems to determine the circuit response / behavior.
2. Evaluate and analyze 1-Φ circuits.
3. Evaluate and analyze 3-Φ AC circuits.
4. Understand the constructional features and operation of 1-Φ transformer.
5. Illustrate the working principle of 3-Φ machine.
6. Illustrate the working principle of 1-Φ machines.

Module	Detailed Contents	Hrs.
Prerequisite	Resistance, inductance, capacitance, series and parallel connections of resistance, concepts of voltage, current, power and energy and its units. Working of wattmeter, Magnetic circuits, MMF, Magnetic field strength, reluctance, series and parallel magnetic circuits, BH Curve, Time domain analysis of first order RL and RC circuits	--
01	DC Circuits: (Only independent source) Kirchhoff's Laws, Ideal and practical Voltage and current Sources, Source Transformation, Mesh and Nodal Analysis, Star-Delta / Delta-Star Transformations, Superposition, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.	**12**
02	AC Circuits :Generation of alternating voltage, basic definitions, average and r.m.s values, phasor and phase difference, sums on phasors, Single-phase ac series and parallel circuits consisting of R, L, C, RL, RC, RLC combinations, definitions - real, reactive and apparent power, admittance (Y), Series and parallel resonance, Q factor	**10**
03	Generation of Three-Phase Voltages, voltage & current relationships in Star and Delta Connections, power measurement in three phase balanced circuit(Only two wattmeter method).	**04**

04	Transformers: Working principle of single-phase transformer, EMF equation of a transformer, Transformer losses, Actual (practical) and ideal transformer, Phasor diagram (considering winding resistance and magnetic leakage), Equivalent circuit, Open-circuit test (no-load test), short circuit (SC) test, efficiency.	**06**
05	Electrical Machines (Numerical not expected): Rotating magnetic field produced by three phase ac, principle of operation of Three-phase induction motor, constructional details and classification of Induction machines.	**02**
06	Principle of operation of Single-Phase induction motors, stepper motor (Single stack variable reluctance and permanent magnet) (Numerical not expected)	**02**
Self-study Topic	Principle of operation of DC generators and DC motors, constructional details and classification of DC machines, e.m.f equation of generator/motor, applications. (Theory question can be asked in University exam, no numericals. The percentage of marks allotted should be maximum of 10% (max. 08marks))	--

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20marks.
2. Total 04 questions need to besolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will beasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in thesyllabus.

Text Books:

1. V. N. Mittal and Arvind Mittal “Basic Electrical Engineering” Tata McGraw Hill, (Revised Edition)
2. Vincent Del Toro “Electrical Engineering Fundamentals”, PHI Second edition, 2011
3. Edward Hughes “Hughes Electrical and Electronic Technology”, Pearson Education (Tenth edition)
4. D P Kothari and I J Nagrath “Theory and Problems of Basic Electrical Engineering”, PHI 13th edition 2011.
5. M. Naidu,S. Kamakshaiah “Introduction to Electrical Engineering” McGraw-Hill Education, 2004
6. B.R Patil “Basic Electrical Engineering” Oxford Higher Education

References:

1. B.L.Theraja “Electrical Engineering “ Vol-I and II.
2. S.N.Singh, “Basic Electrical Engineering” PHI , 2011Book

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL101	Engineering Physics-I	-	01	-	-	-	0.5	0.5

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL101	Engineering Physics-I	--	--	--	--	--	25	--	25

Objectives

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental result and write laboratory report.

Outcomes: Learners will be able to…

1. Perform the experiments based on interference in thin films and analyze the results.
2. Verify the theory learned in the module crystallography.
3. Perform the experiments on various semiconductor devices and analyze their characteristics.
4. Perform simulation study on engineering materials.

Suggested Experiments: (Any five)

1. Determination of radius of curvature of a lens using Newton's ring set up
2. Determination of diameter of wire/hair or thickness of paper using Wedge shape film method.
3. Study of Miller Indices.
4. Study of Hall Effect.
5. Determination of energy band gap of semiconductor.
6. Study of Zener diode as voltage regulator.
7. Study of I/V characteristics of LED
8. Determination of 'h' using Photo cell.
9. Study of I / V characteristics of semiconductor diode
10. Charging and discharging characteristics of supercapacitor.
11. Simulation study of orientational ordering in Nematic like 2D liquid crystal.
12. Simulation experiments based on engineering materials using open source simulation softwares like Avogadro, Chimera, JMOL etc.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) **:** 1**0 marks**
- Project Groupwise (Topic Presentation) **:** **10 marks**
- Attendance (Theory and Tutorial) **:** **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL102	Engineering Chemistry-I	-	01	-	-	-	0.5	0.5

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL102	Engineering Chemistry-I	--	--	--	--	--	25	--	25

Outcomes: Learners will be able to…

1. Determine Chloride content and hardness of water sample
2. Determine free acid ph of different solutions
3. Determine metal ion concentration
4. Synthesize polymers, biodegradable plastics.
5. Determine Viscosity of oil

Suggested Experiments:

1. To determine Chloride content of water by Mohr's Method.
2. To determine total, temporary and permanent hardness of water sample by EDTA method.
3. To determine free acid pH of different solutions using pH meter
4. To determine metal ion concentration using colorimeter.
5. Removal of hardness using ion exchange column.
6. Molecular weight determination of polymers by Oswald Viscometer.
7. Synthesis of UF, PF, Nylon 66.
8. Determination of COD
9. Synthesis of biodegradable polymer using corn starch or potato starch
10. Determination of Viscosity of oil by Redwood Viscometer

Term work:

Term Work shall consist of minimum five experiments.
The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) **:** 1**0 marks**
- Assignments and Viva on practicals **:** **10 marks**
- Attendance (Theory and Tutorial) **:** **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL103	Engineering Mechanics	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL103	Engineering Mechanics	--	--	--	--	--	25	25	50

Objectives

1. To acquaint the concept of equilibrium in two and three dimensional system.
2. To study and analyse motion of moving particles/bodies.

Outcomes: Learners will be able to…

1. Verify equations of equilibrium of coplanar force system
2. Verify law of moments.
3. Determine the centroid of plane lamina.
4. Evaluate co-efficient of friction between the different surfaces in contact.
5. Demonstrate the types of collision/impact and determine corresponding coefficient of restitution.
6. Differentiate the kinematics and kinetics of a particle.

List of Experiments:

Minimum six experiments from the following list of which minimum one should from dynamics.

1. Verification of Polygon law of coplanar forces
2. Verification of Principle of Moments (Bell crank lever.)
3. Determination of support reactions of a Simply Supported Beam.
4. Determination of coefficient of friction) using inclined plane
5. Verification of the equations of equilibrium for Non-concurrent non-parallel (General) force system.
6. Collision of elastic bodies (Law of conservation of momentum).
7. Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)
8. Kinetics of particles. (collision of bodies)

Sr No.	Assignments to be completed during Practical Session.	Minimum Number of Numerical
1	Resultant of Coplanar force system	4
2	Resultant of Non-Coplanar force system	3
3	Centroid of Composite plane Laminas	4
4	Equilibrium of System of Coplanar Forces	4
5	Beam Reaction	4
6	Equilibrium of bodies on inclined plane and problems involving wedges and ladders.	4
7	Kinematics of particles (Variable acceleration + Motion Curves +Projectile motion)	4
8	Kinetics of particles (D'Alemberts Principle, Work Energy Principle, Impulse momentum Principle, Impact and Collisions.)	5

Assessment:

Term Work: It comprises Laboratory Experiments and Assignments.

The distribution of marks for term work shall be as follows:

- Practical Work and Journal : 10 marks.
- Assignments : 10 marks.
- Attendance : 05 Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Oral examination based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL104	Basic Electrical Engineering	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL104	Basic Electrical Engineering	--	--	--	--	--	25	25	50

Objectives

1. To impart the basic concept of network analysis and its application.
2. To provide the basic concept of ac circuits analysis and its application.
3. To illustrate the operation of machines and transformer.

Outcomes: Learners will be able to…

1. Interpret and analyse the behaviour of DC circuits using network theorems.
2. Perform and infer experiment on single phase AC circuits.
3. Demonstrate experiment on three phase AC circuits.
4. Illustrate the performance of single phase transformer and machines.

Suggested List of laboratory experiments (Minimum Eight):

Also minimum two experiments from each course outcome shall be covered

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. To measure output voltage across load resistor/current through load resistor and verify the result using Mesh and Nodal analysis.
3. Verification of Superposition Theorem.
4. Verification Thevenin's Theorem.
5. Verification Norton's Theorem.
6. Verification Maximum Power Transfer Theorem.
7. To find the resistance and inductance of a coil connected in series with a pure resistance using three voltmeter method.
8. To find the resistance and inductance of a coil connected in parallel with a pure resistance using three ammeter method.
9. To find resonance conditions in a R-L-C series resonance circuit
10. To find resonance conditions in a R-L-C parallel resonance circuit.
11. To measure relationship between phase and line, currents and voltages in three phase system (star & delta)
12. To measure Power and phase in three phase system by two wattmeter method.
13. To find the equivalent circuit parameters by conducting OC and SC test on single phase transformer
14. To demonstrate cut-out sections of DC machine.
15. To demonstrate cut-out sections of single phase transformer.

Term Work: It comprises both part a and b

Term work consists of performing minimum 06 practical mentioned as below. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work.
The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/journal) : 10 marks.
- Assignments : 10marks.
- Attendance (Theory and Practical) : 05Marks

End Semester Examination:

Pair of Internal and External Examiner should conduct Oral examination based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL105	Basic Workshop Practice-I	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL105	Basic Workshop Practice-I	--	--	--	--	--	50	--	50

Objectives

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Outcomes: Learners will be able to…

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skill required for hardware maintenance.
3. Able to install an operating system and system drives.
4. Able to identify the network components and perform basic networking and crimping.
5. Able to prepare the edges of jobs and do simple arc welding.
6. Develop the necessary skill required to handle/use different plumping tools.
7. Demonstrate the turning operation with the help of a simple job.

	Detailed Content	Hrs.
	Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to **Compulsory Trades.**	
Trade-1	**Fitting (Compulsory):** • Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. • Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping	**10**

Trade-2	**Hardware and Networking: (Compulsory)** • Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. • Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) • Basic troubleshooting and maintenance • Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students	**08**
Trade-3	**Welding:** • Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.	**06**
Trade 4	**Plumbing:** • Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.	**06**
Trade-5	**Machine Shop:** • At least one turning job is to be demonstrated and simple job to be made for Term Work in a group of 4 students.	**06**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC201	Engineering Mathematics-II	3	--	1*	3	1	--	4

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC201	Engineering Mathematics-II	20	20	20	80	3	25	--	125

Course Objectives

1. The course is aimed to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.
2. To provide hands on experience in using SCILAB software to handle real life problems.

Course Outcomes: Students will be able to…

1. Apply the concepts of First Order and first degree Differential equation to the problems in the field of engineering.
2. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
3. Apply concepts of Beta and Gamma function to solve improper integrals.
4. Apply concepts of Double integral of different coordinate systems to the engineering problems like area and mass.
5. Apply concepts of triple integral of different coordinate systems to the engineering problems and problems based on volume of solids.
6. Solve differential equations and integrations numerically using SCILAB software to experimental aspect of applied mathematics.

Module	Detailed Contents	Hrs.
01	**Differential Equations of First Order and First Degree** 2.1 Exact differential Equations, Equations reducible to exact form by using integrating factors. 1.2 Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation. **# Self learning topics:**Simple application of differential equation of first order and first degree to electricaland Mechanical Engineering problem	**4** **2**
02	**Linear Differential Equations With Constant Coefficients and Variable Coefficients Of Higher Order** 2.1. Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax}, $\sin(ax+b), \cos(ax+b), x^n, e^{ax}V, x\,V$. 2.2. Method of variation of parameters.	**4** **2**

	# Self learning topics: Cauchy's homogeneous linear differential equation and Legendre's differential equation, Applications of Higher order differential equation.	
03	**Beta and Gamma Function, Differentiation under Integral sign and Rectification** **Pre-requisite:**Tracing of curves **3.1** Beta and Gamma functions and its properties. **3.2** Differentiation under integral sign with constant limits of integration. **3.3** Rectification of plane curves.(Cartesian and polar) **# Self learning topics:**Rectification of curve in parametric co-ordinates.	**2** **2** **2**
04	**Multiple Integration-1** 4.1. Double integration-definition, Evaluation of Double Integrals.(Cartesian & Polar) 4.2. Evaluation of double integrals by changing the order of integration. 4.3. Evaluation of integrals over the given region.(Cartesian & Polar) **# Self learning topics:**Application of double integrals to compute Area, Mass.	**2** **2** **2**
05	**Multiple Integration-2** 5.1. Evaluation of double integrals by changing to polar coordinates. 5.2. Application of double integrals to compute Area 5.3.Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). **# Self learning topics:** Application of triple integral to compute volume.	**2** **2** **2**
06	**Numerical solution of ordinary differential equations of first order and first degree, and , Numerical Integration** 6.1. Numerical solution of ordinary differential equation using (a) Euler's method (b) Modified Euler method, (c) Runge-Kutta fourth order method 6.2. Numerical integration- by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all with proof). **# Self learning topics:**Numerical solution of ordinary differential equation using Taylor series method.	**3** **3**

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per
   University pattern for practicals.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write at least 4 SCILAB tutorials (including print out) and at least 6 class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on (i) Euler Method, (ii) Modified Euler Method, (iii) Runge-Kutta Method of fourth order , (iv) Trapezoidal Rule , (v) Simpson's $1/3^{rd}$ Rule (vi) Simpson's 3/8th rule

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	: 05 marks
2.	Class Tutorials on entire syllabus	: 10 marks
3.	SCILAB Tutorials	: 10 marks

Assessment:

Internal Assessment Test:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hrs as mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9th Ed.
3. Engineering Mathematics by Srimanta Pal and SubodhBhunia, Oxford University Press
4. Applied Numerical Methods with MATLABfor Engineers and Scientists by Steven Chapra, McGraw Hill
5. Elementary Linear Algebra with Application by Howard Anton and Christ Rorres. 6th edition.
6. John Wiley & Sons,INC.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC202	Engineering Physics-II	2	--	--	2	--	--	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC202	Engineering Physics-II	15	15	15	60	2	--	--	75

Rationale:

Most of the engineering branches are being off-spring of basic sciences where physics is playing a pivotal role in concept and understanding of foundation of core engineering branches. This syllabus is developed by keeping in mind, needs of all branches that we offer in University of Mumbai.

The topic distribution is being done in systematic manner and whenever required, prerequisite to the topic are mentioned for frictionless teaching–learning process. In the distribution of topics, core physics and its applied form are given priority. At the same time few modules are introduced over emerging trends in the field of technology.

For the purpose of emphasis on applied part, list of suggestive experiments is added. As per new guidelines of AICTE, a scope is kept in the syllabus for simulation technique and use of information technology to supplement laboratory practices. Further, it is ensured that these modules will cover prerequisites needed for engineering courses to be introduced in higher semesters as core subjects or as interdisciplinary subjects in respective branches.

Objectives

1. To give exposure to the topics of fundamental physics in the area of electrodynamics and relativity.
2. To give exposure to fundamentals of physics related with current technology in the field of Nanotechnology and Physics of Sensor Technology.

Outcomes: Learners will be able to…

1. Describe the diffraction through slits and its applications.
2. Apply the foundation of laser and fiber optics in development of modern communication technology.
3. Relate the basics of electrodynamics which is prerequisite for satellite communications, antenna theory etc.
4. Explain the fundamentals of relativity.
5. Assimilate the wide scope of nanotechnology in modern developments and its role in emerging innovating applications.
6. Interpret and explore basic sensing techniques for physical measurements in modern instrumentations.

Module	Detailed Contents	Hrs.
01	**DIFFRACTION** (**Prerequisites** : Wave front and Huygen's principle, reflection and refraction, diffraction, Fresnel diffraction and Fraunhoffer diffraction)	04

	Diffraction: Fraunhoffer diffraction at single slit, Diffraction Grating, Resolving power of a grating; Applications of diffraction grating; Determination of wavelength of light using plane transmission grating	
02	**LASER AND FIBRE OPTICS** (**Prerequisites:** Absorption, recombination, energy bands of p-n junction, refractive index of a material, Snell's law) Laser: spontaneous emission and stimulated emission; metastable state, population inversion, types of pumping, resonant cavity, Einsteins's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser- Holography Fibre optics: Numerical Aperture for step index fibre; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fibres; Fibre optic communication system;	**06**
03	**ELECTRODYNAMICS** **(Prerequisites** : Electric Charges, Coulomb's law-force between two point charges, Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, Gauss's law, Faraday's law) Scalar and Vector field, Physical significance of gradient, curl and divergence in Cartesian co-ordinate system, Gauss's law for electrostatics, Gauss's law for magnetostatics, Faraday's Law and Ampere's circuital law; Maxwell's equations (Free space and time varying fields).	**05**
04	**RELATIVITY** **(Prerequisites**: Cartesian co-ordinate system) Special theory of Relativity: Inertial and Non-inertial Frames of reference, Galilean transformations, Lorentz transformations (space – time coordinates), Time Dilation, Length Contraction and Mass-Energy relation.	**02**
05	**NANOTECHNOLOGY** (**Prerequisites** : Scattering of electrons, Tunneling effect, Electrostatic focusing, magneto static focusing) Nanomaterials : Properties (Optical, electrical, magnetic, structural, mechanical) and applications, Surface to volume ratio; Two main approaches in nanotechnology -Bottom up technique and Top down technique; Tools for characterization of Nanoparticles: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM). Methods to synthesize Nanomaterials: Ball milling, Sputtering, Vapour deposition, Solgel	**04**
06	**PHYSICS OF SENSORS** (**Prerequisites** : Transducer concept, meaning of calibration, piezoelectric effect) Resistive sensors: a) Temperature measurement: PT100 construction, calibration, b) Humidity measurement using resistive sensors, Pressure sensor: Concept of pressure sensing by capacitive, flex and inductive method, Analog pressure sensor: construction working and calibration and applications. Piezoelectric transducers: Concept of piezoelectricity, use of piezoelectric transducer as ultrasonic generator and application of ultrasonic transducer for distance measurement, liquid and air velocity measurement. Optical sensor: Photodiode, construction and use of photodiode as ambient light measurement and flux measurement. Pyroelectric sensors: Construction and working principle, application of pyroelectric sensor as bolometer.	**05**

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

References

1. A text book of Engineering Physics-Avadhanulu&Kshirsagar, S.Chand
2. Optics - Ajay Ghatak, Tata McGraw Hill
3. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
4. Concepts of Modern Physics- ArtherBeiser, Tata Mcgraw Hill
5. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication
6. Introduction to Special Relativity- Robert Resnick, John Wiley and sons
7. Advances In Nano Materials And Applications: History of Nanotechnology From Pre-Historic to Modern Times, Madhuri Sharon, Wiley, USA
8. Nano: The essentials, understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw Hill, 2007.
9. Electronic Instrumentation –H.S. Kalsi, Tata McGraw-Hill Education
10. Handbook of Modern Sensors Physics design and application- Jacob Fraden, Springer, AIP press.
11. Instrumentation & Measurement Techniques by Albert D. Helfrick& William D. Cooper (PHI) Edition

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC203	Engineering Chemistry-II	2	-	-	2	-	-	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC203	Engineering Chemistry-II	15	15	15	60	2	--	--	75

Objectives

The concepts developed in this course will aid in quantification as well as understand the applications of several concepts in Chemistry that have been introduced at the 10 + 2 levels in schools.

Outcomes: Learners will be able to…

1. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
2. Illustrate the concept of emission spectroscopy and describe the phenomena of fluorescence and phosphorescence in relation to it.
3. Explain the concept of electrode potential and nernst theory and relate it to electrochemical cells.
4. Identify different types of corrosion and suggest control measures in industries.
5. Illustrate the principles of green chemistry and study environmental impact.
6. Explain the knowledge of determining the quality of fuel and quantify the oxygen required for combustion of fuel.

Module	Detailed Contents	Hrs.
01	**Principles of Spectroscopy:** Introduction: Principle of spectroscopy, Definition,Origin of spectrum, Classification of spectroscopy – atomic and molecular, selection rules. Table of relation between electromagnetic spectrum, types of spectroscopy and energy changes.	02
02	**Applications of Spectroscopy** Emission spectroscopy- Principle, Instrumentation and applications (Flame Photometry) Introduction to florescence and phosphorescence, Jablonski diagram, application of fluorescence in medicine only.	04
03	**Concept of Electrochemistry** Introduction, concept of electrode potential, Nernst equation, types of electrochemical cells, concept of standard electrode with examples, electrochemical series, simplenumericals.	02

04	**Corrosion:** Definition, Mechanism of Corrosion- (I) Dry or Chemical Corrosion-i) Due to oxygen ii)Due to other gases. (II)Wet or Electrochemical corrosion- Mechanism i) Evolution of hydrogen type ii) Absorption of oxygen. Types of Corrosion- Galvanic cell corrosion, Concentration cell corrosion (differential aeration principle), Pitting corrosion, Intergranular corrosion, Stress corrosion. Factors affecting the rate of corrosion- (i)Nature of metal, (ii)Nature of corroding environment. Methods of corrosion control- (I)Material selection and proper designing,(II) Cathodic protection- i) Sacrificial anodic protection ii) Impressed current method,(III) Metallic coatings- only Cathodic coating (tinning) and anodic coatings (Galvanising)	**06**
05	**Green Chemistry and Synthesis of drugs** Introduction – Definition, significance Twelve Principles of Green chemistry, numerical on atom economy, Conventional and green synthesis of Adipic acid, Indigo, Carbaryl, Ibuprofen, Benzimidazole, Benzyl alcohol, % atom economy and their numericals. Green fuel- Biodiesel.	**04**
06	**Fuels and Combustion** Definition, classification, characteristics of a good fuel, units of heat (no conversions). Calorific value- Definition, Gross or Higher calorific value & Net or lower calorific value, Dulong's formula & numerical for calculations of Gross and Net calorific values. Solid fuels- Analysis of coal- Proximate and Ultimate Analysis- numerical problems and significance. Liquid fuels- Petrol- Knocking, Octane number, Cetane number, Antiknocking agents, unleaded petrol, oxygenates (MTBE), catalytic converter. Combustion- Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels.	**06**

Assessment

Internal Assessment Test

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

Recommended Books :

1. Engineering Chemistry - Jain & Jain, DhanpatRai
2. Engineering Chemistry – Dara & Dara, S Chand
3. Green Chemistry: A textbook – V.K.Ahluwalia, Alpha Science International
4. Fundamentals of Molecular Spectroscopy (4th Edition) - C.N.Banwell, Elaine M. McCash,
   Tata McGraw Hill.
5. Elementary Organic Spectroscopy- Y.R.Sharma, S.Chand and Co.
6. A Text Book of Engineering Chemistry - ShashiChawla, DhanpatRai
7. Engineering Chemistry – Payal Joshi &Shashank Deep (Oxford University Press)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC204	Engineering Graphics	2	--	--	2	--	--	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC204	Engineering Graphics	15	15	15	60	3	--	--	75

Objectives

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge of reading a drawing
3. To improve the visualization skill.

Outcomes: Learners will be able to…

1. Apply the basic principles of projections in Projection of Lines and Planes
2. Apply the basic principles of projections in Projection of Solids.
3. Apply the basic principles of sectional views in Section of solids.
4. Apply the basic principles of projections in converting 3D view to 2D drawing.
5. Read a given drawing.
6. Visualize an object from the given two views.

Module	Detailed Contents	Hrs.
01	**Introduction to Engineering Graphics** Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per IS conventions. Introduction to plain and diagonal scales. **Engineering Curves** Basic construction of Cycloid, Involutes and Helix (of cylinder) only.	2
02	**Projection of Points and Lines** Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. **@ Projection of Planes** Triangular, Square, Rectangular, Pentagonal, Hexagonal andCircular planes inclined to either HP or VP only. (Exclude composite planes).	5
03	**Projection of Solids** (Prism, Pyramid, Cylinder, Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method	5
04	**Section of Solids** Section of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to at least one reference plane (Exclude Curved Section Plane). Use change of position or Auxiliary plane method.	5

05	**#Orthographic and Sectional Orthographic Projections: -** Fundamentals of orthographic projections. Different views of a simple machine part as per the first angle projection methodrecommended by I.S. Full or Half Sectional views of the Simple Machine parts.	**3**
06	**#@ Missing Views:**The identification of missing views from the given views. Create the third view from the two available views so that all the details of the object are obtained.	**1**
07	**#Isometric Views:-** Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views(Excluding Sphere).	**3**
@ only in Term Work (i.e; Questions will not be asked for any examination.)		
# more problems should be discussed during practical hours to strengthen the concepts.		

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each.
Among the two tests One is Conventional (manual drawing) and Second using CAD software.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Any 4 questions need to be solved. There won't be any compulsory Question
3. Total 04 questions need to besolved.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in thesyllabus.

Text Books.

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

Reference Books

3. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publisher.
4. Prof. Sham Tickoo (Purdue University) &GauravVerma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.
5. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC205	C Programming	2	--	--	2	--	--	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC205	C Programming	15	15	15	60	2	--	--	75

Objectives

To provide exposure to problem-solving by developing an algorithm, flowchart and implement the logic using C programming language.

Outcomes: Learner will be able to…

1. Formulate simple algorithms for arithmetic, logical problems and translate them to programs in C language
2. Implement, test and execute programs comprising of control structures.
3. Decompose a problem into functions and synthesize a complete program.
4. Demonstrate the use of arrays, strings and structures in C language.
5. Understand the concept of pointers

Module	Detailed Contents	Hrs.
1	**Introduction** ● Introduction to components of a Computer System ● Introduction to Algorithm and Flowchart **Fundamentals of C Programming** ● Keywords, Identifiers, Constants and Variables ● Data types in C ● Operators in C ● Basic Input and Output Operations ● Expressions and Precedence of Operators ● In-built Functions	5
2	**Control Structures** ● Introduction to Control Structures **Branching and looping structures** ● If statement, If-else statement, Nested if-else, else-if Ladder ● Switch statement ● For loop, While loop, Do while loop ● break and continue	7
3	**Functions** ● Introduction to functions ● Function prototype, Function definition, Accessing a function and parameter passing. ● Recursion.	4

4	**Arrays and Strings** ● Introduction to Arrays ● Declaration and initialization of one dimensional and two-dimensional arrays. ● Definition and initialization of String ● String functions	**4**
5	**Structure and Union** ● Concept of Structure and Union ● Declaration and Initialization of structure and union ● Nested structures ● Array of Structures ● Passing structure to functions	**4**
6	**Pointers** ● Fundamentals of pointers ● Declaration, initialization and dereferencing of pointers ● Operations on Pointers ● Concept of dynamic memory allocation	**4**

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 15 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Total 04 questions need to besolved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will beasked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hrs as mentioned in thesyllabus.

Text Books:

1. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill
2. Kernighan , Ritchie, “The C programming Language”, Prentice Hall of India
3. Sumitabha Das, Computer Fundamentals and C Programming, McGraw-Hill
4. Pradeep Day and ManasGosh ,“Programming in C”, Oxford University Press.

References:

1. Byron Gottfried, “Programing with C”, McGraw Hill (Schaum‟s outline series)
2. Venugopal K.R, Prasad Sudeep, “Mastering C”, McGraw-Hill
3. KanetkarYashwant,” “Let Us C”, BPB Publication.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEC206	Professional Communication and Ethics- I	2	--	--	2	--	--	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEC206	Professional Communication and Ethics- I	10	10	10	40	2	--	--	50

Objectives

1. To demonstrate the fundamental concepts of interpersonal and professional communication.
2. To encourage active listening with focus on content, purpose, ideas and tone.
3. To facilitate fluent speaking skills in social, academic and professional situations.
4. To train in reading strategies for comprehending academic and business correspondence.
5. To promote effective writing skills in business, technology and academic arenas.
6. To inculcate confident personality traits along with grooming and social etiquettes.

Outcomes: Learners will be able to understand how to…

1. Eliminate barriers and use verbal/non-verbal cues at social and workplace situations.
2. Employ listening strategies to comprehend wide-ranging vocabulary, grammatical structures, tone and pronunciation.
3. Prepare effectively for speaking at social, academic and business situations.
4. Use reading strategies for faster comprehension, summarization and evaluation of texts.
5. Acquire effective writing skills for drafting academic, business and technical documents.
6. Successfully interact in all kinds of settings, displaying refined grooming and social skills.

Module	Detailed Contents	Hrs.
1	**FUNDAMENTALS OF COMMUNICATION** **1.1. Introduction to Theory of Communication** ● Definition ● Objectives ● Postulates/Hallmarks ● The Process of Communication ● Organizational Communication ○ Formal (Upward, Downward and Horizontal) ○ Informal (Grapevine) **1.2. Methods of Communication** ● Verbal (Written & Spoken) ● Non-verbal ○ Non-verbal cues perceived through the five senses: (Visual, Auditory, Tactile, Olfactory and Gustatory cues) ○ Non-verbal cues transmitted through the use of: (The Body, Voice, Space, Time and Silence) **1.3. Barriers to Communication** ● Mechanical/External	12

	● Physical/Internal ● Semantic & Linguistic ● Psychological ● Socio-Cultural **1.4. Communication at the Workplace** ● Corporate Communication - Case Studies ● Listening Tasks with Recordings and Activity Sheets ● Short Speeches as Monologues ○ Informative Speeches that Center on People, Events, Processes, Places, or Things ○ Persuasive Speeches to Persuade, Motivate or Take Action ○ Special Occasion Speeches for Ceremonial, Commemorative, or Epideictic purposes ● Pair-work Conversational Activities (Dialogues) ● Short Group Presentations on Business Plans	
2	**VERBAL APTITUDE FOR EMPLOYMENT** **2.1. Vocabulary Building** ● Root words (Etymology) ● Meaning of Words in Context ● Synonyms & Antonyms ● Collocations ● Word Form Charts ● Prefixes & Suffixes ● Standard Abbreviations **2.2. Grammar** ● Identifying Common Errors ○ Subject - Verb Agreement ○ Misplaced Modifiers ○ Articles ○ Prepositions ● Tautologies ● Pleonasms (Redundancies) ● Idioms ● Cliches	**02**
3	**DEVELOPING READING AND WRITING SKILLS** **3.1. Reading Comprehension** ● Long Passages ● Short Passages ● MCQs on Inferential Questions with 4 Options **3.2. Summarization of reading passages, reports, chapters, books** ● Graphic Organizers for Summaries ○ Radial Diagrams like Mind Maps ○ Flow Charts ○ Tree Diagrams ○ Cyclic Diagrams ○ Linear Diagrams like Timelines ○ Pyramids ○ Venn Diagrams ● Point-form Summaries ● One-sentence Summaries of Central Idea **3.3. Paraphrasing** ● Understanding Copyrights ● Running a Plagiarism Check on Paraphrased Passages ● Generating Plagiarism Reports	**02**

	● Basic APA and MLA Referencing Style and Format	
4	**BUSINESS CORRESPONDENCE** **4.1. Seven Cs of Business Correspondence** ● Completeness ● Conciseness ● Consideration ● Concreteness ● Clarity ● Courtesy ● Correctness **4.2. Parts of a Formal Letter and Formats** ● Parts/Elements of a Formal Letter ○ Letterheads and/or Sender's Address ○ Dateline ○ Inside Address ○ Reference Line (Optional) ○ Attention Line (Optional) ○ Salutation ○ Subject Line ○ Body ○ Complimentary Close ○ Signature Block ○ Enclosures/Attachments ● Complete/Full Block Format **4.3. Emails** ● Format of Emails ● Features of Effective Emails ● Language and style of Emails **4.4. Types of Letters in Both Formal Letter Format and Emails** ● Claim & Adjustment Letters ● Request/Permission Letters ● Sales Letters	**06**
5	**BASIC TECHNICAL WRITING** **5.1. Introduction** ● What is Technical Writing? ● Importance and Principles of Technical Writing ● Difference between Technical Writing & Literary Writing ● Framing Definitions ● Difference between Technical Description & Instructions **5.2. Description of a Technical Object** ● Definition ● Diagram ● Discussion of Parts/Characteristics Working **5.3. Writing User Instructions** ● User Instructions ● Special Notices (Note, Warning, Caution and Danger) ● Styles of Presentation ○ Impersonal ○ Indirect ○ Direct ● Imperative **5.4. Description of a Technical / Scientific Process**	**02**

	• Definition • Diagram • Tools/ Apparatus/Software/ Hardware Used • Working • Result	
6	**PERSONALITY DEVELOPMENT AND SOCIAL ETIQUETTES** **6.1. Personality Development** • Introducing Self and/or a Classmate • Formal Dress Code **6.2. Social Etiquettes** • Formal Dining Etiquettes • Cubicle Etiquettes • Responsibility in Using Social Media • Showing Empathy and Respect • Learning Accountability and Accepting Criticism • Demonstrating Flexibility and Cooperation • Selecting Effective Communication Channels	**02**

Assessment:

Internal Assessment Test:
Assessment consists of two class tests of 10 marks each.

TEST I -Public speech on general topics (Maximum 5 mins. per student)

TEST II - Written test covering modules 1 - 6
The second test should be based on theory and application exercises as mentioned in the syllabus. (Note: Summarization should be a compulsory question in Test II and not in the End Semester Theory Examination.)

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 15marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.(e.g. Suppose Q.2 has part (a) from module3 then part (b) will be from any module other than module 3)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus
6. The first module (Fundamentals of Communication) will carry 40 % weightage.

Text Books.

1. Sanjay Kumar & Pushp Lata (2018). Communication Skills with CD. New Delhi: Oxford University Press.
2. Hemphill, P.D., McCormick, D. W., & Hemphill, R. D. (2001). Business Communication with writing improvement exercises. Upper Saddle River, NJ: Prentice Hall.
3. Locker, Kitty O. Kaczmarek, Stephen Kyo. (2019). Business Communication: Building Critical Skills. Place of publication not identified: Mcgraw-hill.
4. Murphy, H. (1999). Effective Business Communication. Place of publication not identified: Mcgraw-Hill.
5. Raman, M., & Sharma, S. (2016). Technical Communication: Principles and practice. New Delhi: Oxford University Press.

6. Kaul, A. (2015). Effective Business Communication. Place of publication not identified: Prentice-Hall of India.
7. Rizvi, A. M. (2010). Effective Technical Communication: A guide for Scientists and Engineers. New Delhi: Tata McGraw Hill.
8. Lewis, N. (2014). Word power made easy. Random House USA.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL201	Engineering Physics-II	-	01	-	-	-	0.5	0.5

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL201	Engineering Physics-II	--	--	--	--	--	25	--	25

Objectives

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental result and write laboratory report.

Outcomes: Learners will be able to…

1. Perform the experiments based on diffraction through slitsusing Laser source and analyze the results.
2. Perform the experiments using optical fibre to measure numerical aperture of a given fibre.
3. Perform the experiments on various sensors and analyze the result.

Suggested Experiments:(Any five)

1. Determination of wavelength using Diffraction grating. (Hg/Na source)
2. Determination of number of lines on the grating surface using LASER Source.
3. Determination of Numerical Aperture of an optical fibre.
4. Determination of wavelength using Diffraction grating.(Laser source)
5. Study of divergence of laser beam
6. Determination of width of a slit using single slit diffraction experiment(laser source)
7. Study of I-V characteristics of Photo diode.
8. Study of ultrasonic distance meter/ interferometer.
9. Study of PT100 calibration and use and thermometer
10. Study of J /K type thermocouple, calibration and use and thermometer
11. Simulation experiments based on nanotechnology using open source simulation softwares like Avogadro, Chimera, JMOL etc.

Term work:

Term Work shall consist of minimum five experiments.
The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) : **10 marks**
- Project Groupwise (Execution & Submission) : **10 marks**
- Attendance (Theory and Tutorial) : **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL202	Engineering Chemistry-II	-	01	-	-	-	0.5	0.5

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL202	Engineering Chemistry-II	--	--	--	--	--	25	--	25

Outcomes: Learner will be able to…

1. Determine moisture and ash content of coal
2. Analyze flue gas
3. Determine saponification and acid value of oil
4. Determine flash point of a lubricating oil
5. Synthesize a drug and a biofuel.
6. Determine na/k and emf of cu-zn system

Suggested Experiments

1. Determination of Moisture content of coal.
2. Determination of Ash content of coal.
3. Flue gas analysis using Orsat's apparatus.
4. Saponification value of oil
5. Acid value of oil
6. Determination of Na/K by Flame photometry.
7. Preparation of Biodiesel from edible oil.
8. To estimate the emf of Cu-Zn system by Potentiometry.
9. Synthesis of Aspirin.
10. Determination of Flash point of a lubricant using Abel's apparatus

Term work:

Term Work shall consist of minimum five experiments.
The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments and Journal) **:** **10 marks**
- Assignments and Viva on practicals **:** **10 marks**
- Attendance (Theory and Practical) **:** **05 marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL203	Engineering Graphics	-	04	-	-	-	2	2

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL203	Engineering Graphics	--	--	--	--	--	25	50	75

Objectives

1. To inculcate the skill of drawing with the basic concepts.
2. To Use AutoCAD for daily working process.
3. To teach basic utility of Computer Aided drafting (CAD) tool

Outcomes: Learner will be able to…

1. Apply the basic principles of projections in 2D drawings using a CAD software.
2. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
3. Apply the concepts of layers to create drawing.
4. Apply basic AutoCAD skills to draw different views of a 3D object.
5. Apply basic AutoCAD skills to draw the isometric view from the given two views.

Component-1 (Use half Imperial Drawing Sheet)

	Activities to be completed in the Drawing Laboratory.	**Hrs**
	One Practice sheet on projection of solids(minimum 2 problems)	4
	# Term Sheet 1: Projection of Solids (3 Problems).	4
	One Practice sheet on Section of Solids. (minimum 2 problems) # Term Sheet 2: Section of solids. (3 problems).	6
	One practice sheet on Orthographic projection. (minimum 1 problem) # Term Sheet 3: Orthographic Projection (With section 1 problem, without section 1 problem).	6
	One practice sheet on Isometric drawing. (minimum 2 problems) # Term Sheet 4: Isometric Projection. (3 problems).	4

Term sheets to be done in laboratory only and to be **submitted as part of term work**.
Note: Practice sheets to be done before starting the Term Sheets.

Component-2

Self-study problems/ Assignment: (In A3 size Sketch book, to be submitted as part of Term Work)

1. Engineering Curves. (2 problems)
2. Projection of Lines (2 problems)
3. Projection of planes (2 problems)
4. Projection of solids. (2 problems)
5. Section of solids (2 problems)
6. Orthographic Projection. (With section 1 problem, without section 1 problem).
7. Missing views. (1 problem)
8. Isometric Drawing. (2 problems)

Computer Graphics: Engineering Graphics Software - Orthographic Projections, Isometric Projections, Co-ordinate Systems, Multi-view Projection.		
	To be Taught in laboratory.	**Hrs**
Part-A	**Overview of Computer Graphics Covering:** Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.	**3**
	Customization & CAD Drawing: Consisting of set up of the drawing page and the printer including scale settings, Setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning.	**3**
	Annotations, layering & other Functions Covering: Applying dimensions to objects, applying annotations to drawings, Setting up and use of layers, layers to create drawings, Create, edit and use customized layers, Changing line lengths through modifying existing lines (extend/lengthen), Printing documents to paper using the print command, orthographic projection techniques, Drawing sectional views of objects (simple machine parts).	**4**
Part-B	*** Activities to be completed in the CAD Laboratory. (All printouts to be the part of Term Work. Preferably, Use A3 size sheets for print out.)** **Component-3**	
	1. Orthographic Projections (without section)- 1 problem	**4**
	2. Orthographic Projection (with section)- 1 problem	**4**
	3. Orthographic Reading – 1 problem	**2**
	4. Isometric Drawing – 3 problem.	**4**

Note: * Give practice sheet problems before going for Term Sheet problems.
Students are supposed to bring complete solution of problems before coming to CAD practical.

Term Work:

Component-1	:	7Marks
Component-2	:	6 Marks
Component-3	:	7 Marks
Attendance	:	5 Marks
Total Marks	**:**	**25 Marks**

Note: Satisfactory submission of all 3 components is mandatory to full fill the Term.

Topic for the End Semester Practical Examination (Auto CAD) (2 hours/ 50 Marks.)

1. Isometric drawing. (1 problem) (20 Marks)
2. Orthographic Projection (With Section) (1 problem). (30 Marks)

Note:

1. **Printout of the answers have to be taken preferably in A3 size sheets and should be Assessed by External Examiner only.**
2. **Knowledge of Auto CAD software, concepts of Engineering Graphics related to specified problem and accuracy of drawing should be considered during evaluation**.

Text Books.

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

Reference Books

1. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) &GauravVerma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.
3. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL204	C programming	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg					
FEL204	C programming	--	--	--	--	--	25	25	50

Outcomes: Learner will be able to…

1. Translate given algorithms to a program.
2. Correct syntax and logical errors.
3. Write iterative as well as recursive programs.
4. Represent data in arrays, strings and structures and manipulate them through a program.
5. Declare pointers and demonstrate call by reference concept.

Lab Description:

Weekly 2 hours of laboratory Programming Assignments on the following topics:

1. Basic data types and I/O operations
2. Branching Statements
3. Loop Statements
4. Arrays
5. Strings
6. Functions
7. Recursion
8. Structure and Union
9. Pointers

Term Work:

Experiments (20 Programs) and Assignments (2 Assignments) should be completed by students on the given time duration

Experiments:	15 Marks
Assignment:	05 Marks
Attendance:	05 Marks
Total:	**25 Marks**

The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

Practical and Oral :

Practical and oral Exam should be conducted for the Lab, on Computer Programming in C subject for given list of experiments.

Implementation:	15 Marks
Oral:	10 Marks
Total:	**25 Marks**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL205	Professional Communication and Ethics- I	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL205	Professional Communication and Ethics- I	--	--	--	--	--	25	--	25

Objectives

To provide practice in ...

1. Active listening with focus on content, purpose, main idea, tone and pronunciation.
2. Fluent speaking and presentation skills in social, academic and professional situations.
3. Faster reading skills for effective comprehension in a variety of texts.
4. Drafting effective written discourse in academics, business and technology.
5. Grooming and projecting impressive persona in all interactions.

Outcomes: Learner will be able to…

1. Listen and comprehend all types of spoken discourse successfully.
2. Speak fluently and make effective professional presentations.
3. Read large quantities of text in a short time to comprehend, summarise and evaluate content.
4. Draft precise business letters, academic essays and technical guidelines.
5. Dress finely and conduct themselves with panache in social, academic and professional situations.

List of Assignments & Activities	Details of Assignments	Details of Activities	Hrs.
1.	Written record of listening activities	Listening practice tasks of 3 types (through audio recordings of (1) Monologues (2) Dialogues (3) Formal/Expert Talk or Lecture)	**02**
2.	Transcription of the public speech along with a plagiarism report	Practice public speech	**02**
3.	Transcription of the public speech along with a plagiarism report	Public speech (Internal Assessment - I)	**02**
4.	Written assignment on barriers and non-verbal communication	Role plays / case studies	**02**
5.	Summarization through graphic organisers (1. Text to graphic	NA	**02**

	organizer 2. Graphic organizer to text)		
6.	Written record of reading activities	Advanced level reading comprehension with MCQs (similar in level and format to CAT, GRE and GMAT verbal sections)	**02**
7.	Aptitude test on vocabulary and grammar	Aptitude test on vocabulary and grammar (similar in level and format to CAT, GRE and GMAT verbal sections)	**02**
8.	2 types of letters in complete block format	NA	**02**
9.	Written assignment on technical writing (Exercises based on framing Definitions, Describing Technical Objects, Framing User Instructions and Describing Technical Processes)	NA	**02**
10.	Documentation on case studies / role plays on Module 6	Case studies / role plays	**02**

Assessment:

The distribution of marks for term work shall be as follows:

- Assignments **:** **20 marks**
- Attendance (Theory and Practical) **:** **05 marks**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Tut.	Pract.	Total
FEL206	Basic Workshop Practice-II	--	2	--	--	--	1	1

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
FEL206	Basic Workshop Practice-II	--	--	--	--	--	50	--	50

Objectives

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Outcomes: Learner will be able to…

1. Develop the necessary skill required to handle/use different carpentry tools.
2. Identify and understand the safe practices to adopt in electrical environment.
3. Demonstrate the wiring practices for the connection of simple electrical load/ equipment.
4. Design, fabricate and assemble pcb.
5. Develop the necessary skill required to handle/use different masons tools.
6. Develop the necessary skill required to use different sheet metal and brazing tools.
7. Able to demonstrate the operation, forging with the help of a simple job.

	Detailed Content	Hrs.
Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to Compulsory Trades.		
Trade-1	**Carpentry(Compulsory)** 6. Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. **7.** Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning	**10**

Trade-2	**Basic Electrical work shop:(Compulsory):** 8. Single phase and three phase wiring. Familiarization. of protection switchgears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the work place safe work practices. Protective equipment, measures and tools. 9. Layout drawing, layout transfer to PCB, etching and drilling and soldering technique	**08**
Trade-3	**Masonry:** **10.** Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.	**06**
Trade 4	**Sheet metal working and Brazing:** 11. Use of sheet metal, working hand tools, cutting , bending , spot welding	**06**
Trade-5	**Forging (Smithy):** 12. At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	**06**

UG- Electronics Engineering

Sr. No.	Subject Code	Subject Name	Count
1	ELC302 ELL301	Electronics Devices and Circuits - I Electronics Devices and Circuits - I Lab	02
2	ELC303 ELL302	Digital Logic Circuits Digital Logic Circuits Lab	02
3	ELC305 ELL303	Electronic Instruments and Measurements Electronic Instruments and Measurements Lab	02
4	ELC304	Electrical Networks Analysis and Synthesis	01
5	ELL304	Skill base Lab OOPM: (C++ and Java)	01
6	ELM301	Mini Project – 1A	01
7	ELC402 ELL401	Electronics Devices and Circuits - II Electronics Devices and Circuits - II Lab	02
8	ELC403 ELL402	Microcontroller Applications Microcontroller Applications Lab	02
9	ELC404 ELL403	Principles of Communication Engineering Analog Communication Lab	02
10	ELL404	Skill Base Lab : Python Programming	01
11	ELM401	Mini Project - 1B	01
12	ELX501 ELXL501	Microcontrollers and Applications Microcontrollers and Applications Lab.	02
13	ELX 502 ELXL502	Digital Communication Digital Communication Lab.	02
14	ELX 504 ELXL503	Design with Linear Integrated Circuits Design with Linear Integrated Circuits Lab.	02
15	ELX 503	Engineering Electromagnetics	01
16	ELXDLO501X ELX DLOl50X	Department Level optional courses-I Department Level optional course-I Lab	02
17	ELX601 ELXL601	Embedded System and RTOS Embedded System and RTOS Lab.	02

18	ELX602 ELXL602	Computer Communication Network Computer Communication Network Lab.	02
19	ELX603 ELXL603	VLSI Design VLSI Design Lab.	02
20	ELX 604	Signals and systems	01
21	ELXDLO502X ELXLDLO601X	Department Level Optional courses-II Department Level Optional courses-II Lab.	02
22	ELX701 ELXL701	Instrumentation System Design Instrumentation System Design Lab.	02
23	ELX702 ELXL702	Power Electronics Power Electronics Lab.	02
24	ELX703 ELXL703	Digital signal processing Digital signal processing Lab.	02
25	ELXDLO703X ELXLDLO703X	Department Level Optional course-III Department Level Optional course- III Lab.	02
26	ELXL704	Project-I	01
27	ELX801 ELXL801	Internet of Things Internet of Things Lab.	02
28	ELX 802 ELXL802	Analog and Mixed VLSI Design Analog and Mixed VLSI Design Lab.	02
29	ELXDLO804X ELXLDLO804X	Department Level Optional course-IV Department Level Optional Courses-IV Lab.	02
30	ELXL803	Project-II	01
		Total	**51**

AC- 23/07/2020
Item No. : 122

UNIVERSITY OF MUMBAI

Program: Bachelor of Engineering
in
Electronics Engineering

Second Year with Effect from AY 2020-21
Third Year with Effect from AY 2021-22
Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20
Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC-23/07/2020
Item No. 122

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year B E in Electronics Engineering**
2	Eligibility for Admission	**First Year Engineering passed in line with the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 Semesters**
6	Level	~~Certificate/Diploma~~/**UG**/~~PG~~ **(Strike out which is not applicable)**
7	Pattern	**Semester**/~~Yearly~~ **(Strike out which is not applicable)**
8	Status	**New**/~~Revised~~ **(Strike out which is not applicable)**
9	To be implemented from Academic Year	**With effect from Academic Year: 2020-2021**

Date:23rd July 2020 Signature:

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Science and Technology (in particular Engineering), of University of Mumbai, has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes, understand the depth and approach of the course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process. However, content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.
There was a concern that the earlier revised curriculum was more focused on providing information and knowledge across various domains of the said program, which led to heavily loading students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum, skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of the curriculum proposed in the present revision is in line with the AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and implementation of online contents from NPTEL/ SWAYAM Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time, in particular Revised syllabus of ‘C ‘scheme, wherever possible, additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In earlier revisions of the curriculum in the years 2012 and 2016, in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum, overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HOD’s/ Faculties of all the institutes are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses and on successful completion, they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface

Technical education in the country is undergoing a paradigm shift in current days. Think tank at national level are deliberating on the issues, which are of utmost importance and posed challenge to all the spheres of technical education. Eventually, impact of these developments was visible and as well adopted on bigger scale by almost all universities across the country. These are primarily an adoption of CBCS (Choice base Credit System) and OBE (Outcome based Education) with student centric and learning centric approach. Education sector in the country, as well, facing critical challenges, such as, the quality of graduates, employability, basic skills, ability to take challenges, work ability in the fields, adoption to the situation, leadership qualities, communication skills and ethical behaviour. On other hand, the aspirants for admission to engineering programs are on decline over the years. An overall admission status across the country is almost 50%; posing threat with more than half the vacancies in various colleges and make their survival difficult. In light of these, an All India Council for Technical Education (AICTE), the national regulator, took initiatives and enforced certain policies for betterment, in timely manner. Few of them are highlighted here, these are design of model curriculum for all prevailing streams, mandatory induction program for new entrants, introduction of skill based and inter/cross discipline courses, mandatory industry internships, creation of digital contents, mandate for use of ICT in teaching learning, virtual laboratory and so on.

To keep the pace with these developments in Technical education, it is mandatory for the Institutes & Universities to adopt these initiatives in phased manner, either partially or in toto. Hence, the ongoing curriculum revision process has a crucial role to play. The BoS of Electronics Engineering under the faculty of Science & Technology, under the gamut of Mumbai University has initiated a step towards adoption of these initiatives. We, the members of Electronics Engineering Board of Studies of Mumbai University feel privileged to present the revised version of curriculum for Electronics Engineering program to be implemented from academic year 2020-21. Some of the highlights of the revision are;

i. Curriculum has been framed with reduced credits and weekly contact hours, thereby providing free slots to the students to brain storm, debate, explore and apply the engineering principles. The leisure provided through this revision shall favour to inculcate innovation and research attitude amongst the students.
ii. New skill based courses have been incorporated in curriculum keeping in view AICTE model curriculum.
iii. Skill based Lab courses have been introduced, which shall change the thought process and enhance the programming skills and logical thinking of the students
iv. Mini-project with assigned credits shall provide an opportunity to work in a group, balancing the group dynamics, develop leadership qualities, facilitate decision making and enhance problem solving ability with focus towards socio-economic development of the country. In addition, it shall be direct application of theoretical knowledge in practice, thereby, nurture learners to become industry ready and enlighten students for Research, Innovation and Entrepreneurship thereby to nurture start-up ecosystem with better means.
v. An usage of ICT through NPTEL/SWAYAM and other Digital initiatives of Govt. of India shall be encouraged, facilitating the students for self learning and achieve the Graduate Attribute (GA) specified by National Board of accreditation (NBA) i.e. lifelong learning.

Thus, this revision of curriculum aimed at creating deep impact on the teaching learning methodology to be adopted by affiliated Institutes, thereby nurturing the students fraternity in a multifaceted directions and create competent technical manpower with legitimate skills. In times to come, these graduates shall shoulder the responsibilities of proliferation of future technologies and support in a big way for 'Make in India' initiative, a reality. In the process, BoS, Electronics Engineering got whole hearted support from all stakeholders including faculty, Heads of department of affiliating institutes, experts faculty who detailed out the course contents, alumni, industry experts and university official providing all procedural support time to time. We put on record their involvement and sincerely thank one and all for contribution and support extended for this noble cause.

Boards of Studies in Electronics Engineering

Sr. No.	Name	Designation	Sr. No.	Name	Designation
1	Dr. R. N. Awale	Chairman	5	Dr. Rajani Mangala	Member
2	Dr. Jyothi Digge	Member	6	Dr. Vikas Gupta	Member
3	Dr. V. A. Vyawahare	Member	7	Dr. D. J. Pete	Member
4	Dr. Srija Unnikrishnan	Member	8	Dr. Vivek Agarwal	Member

Program Structure for Second Year Electronics Engineering

UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

SEMESTER III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical And Oral	Tutorial	Total
ELC301	Engineering Mathematics - III	3	--	1	3	--	1	**4**
ELC302	Electronics Devices and Circuits - I	3	--	--	3	--	--	**3**
ELC303	Digital Logic Circuits	3	--	--	3	--	--	**3**
ELC304	Electrical Networks Analysis and Synthesis	3	--	1	3	--	1	**4**
ELC305	Electronic Instruments and Measurements	3	--	--	3	--	--	**3**
ELL301	Electronics Devices and Circuits - I Lab	--	2	--	--	1	--	**1**
ELL302	Digital Logic Circuits Lab	--	2	--	--	1	--	**1**
ELL303	Electronic Instruments and Measurements Lab	--	2	--	--	1	--	**1**
ELL304	Skill base Lab OOPM: *(C++ and Java)*	--	4	--	--	2	--	**2**
ELM301	Mini Project – 1A	--	4$	--	--	2	--	**2**
Total		**15**	**14**	**2**	**15**	**07**	**2**	**24**

$ indicates work-load of Learner (Not of Faculty), for Mini Project

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical & Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ELC301	Engineering Mathematics - III	20	20	20	80	3	25	--	125
ELC302	Electronics Devices and Circuits - I	20	20	20	80	3	--	--	100
ELC303	Digital Logic Circuits	20	20	20	80	3	--	--	100
ELC304	Electrical Networks Analysis and Synthesis	20	20	20	80	3	25	--	125
ELC305	Electronic Instruments and Measurements	20	20	20	80	3	--	--	100
ELL301	Electronics Devices and Circuits - I Lab	--	--	--	--	--	25	25	50
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50
ELL304	Skill base Lab - OOPM: *(C++ and Java)*	--	--	--	--	--	50	--	50
ELM301	Mini Project - 1A	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	--	**200**	**100**	**800**

Note:

1. Students group and load of faculty per week.

   Mini Project 1 and 2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load: 1 hour per week per four groups

   Major Project 1 and 2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load: In Semester VII– ½ hour per week per project group
   In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.

3. Mini-projects 2-A and 2-B should be based on DLOs.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tutorial	Theory	TW/Pract.	Tutorial	Total
ELC301	Engineering Mathematics - III	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem Exam				
		Test 1	Test 2	Avg of Test 1 & 2					
ELC301	Engineering Mathematics - III	20	20	20	80	25	--	--	125

Pre-requisite:

Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors,

Course Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra and its applications
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: On successful completion of course learner will be able to;

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables.
5. Illustrate the use of matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module No	Contents	Hrs.
01	**Laplace Transform** 1.1 Definition of Laplace transform Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t,* Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	**7**
02	**Inverse Laplace Transform** 2.1. Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	**Fourier Series** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	7
04	**Complex Variables** 4.1 Function *f*(z)of complex variable, limit, continuity and differentiability of *f*(z)Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in Cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	7

05	**Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	6
06	**Vector Differentiation and Integral** 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	6
	Total	**39**

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and secondclass test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Advanced Engineering Mathematics,H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics,Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw HillPublication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	TW/Practical and Oral	Tutorial	Total
ELC302	Electronic Devices & Circuits - I	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours	-	-	-
		Test 1	Test 2	Avg of Test 1 and Test 2		-	-	-	-
ELC 302	Electronic Devices & Circuits - I	20	20	20	80	03	--	--	100

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To analyze and design electronic circuits using semiconductor devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. Explain working of semiconductor devices.
2. Analyze characteristics of semiconductor devices.
3. Perform DC and AC analysis of Electronics circuits.
4. Compare various biasing circuits as well as various configurations of BJT and MOSFETs.
5. Select best circuit for the given specifications/application.
6. Design electronics circuits for given specifications.

Module No.	Unit No.	Contents	Hrs.
1		**PN Junction Diode**	06
	1.1	Fermi level concepts, Basic Diode Structure, Energy Band Diagrams, Zero Applied Bias, Forward bias, Reverse bias, PN junction current, drift and diffusion current, junction capacitance.	
	1.2	DC load line, small signal model, Applied Bias, Reverse Applied Bias, temperature effects.	
2		**Diode applications and Special semiconductor devices**	04
	2.1	Clippers and Clampers, Zener as voltage regulator.	
	2.2	Construction, Working and Characteristics of :Schottky diode, Solar Cells, Photodiodes, LEDs.	
3		**Bipolar Junction Transistor**	10
	3.1	BJT operations, voltages and currents, BJT characteristics (CE, CB, CC configurations), early effect.	
	3.2	DC Circuit Analysis: DC load line and region of Operation, Common Bipolar Transistor Configurations, biasing circuits, bias stability and compensation, analysis and design of biasing circuits.	
	3.3	AC Analysis of BJT Amplifiers: AC load line, small signal models: h-parameter model, re model, Hybrid-pi model. Ac equivalent circuits and analysis to obtain voltage gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers using Hybrid-pi model only.	
4		**Field Effect Devices**	10
	4.1	JFET: Construction, operation and characteristics. MOSFET: Construction, operation and characteristics of D-MOSFET and EMOSFET.	
	4.2	DC Circuit Analysis: DC load line and region of operation, Common-MOSFETs configurations, Analysis and Design of Biasing Circuits	
	4.3	AC Analysis: AC load line, Small-Signal model of MOSFET and its equivalent Circuit, Small-Signal Analysis MOSFET Amplifiers (Common-Source, Source Follower, Common Gate)	
5		**Rectifiers and Filters**	04
	5.1	Rectifiers: Working and analysis of Full wave and Bridge	
	5.2	Filters: C, L, LC, pi.	
6		**Design of Electronic Circuits**	05
	6.1	Design of single stage CE amplifier	
	6.2	Design of single stage CS MOSFET amplifier	
	6.3	Design of full wave rectifier with LC and pi filter.	
		Total	**39**

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

Reference Books:

1. Boylestad," Electronic Devices and Circuit Theory", Pearson
2. David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.
3. Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage
4. S. Salivahanan, N. Suresh Kumar,“Electronic Devices and Circuits”, Tata McGraw Hill
5. Millman and Halkies, “Integrated Electronics”, TATA McGraw Hill.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ELC303	Digital Logic Circuits	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours		--	--
		Test 1	Test 2	Avg of Test 1 and Test 2	--	--	--	--	--
ELC303	Digital Logic Circuits	20	20	20	80	03	--	--	100

Course Pre-requisite:

Basic Electrical & Electronics Engineering

Course Objectives:

1. To understand various number system & amp; codes and to introduce the students to various logic gates, SOP, POS form and their minimization techniques.
2. To teach the working of combinational circuits, their applications and implementation of combinational logic circuits using MSI chips.
3. To teach the elements of sequential logic design, analysis and design of sequential circuits.
4. To understand various counters and shift registers and its design using MSI chips.
5. To explain and describe various logic families and Programmable Logic Devices.
6. To train students in writing program with Verilog hardware description languages.

Course Outcome:

After successful completion of the course students will be able to;

1. Perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
2. Analyse, design and implement Combinational logic circuits.
3. Analyse, design and implement Sequential logic circuits.
4. Design and implement various counter using flip flops and MSI chips.
5. Understand TTL & amp; CMOS logic families, PLDs , CPLD and FPGA.
6. Understand basics of Verilog Hardware Description Language and its programming with combinational and sequential logic circuits.

Module No.	Unit No.	Contents	Hrs.
1		**Fundamentals of Digital Design**	7
	1.1	**Number Systems and Codes:** Review of Number System, Binary Code, Binary Coded Decimal, Octal Code,Hexadecimal Code and their conversions, Binary Arithmetic: One's and two's complements,	
	1.2	**Codes :**Excess-3 Code, Gray Code, Weighted code, Parity Code: Hamming Code	
	1.3	**Logic Gates and Boolean Algebra:** Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables	
2		**Combinational Circuits using basic gates as well as MSI devices**	6
	2.1	**Arithmetic Circuits:** Half adder, Full adder, Ripple carry adder, Carry Look ahead adder, Half Subtractor, Full Subtractor, multiplexer, cascading of Multiplexer , demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1).	
	2.2	**MSI devices :** IC7483, IC74151, IC74138, IC7485.	
3		**Elements of Sequential Logic Design**	6
	3.1	**Sequential Logic:** Latches and Flip-Flops. RS, JK, Master slave flip flops, T & D flip flops with various triggering methods, Conversion of flip flops,	
	3.2	**Counters:** Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counter,Twisted ring counter, Shift Registers, Universal Shift Register.	
4		**Sequential Logic Design**	7
	4.1	**Sequential Logic Design:**Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques (inspection, partition and implication chart method) and state assignment,sequence detector, Clocked synchronous state machine design.	
	4.2	**Sequential logic design practices :**MSI counters (7490, 7492, ,7493,74163, 74169) and applications, MSI Shift registers (74194) and their applications.	
5		**Logic Families and Programmable Logic Devices**	6
	5.1	**Logic Families:** Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND,(Operation of TTL NAND gate), CMOS Logic :- CMOS inverter,CMOS NAND and CMOS NOR, Interfacing CMOS to TTL and TTL to CMOS.	
	5.2	**Programmable Logic Devices**: Concepts of PAL and PLA. Simple logic implementation using PAL and PLA. Introduction to CPLD and FPGA architectures, Numerical based on PLA and PAL.	
6		**Introduction to Verilog HDL**	7
	6.1	**Basics**: Introduction to Hardware Description Language and its core features, synthesis in digital design, logic value system, data types, constants, parameters, wires and registers. **Verilog Constructs:** Continuous & procedural assignment statements, logical, arithmetic, relational, shift operator, always, if, case, loop statements, Gate level modelling, Module instantiation statements.	
	6.2	**Modelling Examples:** Combinational logic eg. Arithmetic circuits, Multiplexer, Demultiplexer, decoder, Sequential logic eg. flip flop, counters.	
		Total	**39**

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.
2. Morris Mano, Digital Design, Pearson Education, Asia 2002.
3. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing, 2018.

Reference Books:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. John F. Warkerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.
3. Stephen Brown and ZvonkoVranesic, Fundamentals of digital logic design with Verilog design, McGraw Hill, 3rd Edition.
4. Digital Circuits and Logic Design – Samuel C. Lee , PHI
5. William I.Flectcher, "An Engineering Approach to Digital Design", PrenticeHall of India.
6. Parag K Lala, "Digital System design using PLD", BS Publications, 2003.
7. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ELC304	Electrical Network Analysis & Synthesis	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC304	Electrical Network Analysis & Synthesis	20	20	20	80	03	25	--	125

Course Pre-requisite:

1. Basic Electrical Engineering
2. Engineering Mathematics I and II

Course Objectives:

1. To learn electrical networks and its analysis in time and frequency domain.
2. To understand synthesis of electrical networks.
3. To understand various types of filters.

Course Outcomes:

After successful completion of the course students will be able to;

1. Explain basic electrical circuits with nodal and mesh analysis and apply network theorems.
2. Apply Laplace Transform for steady state and transient analysis.
3. Determine different network functions and solve complex circuits using network parameters.
4. Realize electrical networks for given network functions using synthesis concepts.
5. Design various types of filters.

Module No.	Unit No.	Contents	Hrs.
1		**Analysis of Circuits**	10
	1.1	**Analysis of DC circuits with dependent sourcesusing**: generalized loop, node matrix analysis, Superposition, Thevenin, Norton's and Maximum Power Transfer theorems.	
	1.2	**Analysis of Coupled Circuits:** Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.	
2		**Time and Frequency Domain Analysis of Electrical Networks**	8
	2.1	**Time Domain Analysis of Electrical Networks:** Forced and natural response,Initial and final conditions in network elements, Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, Transient and steady state response.	
	2.2	**Frequency Domain Analysis of Electrical Networks:** S-domain representation, Concept of complex frequency, Applications of Laplace Transform in solving electrical networks.	
3		**Two Port Networks**	9
	3.1	**Network Functions:**Driving point and Transfer Function, Poles and Zeros, Analysis of ladder networks.	
	3.2	**Two Port Parameters:** Open circuit, Short circuit, Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions.	
	3.3	**Series/parallel connection:** T and Pi representations, interconnection of Two-Port networks.	
4		**Synthesis of Electrical Networks**	7
	4.1	**Realizability Concept:** Hurwitz polynomial, Concept of positive real function, testing for necessary and sufficient conditions for positive real functions.	
	4.2	**Synthesis of RC, RL, LC circuits:** Concepts of synthesis of RC, RL, LC driving point functions, Foster and Cauer forms.	
5		**Introduction to filters**	5
	5.1	**Basic filter circuits:** Low pass, high pass, band pass and band stop filters, cut-off frequency, bandwidth, quality factor, attenuation constant, phase shift, characteristic impedance.	
	5.2	**Design and analysis of filters:** Constant K filters	
		Total	**39**

Text Books:

1. Network Analysis, M. E. Van Valkenburg/T.S. Rathore, Pearson Education, 3rd Edition (2019).
2. Engineering Circuit Analysis, William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven Durbin McGraw Hill, 9th Edition (2018).
3. Networks and Systems, Ashfaq Husain, Khanna Book Publishing Co. (P) Ltd.; 2nd Edition (2019).
4. Circuits and Networks: Analysis and Synthesis, A. Sudhakar and S.P. Shyammohan McGraw Hill Education (India) Private Limited; 5th edition (2015).

Reference Books:

1. Circuit Theory Analysis and Synthesis, A. Chakrabarti, DhanpatRai& Co., Seventh - Revised edition (2018)
2. MahmoodNahvi and Joseph A. Edminister, "Schaum's Outline of Electrical Circuits",McGraw-Hill Education, 7th Edition (2017).
3. Problems and Solutions of Electrical Circuit Analysis, R.K. Mehta & A.K. Mal, CBS Publishers and Distributors Pvt Ltd (2015).
4. Networks and systems, D. Roy Choudhary, New Age International Publishers, 2nd Edition (2013).

Term Work:

This shall consist of at least 10 tutorials based on the entire syllabus.Each tutorial shall have a minimum of four numerical problems solved and duly graded.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub- questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC305	Electronic Instruments and Measurements	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC305	Electronic Instruments and Measurements	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. FEC105-Basic Electrical Engineering
2. FEC101-Engineering Mathematics-I
3. FEC201-Engineering Mathematics-II

Course Objectives:

1. To develop understanding of fundamental principles of electronic measurements.
2. To disseminate basic methods for measurements of electrical quantities.
3. Toimpart knowledge of analog and digital instrumentation.

Course Outcomes:
After successful completion of the course students will be able to:

1. Recall and define instrument characteristics as well as interpret errors in measurements.
2. Understand and Measure various variables or value of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various components of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.
6. Develop a calibration scheme for given instrument.

Module No.	Unit No.	Contents	Hrs.
1	**Fundamental Principles of Measurement**		04
	1.1	Measurement units (SI units of current, charge, EMF, potential difference, voltage, resistance, conductance, magnetic flux & flux density, inductance & capacitance). Components of a general measurement system (instrument).	
	1.2	Instrument characteristics: Static (accuracy, precision, linearity, drift, sensitivity, resolution, hysteresis, dead band). Dynamic (Speed of response, fidelity, lag and dynamic error)	
	1.3	Errors in Measurement: Classification of Errors, methods to eliminate or minimize the errors. Statistical analysis of Errors.	
2	**Measurement of Resistance, Inductance and Capacitance**		08
	2.1	The concept of measurement with bridge, measurement of low, medium and high resistances using Wheatstone bridge, Kelvin double bridge and mega-ohm bridge (Megger). Numerical problems (computation of sensitivity, resolution, range, errors)	
	2.2	Measurement of Inductance, Capacitance and Frequency: Maxwell bridge, Anderson bridge, Hay's bridge, Schering bridge, Wien's bridge. LCR-Q meter. Numerical problems (computation of sensitivity, resolution, range, errors)	
3	**Electronic Instruments**		08
	3.1	Digital DC Voltmeters (DVM): Ramp, dual slope, integrating, successive approximation. AC Voltmeters: Rectifier, average responding, peak responding, true RMS meter. Digital multimeter (DMM), Digital phase meter.	
	3.2	Signal Generators: Low frequency signal generator, function generator, pulse generator, sweep frequency generator.	
	3.3	Wave analyzer: Basic wave analyzer, frequency selective and heterodyne. Harmonic distortion analyzer, spectrum analyzer.	
4	**Oscilloscopes**		08
	4.1	Cathode Ray Oscilloscope: Block diagram of CRO, deflection generator, horizontal sweep generator, delay line, single and dual beam, dual trace CRO, chop and alternate modes	
	4.2	Measurements using Oscilloscope: Measurement of voltage, frequency and phase. Lissagous figures and their use in phase and frequency measurement.	
	4.3	Digital Storage Oscilloscope: Basic DSO operation, sampling rate, auto-set.	
5	**Sensor and Transducers**		08
	5.1	Basics of Sensors and Transducers: Definitions, difference, characteristics, classification and criteria for selection.	
	5.2	Transducers for measurement of- temperature: RTD, thermister, thermocouple, comparison of all three; displacement: Potentiometer, capacitive transducers, LVDT, strain gauge; pressure: load cell, dead weight tester; level: ultrasonic and optical.	
6	**Instrument Calibration**		03
	6.1	Principles and characteristics of calibration. Need of calibration.	
	6.2	Calibration of potentiometer. Use of potentiometer for calibration of voltmeter. DMM as standard instrument for calibration.	
		Total	**39**

Text Books:

1. David Bell, "Electronic Instrumentation and Measurements", Oxford Publishing, 2nd edition, 2003.
2. A. D. Helfrick, W. D. Cooper, "Modern Electronics Instrumentation and Measurement Techniques", NJ. Prentice Hall, 2002.
3. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 2nd edition, 2004.

Reference Books:

1. C. S. Rangan, G. R. Sarma, V. S. V. Mani, "Instrumentation: Devices and Systems", Tata McGraw Hill, 2nd edition, 2004.
2. A. K. Sawhney, "Electrical and Electronic Instruments and Measurements", DhanpatRai& Sons, Delhi, 2015.
3. D. Prensky, "Electronic Instrumentation", Prentice Hall Publication.
4. S. K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 3rd Edition, 2017.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the module

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL301	Electronic Devices & Circuits - I Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL301	Electronic Devices & Circuits - I Lab	--	--	--	--	--	25	25	50

Term Work:

At least 10 experiments covering entire syllabus of ELC302 (Electronic Devices and Circuits I) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiments must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Experiment Title
1	To study passive(R,L,C) and active (BJT,MOSFTET) components.
2	To study equipment (CRO, Function Generator, Power supply).
3	To perform characteristics of PN junction diode.
4	To perform Clippers and Clampers.
5	To perform analysis and design Fixed bias, voltage divider bias for CE amplifier.
6	To perform CE amplifier as voltage amplifier (Calculate Av, Ai, Ri, Ro).

7	To perform CS MOSFET amplifier as voltage amplifier and measurement of its performance parameters.
8	To perform Full wave/Bridge rectifier with LC/pi filter.
9	To perform Zener as a shunt voltage regulator.
10	To design Full wave/Bridge rectifier with LC/pi filter.
11	To design single stage CE Amplifier.
12	To design single stage CS Amplifier.

Suggested Simulation Experiments:

Sr. No.	Experiment Title
1	SPICE/NGSPICE simulation of and implementation for junction analysis
2	SPICE/NGSPICE simulation of and implementation for BJT characteristics
3	SPICE/NGSPICE simulation of and implementation for JFET characteristics
4	SPICE/NGSPICE simulation of for MOSFET characteristics
5	SPICE/NGSPICE simulation of Full wave/Bridge rectifier with LC/pi filters.
6	SPICE/NGSPICE simulation of CE amplifier
7	SPICE/NGSPICE simulation of CS MOSFET amplifier.

(Expected percentage of H/w and software experiments should be 60% & 40% respoectively)

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL302	Digital Logic Circuits Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical &Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50

Term Work:
At least 10 experiments covering entire syllabus of ELC 303 (Digital Logic Circuits) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Course Objective:-

1. To learn the functionality of basic logic gates.
2. To Construct combinational circuits and verify their functionalities.
3. To learn the functionality of flip flops and their conversion.
4. To Design and implement synchronous and asynchronous counters, Shift registers using MSI.
5. To simulate various combinational and sequential circuits and analyze the results using Verilog HDL.

Suggested List of Experiments:

Sr. No.	Hardware Experiment Title
1	To verify different logic gates and implement basic gates using universal gates
2	To implement Boolean function in SOP and POS form
3	To implement half adder, full adder, half Subtractor, full Subtractor
4	To implement BCD adder using binary adder IC 7483

5	To implement logic equations using Multiplexer IC 74151
6	To verify truth table of SR,JK,T and D flip flops
7	To perform Flip flop conversion JK to D, JK to T and D to T flip flop
8	To implement MOD N counter using IC 7490/7492/7493
9	To implement Synchronous counter using IC 74163/74169 **OR** To implement universal shift register using IC 74194

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	To design and simulate Full adder/full subtractor using Verilog HDL
2	To design and simulate Multiplexer/Demultiplexer using Verilog HDL
3	To design and simulate decoder 74138 using Verilog HDL
4	To simulate basic flip flops using Verilog HDL
5	To design and simulate 4 bit counter / up-down counter using Verilog HDL
6	To design and simulate Shift register using Verilog HDL

(Additional suggested experiments (optional) *Implementation of any of above using* ***FPGA/CPLD)***

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL303	Electronic Instruments and Measurements Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50

Course Outcomes:

After successful completion of the course students will be able to:

1. Demonstrate the instrument characteristics as well as interpret errors in measurements.
2. Measure various variables or value (R, L and C) of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various functions of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.
6. Develop a calibration scheme for given instrument.

Term Work:

At least 10 experiments covering entire syllabus of ELC303 (**Electronic Instruments and Measurements**) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments:

Sr. No.	Hardware Experiment Title
1	Study of DSO for measurements of voltage, frequency and phase.
2	Measurement of resistance using wheat-stone /kelvin bridge.
3	Measurement of inductance and Q-factor using Hay's bridge.
4	Measurement of capacitance using Schering bridge.
5	Measurement of frequency using Wien bridge.
6	Study characteristics and use of LVDT.
7	Measurement of temperature using RTD/Thermister.
8	Measurement of displacement using strain gauge.
9	Calibration of potentiometer.
10	Calibration of voltmeter using potentiometer/DMM.

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	Simulation of the zeroth, first order and second order Instrument to understand its dynamic characteristics.
2	Simulation of measurement of rms , average with error indication
3	Simulation of the Working of multichannel oscilloscope and demonstrate the different modes
4	Simulation of measurement of various physical parameters such as Temperature, distance or pressure.
5	Simulation of DAS
6	Simulation of the calibration method and its performance evaluation

Preferably open source software should be used for implementation.

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently..

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL304	Skill base Lab - OOPM: *(C++ and Java)*	--	02* + 02	--	--	02	--	02
* *Theory class to be conducted for full class*								

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ELL304	Skill base Lab - OOPM: *(C++ and Java)*	--	--	--	--	--	50	--	50

Course Pre-requisites:

- Fundamentals of C-Programming

Course Objectives:

1. To understand Object Oriented Programming basics and its features.
2. To understand and apply Object Oriented Programming (OOP) principles using C++
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
4. Able to use a programming language to resolve problems.

Course Outcomes:

After successful completion of the course student will be able to;

1. Use C++ in programming.
2. Use different control structures.
3. Understand fundamental features of an object oriented language: object classes and interfaces, exceptions and libraries of object collections.
4. Understand Java Programming.
5. To develop a program that efficiently implements the features and packaging concept of java in laboratory.
6. To implement Exception Handling and Applets using Java.

Module No.	Unit No.	Topics	Hrs.
1		**C++ Overview**	08
	1.1	Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP and C++ as object orientedprogramminglanguage.	
	1.2	C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.	
2		**C++ Control Structures**	06
	2.1	**Branching -** If statement, If-else Statement, Decision. **Looping –** while, do-while, for loop **Nested control structure-** Switch statement, Continue statement, Break statement.	
	2.2	**Array-** Concepts, Declaration, Definition, Accessing array element, One dimensional and Multidimensional array.	
3		**Object-Oriented Programming using C++**	10
	3.1	**Operator Overloading-** concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. **Function-** Function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function. **Constructor-** Definition, Types of Constructor, Constructor Overloading, Destructor.	
	3.2	**Inheritance-** Introduction, Types of Inheritance, Inheritance, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Visibility Modes Public, Private, Protected and Friend, Aggregation, Classes Within Classes. Deriving a class from Base Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, **Polymorphism-** concept, relationship among objects in inheritance hierarchy, Runtime & Compile Time Polymorphism, abstract classes, Virtual Base Class.	
4		**Introduction to Java**	06
	4.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based.Difference between C++ and Java.	
	4.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
5		**Inheritance, Polymorphism, Encapsulation using Java**	10
	5.1	**Classes and Methods**: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. **String:** String Class and Methods in Java.	

	5.2	**Inheritances:** Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
6		**Exception Handling and Applets in Java**	08
	6.1	**Exception Handling:** fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception subclasses). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Print Writer class. **Threading:** Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread	
	6.2	**Applet:** Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
	Total		**48**

Textbooks:

1. BjarneStroustrup, "The C++ Programming language", Third edition, Pearson Education, 2000.
2. Deitel, "C++ How to Program", 4th Edition, Pearson Education, 2005.
3. D. T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, Edition, 2015.
4. YashwantKanitkar, "Let Us Java", BPB Publications, 4nd Edition, 2019.

Reference Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, 10th Edition, 2017.
2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI , 2009.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Languageser Guide", Pearson Education.
4. SachinMalhotra, SaurabhChaudhary "Programming in Java", Oxford University Press, 2010

Software Tools:

1. Raptor-Flowchart Simulation:http://raptor.martincarlisle.com/
2. Eclipse: https://eclipse.org/
3. Netbeans:https://netbeans.org/downloads/
4. CodeBlock:http://www.codeblocks.org/
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Suggested list of Experiments:

Sr. No	Write C++ Program to
1	Add Two Numbers
2	Print Number Entered by User
3	Swap Two Numbers
4	Check Whether Number is Even or Odd
5	Find Largest Number Among Three Numbers
6	Create a simple class and object.
7	Create an object of a class and access class attributes
8	Create class methods
9	Create a class to read and add two distance
10	Create a class for student to get and print details of a student.
11	Demonstrate example of friend function with class
12	Implement inheritance.

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40,declare the student as “Pass” else “Fail””
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'runnable' interface or creating 'Thread Class.
15	Demonstrate Hello World Applet Example

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:

At least **16** experiments (**08 experiments** each on **C++** and **JAVA**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiments and are graded from time to time.

The grades will be converted to marks as per "**Choice Based Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course code	Course Name	Credits
ELM 301	Mini Project - 1A	02

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELM 301	Mini Project - 1A	--	--	--	--	--	25	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentalsto attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcomes:

Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book: 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of components/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Program Structure for Second Year Electronics Engineering

UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

SEMESTER IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC401	Engineering Mathematics - IV	3	--	1	3	--	1	4
ELC402	Electronics Devices and Circuits - II	3	--	--	3	--	--	3
ELC403	Microcontroller Applications	3	--	--	3	--	--	3
ELC404	Principles of Communication Engg	3	--	1	3	--	1	4
ELC405	Signals and Systems	3	--	--	3	--	--	3
ELL401	Electronics Devices and Circuits - II Lab	--	2	--	--	1	--	1
ELL402	Microcontroller Applications Lab	--	2	--	--	1	--	1
ELL403	Analog Communication Lab	--	2	--	--	1	--	1
ELL404	Skill Base Lab : *Python Programming*	--	4	--	--	2	--	2
ELM401	Mini Project - 1B	--	4$	--	--	2	--	2
Total		15	14	2	15	07	2	24

$ indicates workload of Learner (Not for Faculty), for Mini Project

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical and oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (inHrs)			
		Test 1	Test 2	Avg.					
ELC401	**Engineering Mathematics - IV**	20	20	20	80	3	25	--	**125**
ELC402	**Electronics Devices and Circuits -II**	20	20	20	80	3	--	--	**100**
ELC403	**Microcontroller Applications**	20	20	20	80	3	--	--	**100**
ELC404	**Principles of Communication Engg**	20	20	20	80	3	--	--	**100**
ELC405	**Signals and Systems**	20	20	20	80	3	25	--	**125**
ELL401	**Electronics Devices and Circuits - II Lab**	--	--	--	--	--	25	25	**50**
ELL402	**Microcontroller Applications Lab**	--	--	--	--	--	25	25	**50**
ELL403	**Analog Communication Lab**	--	--	--	--	--	25	25	**50**
ELL404	**Skill Base Lab : *Python Programming***	--	--	--	--	--	50	--	**50**
ELM401	**Mini Project - 1B**	--	--	--	--	--	25	25	**50**
Total		**--**	**--**	**100**	**400**	**--**	**200**	**100**	**800**

Note:

1. Studentsgroupandloadoffacultyperweek.

   MiniProject 1 and2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load:1 hour per week per four groups

   MajorProject 1 and 2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load: In Semester VII – ½ hour per week per project group
   In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.

3. Mini-projects 2-A and 2-B should be based on DLOs.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC401	Engineering Mathematics - IV	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC401	Engineering Mathematics - IV	20	20	20	80	03	25	--	125

Pre-requisite:

Engineering Mathematics - I, Engineering Mathematics - II,
Engineering Mathematics - III, Binomial Distribution.

Course Objectives: The course is aimed;

1. To studythe line and contour integrals and expansion of complex valued function in a power series.
2. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
3. To study the probability distributions and expectations.
4. To acquaint with the concepts of vector spaces used in the field of machine learning and engineering problems.
5. To familiarize withthe concepts of Quadratic forms and Singular value decomposition.
6. To learn the concepts of Calculus of Variations.

Course Outcomes:

On successful completion of course, learner will be able to;

1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2. Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
5. Use the concept of Quadratic forms and Singular value decomposition in various Engineering applications.
6. Find the extremals of the functional using the concept of Calculus of variation.

Module No.	Detailed Contents	Hrs.
01	**Complex Integration** 1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 1.2 Taylor's and Laurent's series (without proof). 1.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof). **Self-learning Topics:** Application of Residue Theorem to evaluate realintegrations, Z-Transform.	7
02	**Statistical Techniques** 2.1 Karl Pearson's Coefficient of correlation (r) . 2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) 2.3 Lines of regression. 2.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	6
03	**Probability Distributions** 3.1. Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function. 3.2 Expectation, mean and variance. 3.3 Probability distribution: Poisson & normal distribution. **Self-learning Topics:** Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.	7
04	**Linear Algebra: Vector Spaces** 4.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (with proof), Unit vector. 4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors. 4.3 Vector spaces over real field, subspaces. **Self-Learning Topics**:- Linear combinations, linear Dependence andIndependence, QR decomposition.	6

05	**Linear Algebra: Quadratic Forms** 5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. 5.2 Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite. 5.3 Reduction of Quadratic form to a canonical form using congruent transformations. 5.4 Singular Value Decomposition. **Self-learning Topics:** Orthogonal Transformations**,** Applications of Quadratic forms and SVD in Engineering.	7
06	**Calculus of Variations:** 6.1 Euler- Lagrange equation(Without Proof), When F does not contain y, When F does not contain x, When F contains x,y,y'. 6.2 Isoperimetric problems-Lagrange Method. 6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method. **Self-Learning Topics:-**Brachistochrone Problem, Variational Problem,Hamilton Principle, Principle of Least action,Several dependent variables.	6
Total		**39**

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and secondclass test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Advanced engineering mathematics H.K. Das, S. Chand, Publications.
4. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
5. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
7. Beginning Linear Algebra Seymour Lipschutz Schaum's Outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC402	Electronic Devices & Circuits - II	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC402	Electronic Devices & Circuits - II	20	20	20	80	03	--	--	100

Pre-requisite :

- **ELC302:** Electronic Devices and Circuits - I

Course Objectives:

1. To enhance comprehension capabilities of students through understanding of electronic devices and circuits.
2. To perform DC and AC analysis of single stage and multistage amplifiers.
3. To design electronic circuits using semiconductor devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. Students will be able to understand performance of amplifiers with the help of frequency response.
2. Students will be able to perform DC and AC analysis of single stage and multistage amplifiers, oscillators differential amplifiers and power amplifiers.
3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters.
4. Student will be able to select appropriate circuit for given specifications/applications.

Module No.	Unit No.	Contents	Hrs.
1		**Frequency Response of Amplifiers**	
	1.1	Low frequency response and analysis: Effect of coupling, bypass and load capacitances on single stage MOSFET amplifiers.	
	1.2	High frequency response and analysis: Effect of parasitic capacitances on MOSFET amplifiers. High frequency equivalent circuit of MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth.	7
2		**Frequency Response of Multistage Amplifiers**	
	2.1	Types of coupling. Low, mid and high frequency response and analysis of multistage amplifiers (CS-CS, CS-CG).	7
3		**Feedback Amplifiers**	
	3.1	Types of negative feedback, block diagram representation, Effect of negative feedback on Input impedance, Output impedance, Gain and Bandwidth with derivation, feedback topologies (Introduction only).	5
	3.2	Analysis of voltage series negative feedback with appropriate circuits.	
4		**Oscillators**	
	4.1	Positive feedback and principle of oscillations, RC oscillators: Phase shift oscillators, Wien bridge oscillators, LC Oscillators: Hartley and Colpitts. Crystal Oscillator (MOSFET circuit analysis).	4
5		**Differential Amplifiers**	
	5.1	MOSFET current sources, Cascode current mirror, advanced MOSFET active load, small signal analysis: MOSFET active load.	
	5.2	Basic MOSFET differential amplifier, DC characteristics, transfer characteristics, differential and common mode input impedances. MOSFET differential amplifier with active load.	8
6		**Power Amplifiers**	
	6.1	Power MOSFETs, Heat Sinks, Class A, Class B, Class C and Class AB operation, Power efficiency.	8
	6.2	Class AB output stage with diode biasing, VBE multiplier biasing, input buffer transistors, Darlington configuration.	
	Total		**39**

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar," Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

Reference Books:

1. Robert Boylestad," Electronic Devices and Circuit Theory", Pearson.
2. David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.
3. Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage
4. S. Salivahanan, N. Suresh Kumar,“Electronic Devices and Circuits”, Tata McGraw Hill.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will beasked.
4. Remaining questions will be selected from all themodules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC403	Microcontroller Applications	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC403	Microcontroller Applications	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. ELC302: Electronics Devices and Circuits –I
2. ELC303: Digital Logic Circuits

Course Objectives:

1. To study the Architecture, Memory and hardware features of the 8051 microcontroller.
2. To study Assembly and C language programming for 8051.
3. To study interfacing of various I/O devices.
4. To build a microcontroller-based system.

Course Outcomes:

After successful completion of the course students will be able to:

1. To explain fundamental concepts of microcontrollers.
2. To develop programming skills for microcontrollers using Assembly and C concepts
3. To interface various devices to the microcontroller
4. To design and implement microcontroller-based systems.

Module No.	Unit No.	Contents	Hrs.
1		**8051 Microcontroller Architecture**	06
	1.1	Introduction to the concepts of Microprocessors and Microcontrollers	
	1.2	Prerequisites: Concept of Buses, Read/write operations, T state, Machine cycle and Instruction cycle	
	1.3	8051 Architecture	
	1..4	8051 Memory organisation	
	1.5	RISC and CISC Concepts, Harvard and Von Neumann Architectures	
	1.6	Overview of various available Microcontrollers	
	1.7	Applications of Microcontrollers	
2		**8051 Assembly language programming**	06
	2.1	Addressing modes of 8051.	
	2.2	Assembler Directives	
	2.3	Instruction Set: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions.	
3		**8051 Internal Hardware**	07
	3.1	I/O ports and programming	
	3.2	Timers/Counters and programming	
	3.3	Serial port and programming	
	3.4	Interrupts and programming	
	3.5	Low power modes of the 8051	
4		**8051 programming in Embedded C**	06
	4.1	Embedded C-programming concepts: Data types, Modifiers, Qualifiers, Functions, Macros, Interrupt service routines.	
	4.2	Embedded C programming for 8051 (including programming I/O ports, Timers/Counters, Serial port and Interrupts)	
5		**8051 Interfacing –Part 1**	07
	5.1	Interfacing external memory to 8051	
	5.2	Display interfacing: 7-segment LED display, 16x2 generic alphanumeric LCD display.	
	5.3	Keyboard interfacing: 4x4 matrix keyboard	
		(Interfacing examples must be done using Assembly language & Embedded C)	
6		**8051 Interfacing –Part 2**	07
	6.1	Analog devices interfacing: 8-bit ADC, 8-bit DAC, temperature sensor (LM35)	
	6.2	Motor interfacing: Relay, DC motor (speed control using PWM), Stepper motor and Servo motor.	
	6.3	8051 Microcontroller based system design (including Sensors and Actuators)	
		(Interfacing examples must be done using Assembly language & Embedded C)	
		Total	**39**

Text Books:

1. M.A.Mazidi, J.C.Mazidi, Rolin D. McKinlay,"The 8051 Microcontroller and Embedded Systems Using Assembly and C", Pearson Education, Second Edition, 2007.
2. Kenneth J. Ayala, "The 8051 Microcontroller", Cengage Learning India Pvt. Ltd, Third Edition, 2005.

Reference Books:

1. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2009.
2. Manish K Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014.
3. Ajay V Deshmukh, "Microcontroller Theory And Applications ", Tata Mcgraw Hill, 2017

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Term Work	Practical or Oral	Total
ELC404	Principles of Communication Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC404	Principles of Communication Engineering	20	20	20	80	3	--	--	100

Prerequisite:

- **Engineering Mathematics - III**
- **Engineering Mathematics - IV**

Course Objectives:

1. Understand the need for various analog modulation techniques
2. Analyze the characteristics of the receivers
3. Understand pulse modulation methods
4. Identify the necessity of multiplexing

Course Outcomes:

After successful completion of the course students will be able to:

1. describe the various elements of communication system.
2. recognize the need for multiplexing techniques.
3. analyze the performance of different analog modulation methods.
4. illustrate generation and detection of amplitude and frequency modulated systems.
5. characterize pulse modulation techniques.

Module No.	Unit No.	Topics	Hrs
1		**Introduction to Electronic Communication**	04
	1.1	**Introduction:** Electromagnetic frequency spectrum, concepts of wave propagation-ground wave, sky wave and space wave	
	1.2	**Elements of communication systems:** Information sources, communication channels, noise, sources of noises, need for modulation, bandwidth and power trade-off.	
2		**Amplitude Modulation and demodulation**	10
	2.1	**Amplitude Modulation:** Types of Analog Modulation, Principles of Amplitude Modulation, AM for a Complex Modulating Signal, AM Power Distribution, AM Current Distribution, Limitations of AM, AM modulators and Demodulator	
	2.2	**Types of AM**: Modulation & Demodulation Techniques: DSB-SC, SSB-SC, Comparison of AM, DSBSC and SSB	
	2.3	**Applications of AM:**AM Radio broadcasting, TV broadcasting of video	
3		**Angle modulation and demodulation**	09
	3.1	**Frequency Modulation:** Principles of Angle Modulation, Theory of FM— Basic Concepts, Spectrum Analysis of FM Wave, Narrowband and Wideband FM, Noise triangle, Pre-emphasis, de-emphasis FM Generation: Direct methods and Indirect method, FM Detection: Frequency discriminator and Phase discriminator methods	
	3.2	**Phase Modulation**: Theory of Phase Modulation, Relationship between FM and PM, Advantages and Disadvantages of Angle Modulation, Comparison of AM, FM and PM	
	3.3	**Applications of FM:** FM Radio broadcasting, TV broadcasting of sound	
4		**Radio Transmitters and Receivers**	06
	4.1	**Radio receivers:** Receiver Characteristics: Sensitivity, Selectivity, Fidelity, Image frequency rejection ratio, TRF Receivers and its characteristics, Concept of Heterodyning, Superheterodyne Receiver, choice of Intermediate frequency	
	4.2	**AM and FM Transmitters and Receivers**: AM and FM Radio Transmitters, AM and FM Radio Receivers, Practical diode detector, Automatic Gain Control (AGC), Types of AGC, Automatic Frequency Control (AFC) and Importance of Limiter	
5		**Pulse-Modulation and Multiplexing**	10
	5.1	**Introduction to digital transmission of signals**: comparison of Digital Analog Transmissions, Concept of regenerative Repeater	
	5.2	**Sampling and quantization**: Sampling Theorem, Aliasing error, Natural Sampling, Flat top sampling, Quantization of Signals	
	5.3	**Pulse Modulation Techniques**: Generation and detection of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM)	
	5.4	**PCM and Multiplexing**: Pulse-Code Modulation (PCM), Significance of Companding for voice signals, Delta Modulation, Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM)	
Total			**39**

Text Books:

1. Kennedy and Davis, “Electronics Communication System”, Tata McGrawHill, Fourth Edition
2. T L Singal, “Analog and Digital Communication”, Tata McGrawHill
3. B.P. Lathi, “Modern Digital and analog Communication System”, OXFORD, Fourth Edition

Reference Books:

1. Wayne Tomasi, “Electronics Communication Systems”, Pearson Education, Fifth Edition
2. Taub and Schilling, “Principles of Communication Systems”, Tata McGraw Hill, Fourth Edition
3. Roy Blake, “Electronics Communication System”, Thomson learning, Second Edition
4. R P Singh & Sapre, “Analog and Digital communication”, Tata McGraw Hill, Third Edition
5. Robert J. Schoenbeck, “Electronics communications modulation and transmission”, Second Edition
6. Lean W Couch, “Digital and Analog communication system”, Pearson Education, Sixth Edition
7. Roddy Coolen, “Electronic Communications”, PHI, Fourth Edition

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20marks.
2. The students need to solve total 4questions.
3. Question No. 1 will be compulsory and based on entiresyllabus.
4. Remaining questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC405	Signals and Systems	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC405	Signals and Systems	20	20	20	80	03	25	--	125

Course Pre-requisites:

- Basic knowledge of - Integration, Differentiation, Complex Numbers, Partial Fractions
- Basics of Laplace transform, Fourier transform and Z transform (Engineering Mathematics - I, II & III)

Course Objectives:

1. To introduce the mathematical concepts of continuous and discrete time signals and systems.
2. To acquaint the students with various time domain and frequency domain methods for analysis of signals and systems.

Course Outcomes:

After successful completion of the course students will be able to:

1. Identify and differentiate between continuous and discrete time signals and systems.
2. Develop input output relationship for LTI systems.
3. Apply the concept of Laplace transform and understand conversion from time domain to frequency domain for continuous time systems.
4. Apply the concept of Z transform and comprehend conversion from time domain to frequency domain for discrete time systems.
5. Analyse continuous time signals using Fourier series.
6. Analyse discrete time signals using Fourier Transform.

Module No.	Unit No.	CONTENTS	Hrs.
1		**Continuous and Discrete Time Signals and Systems**	8
	1.1	Mathematical Representation and Classification of Continuous Time CT) and Discrete Time (DT) Signals Arithmetic Operations on Signals, Time Shifting, Time Scaling, Time Reversal of Signals, Sampling Theorem and Aliasing	
	1.2	Mathematical Representation and Classification of CT systems	
	1.3	Mathematical Representation and Classification of DT systems	
2		**Time Domain Analysis of Continuous And Discrete Signals and Systems**	7
	2.1	Properties of Linear Time Invariant (LTI) systems, Impulse and Step Response	
	2.2	Use of Convolution Integral and Convolution Sum and Correlation for Analysis of LTI Systems	
	2.3	Properties of Convolution Integral/Sum	
3		**Frequency Domain Analysis of Continuous Time System using Laplace Transform**	6
	3.1	Need of Laplace Transform, Review of Laplace Transform, Concept of ROC, Properties, Inverse Laplace Transform, Poles and Zeros	
	3.2	Analysis and characterization of LTI system using Laplace transform: impulse and step response, causality, stability, stability of causal system	
4		**Frequency Domain Analysis of Discrete Time System using Z Transform**	6
	4.1	Need for Z Transform, Definition, Properties of Unilateral and Bilateral Z Transform, Mapping with s Plane, Relationship with Laplace Transform	
	4.2	Z Transform of Standard Signals, ROC, Poles and Zeros of Transfer Function, Inverse Z Transform	
	4.3	Analysis and Characterization of LTI System Using Z Transform: Impulse and Step Response, Causality, Stability in z-Domain.	
5		**Frequency Domain Analysis of Continuous Time Signals**	6
	5.1	Fourier Series of Continuous Time Signals ,Properties of Fourier series	
	5.2	Fourier Transform, Properties of Fourier Transform, Fourier Transform of Standard Signals, Relationship Between Fourier and Laplace Transform	
6		**Frequency Domain Analysis of Discrete Time Signals**	6
	6.1	Concept of Discrete Time Fourier Series, Properties of DTFS , Discrete Time Fourier Transform and Determination of Magnitude and Phase Functions using DTFT	
	6.2	Relation between Z transform and DTFT	
		Total	**39**

Text Books:

1. Tarun Kumar Rawat, “Signals and Systems”, Oxford University Press, 2016.
2. A. Nagoor Kani, “Signals and Systems”, Tata McGraw-Hill Education, 2014.

Reference Books:

1. John Proakis and Dimitris Monolakis, “Digital Signal Processing”, Pearson Publications, 4th Edition, 2006.
2. Alan V. Oppenheim, AlanS. Willsky, and S.Hamid Nawab, “Signals and Systems”, 2nd Edition, PHI learning, 2010
3. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2nd Edition, 2006.

Internal Assessment (IA):

Two tests must be conducted, which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus, wherein sub questions of 2 to 5 marks will be asked.
4. The remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL401	Electronic Devices & Circuits - II Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL401	Electronic Devices & Circuits - II Lab	--	--	--	--	--	25	25	50

Term Work:

At least 10 experiments covering entire syllabus of **ELC 402** (Electronic Devices and Circuits-II) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Hardware Experiment Name
1	To implement single stage MOSFET amplifier (CS) and study its frequency response
2	To implement Cascode amplifier and study its frequency response.
3	To determine input and output impedance of amplifier with and without feedback.
4	To Implement two stage RC coupled CE amplifier and plot frequency response.
5	To perform an experiment to study performance of RC phase shift oscillator.

6	To perform an experiment to study performance of Hartley oscillator.
7	To perform an experiment to study performance of Colpitts oscillator.
8	To perform an experiment to study performance of Crystal oscillator.
9	To perform an experiment to study Class B push pull amplifier.
10	To perform an experiment to study Class AB amplifier.

Suggested Simulation Experiments:

Sr. No.	Simulation Experiment Name
1	SPICE simulation of frequency response of single stage CS MOSFET amplifier.
2	SPICE simulation of frequency response of Cascade amplifier.
3	SPICE simulation of frequency response of two stage RC coupled CS amplifier.
4	SPICE simulation of RC phase shift oscillator.
5	SPICE simulation of Wein Bridge oscillator.
6	SPICE simulation of Hartley oscillator.
7	SPICE simulation of Colpitts oscillator.
8	SPICE simulation of Crystal oscillator.
9	SPICE simulation of Class B push pull amplifier.
10	SPICE simulation of Class AB amplifier.

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL402	Microcontroller Applications Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL402	Microcontroller Applications Lab	--	--	--	--	--	25	25	50

Prerequisite: C Programming

Course Objectives:

1. To study Assembly and C language programming for 8051.
2. To study interfacing of various I/O devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. To develop programming skills for microcontrollers using Assembly and C concepts
2. To interface various devices to the Microcontroller

Term Work:

At least 10 experiments covering entire syllabus of **Microcontroller Applications (ELC403) s**hould be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Experiment title
1	Arithmetic Operations
2	Logical Operations
3	Branching operations
4	I/O port programming
5	Applications of Timers
6	Serial port programming
7	Interrupts programming
8	Seven Segment Display Interfacing
9	LCD Interfacing
10	Interfacing a Matrix keyboard
11	Interfacing a Relay
12	Sensor interfacing using an ADC
13	Generation of different waveforms using DAC
14	Speed Control of DC Motor (using PWM)
15	Stepper Motor Interfacing
Atleast 05 exeperiments must be performed using Embeded C and experiments should have mix i.e. Hardware and simulation ones.	

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL403	Principles of Communication Engineering Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL403	Principles of Communication Engineering Lab	--	--	--	--	--	25	25	50

Term Work:

At least 10 experiments covering entire syllabus of ***ELC 404*** (Principles of Communication Engg.) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of experiments/Tutorials:

Sr. No.	Tutorial/Experiment Title
1	Tutorial on Signal Representations- Fourier Series
2	Tutorial on Signal Representations- Fourier Transforms
3	Amplitude Modulation and demodulation
4	DSB-SC BalancedModulator
5	Frequency Modulation and Demodulation

6	Super-heterodyne radio receiver
7	Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulation
8	Verification of SamplingTheorem
9	Pulse Code Modulation
10	Delta Modulation and Adaptive Delta Modulation

List of Simulation/Software Experiments

Sr. No.	Simulation Experiments Name
1	Simulation of Generation of Signals
2	Simulation of Fourier Transform
3	Simulation of PSD of a Signal
4	Simulation of Multiplexing (TDM/FDM)
5	Simulation of Amplitude Modulation and Demodulation
6	Simulation of Frequency Modulation and Demodulation
7	Simulation of Phase Modulation and Demodulation

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL 404	Skill-Base Lab: *Python Programming*	--	01$ + 03	--	--	02	--	02
$ One-hour theory per week for the complete class. (For simplifying its implementation, 2hrs. theory on alternate weeks can be conducted)								

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELL404	Skill-Base Lab: *Python Programming*	--	--	--	--	--	50	--	50

Course pre-requisite:

ECL 304 – Skill Lab: C++ and Java Programming

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore file handling in Python
3. Infer the Object-oriented Programming concepts in Python
4. Formulate GUI Programming and Databases operations in Python
5. Develop applications using variety of libraries and functions

Course Outcomes:

After successful completion of the course student will be able to;

1. Describe syntax and semantics in Python
2. Illustrate different file handling operations
3. Interpret object-oriented programming in Python
4. Design GUI Applications in Python
5. Express proficiency in the handling Python libraries for data science
6. Develop machine learning applications using Python.

Module No.	Unit No.	Content	Hrs.
1		**Introduction to Python**	06
	1.1	Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input Statements in python.	
	1.2	Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures.	
	1.3	Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements.	
2		**Functions and File I/O Handling**	06
	2.1	Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code.	
	2.2	File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, with keywords, Moving within a file, Manipulating files and directories, OS and SYS modules.	
3		**Object Oriented Programming**	08
	3.1	Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes.	
	3.2	Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Exception Handling, Link list, Stack, Queues.	
4		**Graphical User Interface and Image processing**	08
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.	
	4.2	Database: Sqilite database connection, Create, Append, update, delete records from database using GUI.	
	4.3	Basic Image Processing using OpenCV library, simple image manipulation using image module.	
5		**Numpy, Pandas, Matplotlib, Seaborn, Scipy**	10
	5.1	Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy.	
	5.2	Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation.	
	5.3	Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn.	
	5.4	Introduction to Scipy, Scipy Sub packages – Integration and Optimization, Eigen	

		values and Eigen Vectors, Statistic, Weave and IO.	
6		**Python Applications**	10
	6.1	GUI based applications	
	6.2	Applications in Image Processing, Networking	
	6.3	Machine Learning, Linear Regression, Logistic Regression	
	6.4	Classification using K nearest neighbor	
	6.5	Support Vector Machines	
Total			48

Text Books:

1. Yashvant Kanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications; 1st edition (8 July 2019).
2. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT Publisher, August 2015.
3. John Grayson, "Python and Tkinter Programming", Manning Publications (1 March 1999).
4. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
6. Introduction to computing and problem solving using python, E Balagurusamy, McGraw Hill Education

Reference books:

1. Eric Matthes, "Python Crash Course A hands-on, Project Based Introduction to programming" No Starch Press; 1st edition (8 December 2015).
2. Paul Barry, "Head First Python" O'Reilly; 2nd edition (16 December 2016)
3. Zed A. Shaw, "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly
4. Beautiful World of Computers and Code", Addison Wesley; 3rd edition (1 October 2013).
5. Andreas C. Mueller, "Introduction to Machine Learning with Python", O'Reilly; 1st edition (7 October 2016)
6. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media; 3rd edition (10 May 2013).
7. Bhaskar Chaudhary, "Tkinter GUI Application Development Blueprints: Master GUI
8. Programming in Tkinter as you design, implement, and deliver 10 real world application", Packt Publishing (November 30, 2015)

Software Tools:

- Python IDE: https://www.python.org/downloads/
- Anaconda Environment: https://www.anaconda.com/distribution/

Online Repository:

1. Github
2. Python 3 Documentation: https://docs.python.org/3/
3. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
4. http://spoken-tutorial.org
5. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
6. Numpy Documentation: https://numpy.org/doc/
7. Pandas Documentation: https://pandas.pydata.org/docs/
8. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
9. Scipy Documentation: https://www.scipy.org/docs.html
10. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
11. https://nptel.ac.in/courses/106/106/106106182/

Sr. No.	Problem Statement	Module No.
1	1. Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc. 2. Write Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc) 3. Write Python program to implement control structures. 4. Assume a suitable value for distance between two cities (in km). 5. Write a program to convert and print this distance in meters, feet, inches and centimeter. 6. Write a program to carry out the following operations on the given set 7. s = {10, 2, -3, 4, 5, 88} a) Number of items in sets s b) Maximum element in sets s c) Minimum element in sets s d) Sum of all elements in sets s e) Obtain a new sorted set from s, set s remaining unchanged f) Report whether 100 is an element of sets s g) Report whether -3 is not an element of sets s.	Module 1
2	1. Write python program to understand different File handling operations 2. Create 3 lists – a list of names, a list of ages and a list of salaries. 3. Generate and print a list of tuples containing name, age and salary from the 3 lists. From this list generate 3 tuples – one containing all names, another containing all ages and third containing all salaries.	Module 2
3	1. Write Python program to implement classes, object, Static method and inner class 2. If any integer is given as in input through the keyboard, write a program to find whether it is odd or even number. 3. If ages of Ram, Shyam, and Ajay are given as an input through the keyboard, write a program to determine the youngest of the three. 4. Write a program that prints square root and cube root of numbers from 1 to 10, up to 4	Module 3

	decimal places. Ensure that the output is displayed in separate lines, with number center-justified and square and cube roots right-justified. 5. Write a program to find the factorial value of any number enteredthrough the keyboard. 6. Write a program that defines a function count_lower_upper( ) that accepts a string and calculates the number of uppercase and lowercase alphabets in it. It should return these values as a dictionary. Call this function for some sample strings. 7. A 5-digit positive integer is entered through the keyboard, write arecursive function to calculate sum of digits of 5-digit number.	
4	1. Write Python program to create, append, update, delete records from database using GUI. 2. Write Python program to obtain histogram of any image 3. Write Python Program to split color image in R,G,B and obtain a. individual histograms. 4. Write Python program for histogram equalization 5. Write Python Program for edge detection 6. Write Python Program for image segmentation 7. Write Python program to implement GUI Canvas application using Tkinter 8. Write Python program to implement GUI Frame application using Tkinter	Module 4
5	1. Write Python program to study define, edit arrays and perform arithmetic operations. 2. Write python program to study selection, indexing, merging, joining, concatenation in data frames 3. Evaluate the dataset containing the GDPs of different countries to: a) Find and print the name of the country with the highest GDP b) Find and print the name of the country with the lowest GDP c) Print text and input values iteratively d) Print the entire list of the countries with their GDPs e) Print the highest GDP value, lowest GDP value, mean GDP value, standardized GDP value, and the sum of all the GDPs 4. Analyze the Federal Aviation Authority (FAA) dataset using Pandas to do the following: a) View: aircraft make name, state name, aircraft model name, text information, flight phase, event description type, fatal flag b) Clean the dataset and replace the fatal flag NaN with "No". c) Find the aircraft types and their occurrences in the dataset d) Remove all the observations where aircraft names are not available e) Display the observations where fatal flag is "Yes" 5. Analyze the "auto mpg data" and draw a pair plot using seabornlibrary for mpg, weight, and origin. (a) Origin: This dataset was taken from the StatLib library maintained at Carnegie Mellon University. • Number of Instances: 398 • Number of Attributes: 9 including the class attribute • Attribute Information: • mpg: continuous • cylinders: multi-valued discrete • displacement: continuous	Module 5

	• horsepower: continuous • weight: continuous • acceleration: continuous • model year: multi-valued discrete • origin: multi-valued discrete • car name: string (unique for each instance) 6. Write python program to use SciPy to solve a linear algebraproblem. 7. There is a test with 30 questions worth 150 marks. The test has twotypes of questions: 1. True or false – carries 4 marks each 2. Multiple-choice – carries 9 marks each. Find the number of true or false and multiple-choice questions.	
6	1. Write python program to study linear regression 2. Write python program to study multiple linear regression 3. Write python program to study logistic regression 4. Write python program to study Support Vector Machine 5. Write python program to study decision tree algorithm 6. Write python program to study two-way communication between client and server.	Module 6

Suggested list of course projects:

- Speed typing Test using Python
- Music player in Python
- Calculator app using tkinter
- Train announcement system using python
- Dice rolling simulator
- Expense tracker
- Contact book using python
- Develop classification model using freely available datasets
- Develop python application for sentiment analysis

Note:

Suggested List of Experimentsand problem statements are indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:

At least 12 experiments and 1 course project should be performed. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per "Credit and Grading System" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Credits
ELM 401	Mini Project - 1B	02

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELM 401	Mini Project - 1B	--	--	--	--	--	25	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentalsto attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcomes:

Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.

- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book: 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of components/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

UNIVERSITY OF MUMBAI

Scheme

for

Bachelor of Engineering

in

Electronics Engineering

Second Year with Effect from AY 2020-21
Third Year with Effect from AY 2021-22
Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20
Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Program Structure for Second Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC301	Engineering Mathematics - III	3	-	1	3	-	1	**4**
ELC302	Electronics Devices and circuits - I	3	-	-	3	-	-	**3**
ELC303	Digital Logic Circuits	3	-	-	3	-	-	**3**
ELC304	Electrical Networks Analysis and Synthesis	3	-	1	3	-	1	**4**
ELC305	Electronic Instruments and Measurements	3	-	-	3	-	-	**3**
ELL301	Electronics Devices and Circuits - I Lab	-	2	-	-	1	-	**1**
ELL302	Digital Logic Circuits Lab	-	2	-	-	1	-	**1**
ELL303	Electronic Instruments and Measurements Lab	-	2	-	-	1	-	**1**
ELL304	Skill-base Lab - OOPM: (C++ and Java)	-	4	-	-	2	-	**2**
ELM301	Mini Project - 1A	-	4$	-	-	2	-	**2**
Total		**15**	**14**	**2**	**15**	**07**	**2**	**24**

$ indicates workload of learner(Not faculty), for mini-project

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/Oral	Total
		Test 1	Test 2	Av					
ELC301	Engineering Mathematics - III	20	20	20	80	03	25	-	**125**
ELC302	Electronics Devices and Circuits - I	20	20	20	80	03	-	-	**100**
ELC303	Digital Logic Circuits	20	20	20	80	03	-	-	**100**
ELC304	Electrical Networks Analysis and Synthesis	20	20	20	80	03	25	-	**120**
ELC305	Electronic Instruments and Measurements	20	20	20	80	03	-	-	**100**
ELL301	Electronics Devices and Circuits - I Lab	-	-	-	-	-	25	25	**50**
ELL302	Digital Logic Circuits Lab	-	-	-	-	-	25	25	**50**
ELL303	Electronic Instruments and Measurements Lab	-	-	--	-	-	25	25	**50**
ELL304	Skill base Lab - OOPM: *(C++ and Java)*	-	-	-	-	-	50	-	**50**
ELM301	Mini Project - 1A	-	-	-	-	-	25	25	**50**
	Total	-	-	**100**	**400**	-	**200**	**100**	**800**

Program Structure for Second Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC401	Engineering Mathematics - IV	3	-	1	3	-	1	4
ELC402	Electronics Devices and Circuits - II	3	-	-	3	-	-	3
ELC403	Microcontroller Applications	3	-	-	3	-	-	3
ELC404	Analog Communication	3	-	-	3	-	-	3
ELC405	Signals and Systems	3	-	1	3	-	1	4
ELL401	Electronics Devices and Circuits - II Lab	-	2	-	-	1	-	1
ELL402	Microcontroller Applications Lab	-	2	-	-	1	-	1
ELL403	Analog Communication Lab	-	2	-	-	1	-	1
ELL404	Skill base Lab: *Python Learning*	-	4	-	-	2	-	2
ELM401	Mini Project – 1B	-	4$	-	-	2	-	2
Total		**15**	**14**	**2**	**15**	**7**	**2**	**24**

$ indicates workload of learner(Not faculty), for mini project

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		Test 1	Test 2	Av					
ELC401	Engineering Mathematics - IV	20	20	20	80	03	25	-	125
ELC402	Electronics Devices and Circuits - II	20	20	20	80	03	-	-	100
ELC403	Microcontroller Applications	20	20	20	80	03	-	-	100
ELC404	Analog Communication	20	20	20	80	03	-	-	100
ELC405	Signals and Systems	20	20	20	80	03	25	-	125
ELL401	Electronics Devices and Circuits - II Lab	-	-	-	-	-	25	25	50
ELL402	Microcontroller Applications Lab	-	-	-	--	-	25	25	50
ELL403	Analog Communication Lab	-	-	--	-	-	25	25	50
ELL404	Skill base Lab: *Python Learning*	-	-	-	-	-	50	-	50
ELM401	Mini Project – 1B	-	-	-	-	-	25	25	50
	Total	**-**	**-**	**100**	**400**	**-**	**200**	**100**	**800**

Program Structure for Third Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2021-2022)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC501	Principles of Control System	3	-	-	3	-	-	**3**
ELC502	Digital Signal Processing	3	-	-	3	-	-	**3**
ELC503	Linear Integrated Circuits	3	-	-	3	-	-	**3**
ELC504	Digital Communication	3	-	-	3	-	-	**3**
ELDO501	Department Optional Course - I	3	-	-	3	-	-	**3**
ELL501	Principles of Control System Lab	-	2	-	-	1	-	**1**
ELL502	Linear Integrated Circuits Lab	-	2	-	-	1	-	**1**
ELL503	Digital Communication Lab	-	2	-	-	1	-	**1**
ELL504	Business Communication and Ethics	-	2*+2	-	-	2	-	**2**
ELM501	Mini Project – 2 A	-	4$	-	-	2	-	**2**
Total		**15**	**14**	**-**	**15**	**7**	**-**	**22**

**Theory class; $ indicates workload of learner (Not faculty), for mini-project*

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		Test 1	Test 2	Av					
ELC501	Principles of Control System	20	20	20	80	03	-	-	**100**
ELC502	Digital Signal Processing	20	20	20	80	03	-	-	**100**
ELC503	Linear Integrated Circuits	20	20	20	80	03	-	-	**100**
ELC504	Digital Communication	20	20	20	80	03	-	-	**100**
ELDO501	Department Optional Course - I	20	20	20	80	03	-	-	**100**
ELL501	Principles of Control System Lab	-	-	-	-	-	25	25	**50**
ELL502	Linear Integrated Circuits Lab	-	-	-	-	-	25	25	**50**
ELL503	Digital Communication Lab	-	-	-	-	-	25	25	**50**
ELL504	Business Communication and Ethics	-	-	-	-	-	50	-	**50**
ELM501	Mini Project – 2 A						25	25	**50**
	Total			**100**	**400**	**-**	**150**	**100**	**750**

Department Level Optional Couse - I (ELDO 501):

1. Data Structures	3. Neural Network and Fuzzy Logic
2. Biomedical Instrumentation	4. Computer Organization Architecture

Program Structure for Third Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2021-2022)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC601	Basic VLSI Design	3	-	-	3	-	-	**3**
ELC602	Electromagnetic Engineering	3	-	-	3	-	-	**3**
ELC603	Computer Communication Networks	3	-	-	3	-	-	**3**
ELC604	Embedded Systems and Real Time Operating Systems	3	-	-	3	-	-	**3**
ELDO601	Department Optional Course – II	3	-	-	3	-	-	**3**
ELL601	Basic VLSI Design Lab	-	2			1		**1**
ELL602	CCN Lab	-	2	-	-	1	-	**1**
ELL603	Embedded Systems and Real Time Operating Systems Lab	-	2	-	-	1	-	**1**
ELL604	Database Management Systems Lab	-	4	-	-	2	-	**2**
ELM601	Mini Project – 2 B	-	4$	-	-	2	-	**2**
Total		**15**	**14**	**-**	**15**	**7**	**-**	**22**

$ indicates workload of learner(Not faculty), for mini-project

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		Test 1	Test 2	Av					
ELC601	Basic VLSI Design	20	20	20	80	03	-	-	**100**
ELC602	Electromagnetic Engineering	20	20	20	80	03	-	-	**100**
ELC603	Computer Communication Networks	20	20	20	80	03	-	-	**100**
ELC604	Embedded Systems and Real Time Operating Systems	20	20	20	80	03	-	-	**100**
ELDO601	Department Optional Course – II	20	20	20	80	03	-	-	**100**
ELL601	Basic VLSI Design Lab	-	-	-	-	-	25	25	**50**
ELL602	CCN Lab	-	-	-	-	-	25	25	**50**
ELL603	Embedded Systems and Real Time Operating Systems Lab	-	-	-	-	-	25	25	**50**
ELL604	Database Management Systems Lab	-	-	-	-	-	50	-	**50**
ELM601	Mini Project – 2B						25	25	**50**
	Total			**100**	**400**	**-**	**150**	**100**	**750**

Department Level Optional Couse - II (ELDO 601):

1. Digital Control System	3. Machine Learning
2. Digital Image Processing and Machine Vision	4. Digital Design with Reconfigurable Architecture

Program Structure for Final Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2022-2023)

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC701	Power Electronics	3	-	-	3	-	-	**3**
ELC702	Internet of Things	3	-	-	3	-	-	**3**
ELDO701	Department Optional Course - III	3	-	-	3	-	-	**3**
ELDO702	Department Optional Course - IV	3	-	-	3	-	-	**3**
ELIO701	Institute Optional Course - I	3	-	-	3	-	-	**3**
ELL701	Power Electronics Lab	-	2			1		**1**
ELL702	Internet of Things Lab	-	2	-	-	1	-	**1**
ELL703	Department Optional Course - III Lab	-	2	-	-	1	-	**1**
ELP701	Major Project - I	-	6	-	-	3	-	**3**
	Total	**15**	**12**	**-**	**15**	**6**	**-**	**21**

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		Test 1	Test 2	Av					
ELC701	Power Electronics	20	20	20	80	03	-	-	**100**
ELC702	Internet of Things	20	20	20	80	03	-	-	**100**
ELDO701	Department Optional Course - III	20	20	20	80	03	-	-	**100**
ELDO702	Department Optional Course - IV	20	20	20	80	03	-	-	**100**
ELIO701	Institute Optional Course - I	20	20	20	80	03	-	-	**100**
ELL701	Power Electronics Lab	-	-	-	-	-	25	25	**50**
ELL702	Internet of Things Lab	-	-	-	-	-	25	25	**50**
ELL703	Department Optional Course - III Lab	-	-	-	-	-	25	25	**50**
ELP701	Major Project - I	-	-	-	-	-	50	-	**50**
	Total			**100**	**400**	**-**	**125**	**75**	**700**

Department Level Optional Courses:

Department Level Optional Course -III (ELDO701)	Department Level Optional Course -IV (ELDO702)
1. Mixed Signal VLSI Design	1. Wireless Communication
2. Embedded GPU	2. Cloud Computing
3. Artificial Intelligence	3. Robotics
4. Advanced Networking Technologies	4. Data Science and applications

Program Structure for Final Year Electronics Engineering
UNIVERSITY OF MUMBAI
(With Effect from 2022-2023)

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		TH	PR	Tut	TH	Pract	Tut	Total
ELC801	Industrial Automation	3	-	-	3	-	-	**3**
ELDO801	Department Optional Course - V	3	-	-	3	-	-	**3**
ELDO802	Department Optional Course – VI	3	-	-	3	-	-	**3**
ELIO801	Institute Optional Course - II	3	-	-	3	-	-	**3**
ELL801	Industrial Automation Lab	-	2	-	-	1	-	**1**
ELL802	Department Optional Course – V Lab	-	2	-	-	1	-	**1**
ELP801	Major Project - II	-	12	-	-	6	-	**6**
	Total	**12**	**16**	**-**	**12**	**8**	**-**	**20**

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		Test 1	Test 2	Av					
ELC801	Industrial Automation	20	20	20	80	03	-	-	**100**
ELDO801	Department Optional Course - V	20	20	20	80	03	-	-	**100**
ELDO802	Department Optional Course – VI	20	20	20	80	03	-	-	**100**
ELIO801	Institute Optional Course - II	20	20	20	80	03	-	-	**100**
ELL801	Industrial Automation Lab	-	-	-	-	-	25	25	**50**
ELL802	Department Optional Course – V Lab	-	-	-	-	-	25	25	**50**
ELP801	Major Project - II	-	-	-	-	-	50	100	**150**
	Total			**80**	**320**	**-**	**100**	**150**	**650**

Department Level Optional Courses:

Department Level Optional Course -V (ELDO801)	Department Level Optional Course -VI (ELDO802)
1. Microelectromechanical Systems (MEMS)	1. Next Generation Networks
2. Web Design	2. Industrial Internet of Things
3. Advanced Power Electronics	3. System on Chip
4. Virtual Instrumentation	4. Integrated Circuit Technology

Note:

1. Students group and load of faculty per week.

   Mini Project 1 and 2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load: 1 hour per week per four groups

   Major Project 1 and 2:
   Students can form groups with minimum 2 (Two) and not more than 4 (Four)
   Faculty Load: In Semester VII– ½ hour per week per project group
   In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.

3. Mini-projects 2-A and 2-B should be based on DLOs.

UNIVERSITYOFMUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics Engineering

Second Year with Effect from **AY 2017-18**
Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Dean, Faculty of Science and Technology

Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development. Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, semester-based credit and grading system is also introduced to ensure quality of engineering education. Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scales to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc. Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017- 18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Dean (I/c) Faculty of Science and Technology,
Member - Academic Council,
University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Electronics Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming session, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Electronics Engineering. The Program Educational Objectives finalized for the undergraduate program in Electronics Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr.Sudhakar S. Mande

Chairman, Board of Studies in Electronics Engineering, University of Mumbai

S.E. (Electronics Engineering) – Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX301	Applied Mathematics III	04	---	01@	04	---	01	05
ELX302	Electronic Devices and Circuits I	04	---	---	04	---	---	04
ELX303	Digital Circuit Design	04	---	---	04	---	---	04
ELX304	Electrical Network Analysis and Synthesis	04	---	---	04	---	---	04
ELX305	Electronic Instrumentation and Measurements	04	---	---	04	---	---	04
ELXL301	Electronic Devices and Circuits I Lab		02	---	---	01	---	01
ELXL302	Digital Circuit Design Lab.		02	---	---	01	---	01
ELXL303	Electrical Network Analysis and Synthesis Lab		02	---	---	01	---	01
ELXL304	Object Oriented Programming Methodology Lab.		02+02#	---	---	02	---	02
	Total	**20**	**08**	**01**	**20**	**05**	**01**	**26**

@1 hour tutorial class-wise

#02 hours class-wise and 02 hours batch-wise

Course Code	Course Name	Examination Scheme – Semester III							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX301	Applied Mathematics III	20	20	20	80	03	25	---	125
ELX302	Electronic Devices and Circuits I	20	20	20	80	03	--	---	100
ELX303	Digital Circuit Design	20	20	20	80	03	---	---	100
ELX304	Electrical Network Analysis and Synthesis	20	20	20	80	03	---	---	100
ELX305	Electronic Instrumentation and Measurements	20	20	20	80	03	---	---	100
ELXL301	Electronic Devices and Circuits I Lab						25	25	50
ELXL302	Digital Circuit Design Lab.						25	25	50
ELXL303	Object Oriented Programming Methodology Lab.						25	25	50
ELXL304	Electrical Network Analysis and Synthesis Lab						25	---	25
Total		**100**	**100**	**100**	**400**	**15**	**125**	**75**	**700**

S.E. (Electronics Engineering) – Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX401	Applied Mathematics IV	04	---	---	04	---	01	05
ELX 402	Electronic Devices and Circuits II	04	---	---	04	---	---	04
ELX 403	Microprocessors and Applications	04	---	---	04	---	---	04
ELX 404	Digital System Design	04	---	---	04	---	---	04
ELX 405	Principles of Communication Engineering	04	---	---	04	---	---	04
ELX 406	Linear Control Systems	04	---	---	04	---	---	04
ELXL 401	Electronic Devices and Circuits II Lab.		02	---	---	01	---	01
ELXL 402	Microprocessors and Applications Lab.		02	---	---	01	---	01
ELXL 403	Digital System Design Lab.		02	---	---	01	---	01
ELXL 404	Principles of Communication Engineering Lab.		02	---	---	01	---	01
	Total	**24**	**08**	**---**	**24**	**04**	**01**	**29**

Course Code	Course Name	Examination Scheme – Semester IV							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX401	Applied Mathematics IV	20	20	20	80	3	25	---	125
ELX 402	Electronic Devices and Circuits II	20	20	20	80	3	---	---	100
ELX 403	Microprocessors and Applications	20	20	20	80	3	---	---	100
ELX 404	Digital System Design	20	20	20	80	3	---	---	100
ELX 405	Principles of Communication Engineering	20	20	20	80	3	---	---	100
ELX 406	Linear Control Systems	20	20	20	80	3	---	---	100
ELXL401	Electronic Devices and Circuits II Lab.						25	25	50
ELXL402	Microprocessors and Applications Lab.						25	25	50
ELXL 403	Digital System Design Lab.						25	25	50
ELXL404	Principles of Communication Engineering Lab.						25	---	25
Total		**120**	**120**	**120**	**480**	**18**	**125**	**75**	**800**

T.E. (Electronics Engineering) – Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX501	Microcontrollers and Applications	04	--	---	04	---	---	04
ELX 502	Digital Communication	04	-	--	04	---	---	04
ELX 503	Engineering Electromagnetics	04	-	@01	04	---	01	05
ELX 504	Design with Linear Integrated Circuits	04	02	---	04	---	---	04
ELX 505	Business Communication & Ethics		02+02#		---	02	---	02
ELXDLO501X	Department Level optional courses I	04	02	---	04		---	04
ELXL501	Microcontrollers and Applications Lab.					01	---	01
ELXL502	Digital Communication Lab.					01	---	01
ELXL503	Design with Linear Integrated Circuits Lab.					01	---	01
ELX DLOl50X	Department Level optional course-I Lab					01	---	01
	TOTAL	**20**	**08**	**01**	**20**	**06**	**01**	**27**

@1 hour tutorial class-wise 02 hours class-wise #02 hours batch-wise

Course Code	Course Name	Examination Scheme – Semester V							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX501	Micro-controllers and Applications	20	20	20	80	03	---	---	100
ELX 502	Digital Communication	20	20	20	80	03	---	---	100
ELX 503	Engineering Electromagnetics	20	20	20	80	03	25	---	125
ELX 504	Design with Linear Integrated Circuits	20	20	20	80	03	---	---	100
ELX 505	Business Communication & Ethics	---	---	---	---	---	50	---	50
ELX DLO501X	Department Level Elective-I	20	20	20	80	03	---	---	100
ELXL501	Micro-controllers and Applications Lab.						25	25	50
ELXL 502	Digital Communication Lab.						25	25	50
ELXL 503	Design with Linear Integrated Circuits Lab.						25	25	50
ELXL DLO501X	Department Elective I lab						25	25	50
Total		**100**	**100**	**100**	**400**	**15**	**175**	**100**	**775**

Course Code	Department Level Optional Course I
ELXDLO5011	Database and Management System
ELXDLO5012	Digital Control system
ELXDLO5013	ASIC Verification
ELXDLO5014	Biomedical Instrumentation

T.E. (Electronics Engineering) – Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX601	Embedded System and RTOS	04	--	---	04	---	---	04
ELX 602	Computer Communication Network	04	--	---	04	---	---	04
ELX 603	VLSI Design	04	--	---	04	---	---	04
ELX 604	Signals and systems	04	--	@01	04	---	01	05
ELXDLO502X	Department Level Optional courses II	04	--	---	04	---	---	04
ELXL601	Embedded System and RTOS Lab.	--	02	--	--	01	---	01
ELXL 602	Computer Communication Network Lab.	--	02	--	--	01	--	01
ELXL 603	VLSI Design Lab.	--	02	--		01	---	01
ELXLDLO601X	Department Level Optional courses IILab.	--	02	--		01	---	01
TOTAL		**20**	**08**	**01**	**20**	**04**	**01**	**25**

Course Code	Course Name	Examination Scheme – Semester VI							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX601	Embedded System and RTOS	20	20	20	80	03	---	---	100
ELX 602	Computer Communication Network	20	20	20	80	03	---	---	100
ELX 603	VLSI Design	20	20	20	80	03	---	---	100
ELX 604	Signals and systems	20	20	20	80	03	25	---	125
ELXDLO602X	Department Level Optional courses II*	20	20	20	80	03	---	---	100
ELXL601	Embedded System and RTOS Lab.						25	25	50
ELXL 602	Computer Communication Network Lab.						25	25	50
ELXL 603	VLSI Design Lab.						25	25	50
ELXLDLO602X	Department Level Optional Courses II*Lab.						25	25	50
Total		**100**	**100**	**100**	**400**	**15**	**125**	**100**	**725**

Course Code	Department Level Optional Course II
ELXDLO6021	Microwave Engineering
ELXDLO6022	Electronics Product Design
ELXDLO6023	Wireless Communication
ELXDLO6024	Computer Organization and Architecture

B.E. (Electronics Engineering) – Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX701	Instrumentation System Design	04	--	---	04	---	---	04
ELX702	Power Electronics	04	--	---	04	---	---	04
ELX703	Digital signal processing	04	--	---	04	---	---	04
ELXDLO703X	Department Level Optional course III	04	--	---	04	---	---	04
ILO701X	Institute Level Optional Course I#	03	---	---	03	---	---	03
ELXL701	Instrumentation System Design Lab.		02			01	---	01
ELXL702	Power Electronics Lab.		02			01	---	01
ELXL703	Digital signal processing Lab.		02			01	---	01
ELXL704	Project-I	---	06	---	---	03	---	03
ELXLDLO703X	Dept. Level Optional course III Lab.		02			01	---	01
	TOTAL	**19**	**14**	---	**19**	**07**	---	**26**

Course Code	Course Name	Examination Scheme – Semester VII							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX701	Instrumentation System Design	20	20	20	80	03	---	---	100
ELX 702	Power Electronics	20	20	20	80	03	---	---	100
ELX 703	Digital signal processing	20	20	20	80	03	---	---	100
ELXDLO703X	Department Level Optional courses III*	20	20	20	80	03	---	---	100
ILO701X	Institute Level Optional Subject	20	20	20	80	03	---	---	100
ELXL701	Instrumentation System Design Lab.						25	25	50
ELXL702	Power Electronics Lab.						25	25	50
ELXL703	Digital signal processing Lab.						25	25	50
ELXL704	Project-I	---	---	---	---	---	50	50	100
ELXLDLO703X	Dept. Level Optional courses III Lab.						25	25	50
Total		**100**	**100**	**100**	**400**	**15**	**150**	**150**	**800**

B.E. (Electronics Engineering) – Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX801	Internet of Things	04	--	---	04	---	---	04
ELX 802	Analog and Mixed VLSI Design	04	--	---	04	---	---	04
ELXDLO804X	Department Level Optional course IV	04	--	---	04	---	---	04
ILO802X	Institute Level Optional course II#	03	---	---	03	---	---	03
ELXL801	Internet of Things Lab.		02			01	---	01
ELXL802	Analog and Mixed VLSI Design Lab.		02			01	---	01
ELXL803	Project-II	---	12	---	---	06	---	06
ELXLDLO804X	Department Level Optional Courses IV Lab.		02			01	---	01
	TOTAL	**15**	**18**	---	**15**	**9**	---	**24**

Course Code	Course Name	Examination Scheme – Semester VIII							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX801	Internet of Things	20	20	20	80	03	---	---	100
ELX 802	Analog and Mixed VLSI Design	20	20	20	80	03	---	---	100
ELXDLO804X	Department Level Optional course IV	20	20	20	80	03	---	---	100
ILO802X	Institute Level Optional course II	20	20	20	80	03	---	---	100
ELXL801	Internet of Things Lab.						25	25	50
ELXL802	Analog and Mixed VLSI Design Lab.						25	25	50
ELXL803	Project-II	---	---	---	---	---	100	50	150
ELXLDLO804X	Department Level Optional Courses IV Lab.						25	25	50
Total		**80**	**80**	**80**	**320**	**15**	**175**	**125**	**700**

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I#
ELXDLO7031	Neural Network and Fuzzy Logic	ILO7011	Product Lifecycle Management
ELXDLO7032	Advance Networking Technologies	ILO7012	Reliability Engineering
ELXDLO7033	Robotics	ILO7013	Management Information System
ELXDLO7034	Integrated Circuit Technology	ILO7014	Design of Experiments
		ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II#
ELXDLO8041	Advanced Power Electronics	ILO8021	Project Management
ELXDLO8042	MEMS Technology	ILO8022	Finance Management
ELXDLO8043	Virtual Instrumentation	ILO8023	Entrepreneurship Development and Management
ELXDLO8044	Digital Image Processing	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX 501	Microcontrollers and Applications	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Dura-tion (hrs)					
		Test 1	Test 2	Avg.							
ELX 501	Microcontrollers &Applications	20	20	20	80	03	--	--	-	--	100

Course Code	Course Name	Credits
ELX 501	Microcontrollers and Applications	04
Course Objectives	To study 8-bit microcontroller architecture for system design along with exposure to advanced 32-bit architecture.	
Course Outcomes	1. Explain 8051 microcontroller architecture. 2. Develop assembly language programmes for 8051 microcontroller. 3. Design and implement 8051 based systems. 4. Explain advanced features of Cortex-M3 architecture.	

Module		Contents	Time
1.		**8051 Microcontroller Architecture**	04
	1.1	Introduction to microcontroller.	
	1.2	Overview of MCS51 family.	
	1.3	8051 architectural features.	
	1.4	Memory organisation.	
2.		**8051 Microcontroller assembly language programming**	10
	2.1	Addressing modes of 8051.	
	2.2	Instruction Set: Data transfer, Arithmetic, Logical, Branching.	
	2.3	Assembly Language Programming.	
3.		**8051 Internal Hardware & Programming**	10
	3.l	I/O port structure and programming.	
	3.2	Interrupts and programming.	
	3.3	Timer/Counter and programming.	
	3.4	Serial port and programming.	

4.		**8051 Interfacing & Applications**	**12**
	4.1	Display interfacing: 7-segment LED display, 16x2 generic alphanumeric LCD display.	
	4.2	Keyboard interfacing: 4x4 matrix keyboard.	
	4.3	Analog devices interfacing: 8-bit ADC/DAC, temperature sensor (LM35).	
	4.4	Motor interfacing: Relay, dc motor, stepper motor and servo motor.	
5.		**ARM CORTEX-M3 Architecture**	**12**
	5.1	Comparison of CISC & RISC architectures, overview of ARM family.	
	5.2	ARM Cortex-M3 architecture, Programmer's model: Operation Modes and States, registers, special registers, Application Program Status Register-Integer status flags, Q status flag, GE bits.	
	5.3	Memory system: Features and memory map	
	5.4	Exceptions and Interrupts-Nested vectored interrupt controller	
		Total	**48**

Text books:

1.M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay,"The 8051 Microcontroller and Embedded Systems Using Assembly and C", Pearson Education, 2nd Edition.

2.Joseph Yiu,"The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 2014, 3rd Edition.

Reference Books:

1.Kenneth J. Ayala,"The 8051 Microcontroller", Cengage Learning India Pvt. Ltd, 3rdEdition.

2.David Seal, "ARM Architecture", Reference Manual (2nd Edition), Publisher Addison Wesley.

3.Andrew Sloss, Dominic Symes, Chris Wright,"ARMSystem Developers Guide: Designing and Optimising System Software", Publisher Elsevier Inc. 2004.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total of 4 questions.
3. Question No.1 will be compulsory and based on the entire syllabus.
4. Remaining question (Q.2 to Q.6) will be set from all the modules.
5. Weightage of marks, commensurate with the time allocated to the respective module.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 502	Digital Communication	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX 502	Digital Communication	20	20	20	80	-	--	--	100

Course Pre-requisite: ELX405 Principles of Communication Engineering

Course Objectives:

The objectives of this course are to:

1. Understand the typical subsystems of a digital communication system
2. Understand the significance of the trade-off between SNR and Bandwidth
3. Understand the effect of ISI in Baseband transmission of a digital signal.
4. Analyze various Digital modulation techniques
5. Identify the necessity of Source encoding and Channel encoding in Digital communication

Course Outcomes:

On successful completion of the course the students will be able to:

1. Comprehend the advantages of digital communication over analog communication and explain need for various subsystems in Digital communication systems
2. Realize the implications of Shannon-Hartley Capacity theorem while designing the efficient Source encoding technique.
3. Understand the impact of Inter Symbol Interference in Baseband transmission and methods to mitigate its effect
4. Analyze various Digital modulation methods and assess them based on parameters such as spectral efficiency , Power efficiency, Probability of error in detection
5. Explain the concept and need for designing efficient Forward Error Correcting codes.
6. Realize the areas of application of Digital communication.

Module No.	Unit No.	Topics	Hrs.
1.		**Introduction to Digital communication system:**	06
	1.1	A typical Digital communication system, Advantages and disadvantages of Digital transmission, significance of digitization: PCM encoding of voice and image signals.	
	1.2	**Concept of Probability Theory in Communication Systems:** Random variables, Mean and Variance of Random variables and sum of random variables ,Definition with examples,	
	1.3	**Useful PDFs & CDFs** :Gaussian, Rayleigh pdf & Rician Distribution, Binomial Distribution, Poisson Distribution, Central-Limit Theorem, Binary Synchronous Channel(BSC), development of Optimal receiver	
2.		**Information Theory and Source Coding**	06
	2.1	Measure of Information, Entropy, Information rate, Channel capacity, Shannon – Hartley Capacity Theorem and its Implications.	
	2.2	Shannon-Fano encoding, Huffman encoding , Code Efficiency & Redundancy.	
3.		**Pulse Shaping for Optimum Transmission:**	08
	3.1	Line codes and their desirable properties, PSD of digital data	
	3.2	Baseband PAM transmission: Concept of Inter symbol interference(ISI),Raised Cosine filter , Nyquist Bandwidth. Concept of equalizer to overcome ISI	
	3.3	Correlative coding: Duo-binary encoding and modified duo-binary encoding	
4.0		**Digital Modulation Techniques**	14
	4.1	Concept of Binary and M-ary transmission, Coherent and Non- Coherent reception, Power spectral density of Pass-band signal, Signal space Representation and Euclidian distance	
	4.2	Pass Band Amplitude modulation & Demodulation: BASK , M-ary PAM ,Digital Phase Modulation & Demodulation: BPSK, OQPSK, QPSK, M-ary PSK, QAM , Digital Frequency Modulation &Demodulation :BFSK, MSK , M-ary FSK	
	4.3	Comparison of all techniques based on Spectral efficiency, Power efficiency, Probability of error in detection	
	4.4	**Optimal Reception of Digital Data**: A baseband signal receiver and its Probability of error, The Optimum receiver, Matched filter, & its properties.	

5.0		**Error Control codes:**	**10**
	5.1	Need for channel encoding, Concept of Error detection and correction , Forward Error correction	
	5.2	**Linear block codes** : Hamming Distance, Hamming Weight, Systematic codes ,Syndrome Testing	
	5.3	**Cyclic codes**; Generator polynomial for Cyclic codes, Systematic cyclic codes, Feedback shift register for Polynomial division	
	5.4	**Convolution codes**: Convolution encoder , Impulse response of encoder, State diagram, trellis diagram Representations	
6.0		**Applications of Digital communication**	**06**
	6.1	**Satellite communication system** : Satellite communication System model, Transponder ,Satellite Orbits : LEO, MEO, GEO , Link analysis	
	6.2	**Optical Communication system** : Advantages of Optical communication ,Signal transmission in Optical fibres, Optical sources and Optical Detectors, Optical Digital Communication system.	
		Total	**48**

Recommended Text Books:

1. Simon Haykin, "*Communication System*", John Wiley And Sons ,4th Ed
2. Taub Schilling & Saha, "*Principles Of Communication Systems*", Tata Mc-Graw Hill, Third Ed
3. B P Lathi & Zhi Ding ,"*Modern Digital and Analog communication systems" -4E*, Oxford University Press , Indian Ed.
4. R N Mutagi, "*Digital Communication"*, Oxford University Press, 2nd Ed.

Reference Books:

1. Bernad Sklar,- "Digital communication", Pearson Education, 2nd Ed.
2. Simon Haykin, "Digital communication", John wiley and sons
3. PROAKIS & SALEHI, "Communication system Engineering", Pearson Education.
4. Anil K.Maini & Varsha Agarwal, "Satellite communications", Wiley publication.
5. Amitabha Bhattacharya, "*Digital Communication*", Tata Mcgraw Hill

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 503	Engineering Electromagnetic	04	--	01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX 503	Engineering Electromagnetic	20	20	20	80	25	--	--	125

Course Objectives:

1. To study correlation between electrostatics, steady magnetic field and time varying fields using Maxwell's equations for different media.
2. To calculate energy transported by means of electromagnetic waves from one point to another and to study polarization of waves.
3. To solve electromagnetic problems using different numerical methods.
4. To extend the students' understanding about the propagation of the waves of different types.
5. To understand the radiation concepts.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Analyze the behaviour of electromagnetic waves in different media.
2. Evaluate various parameters of transmission lines and radiating systems.
3. Apply computational techniques to analyze electromagnetic field distribution.
4. Understand different mechanisms of radio wave propagation.

Module No.	Unit No.	Topics	Hrs.
1.0		**Basic Laws of Electromagnetic and Maxwell's Equations**	10
	1.1	Coulomb's law, Gauss's law, Bio-Savart's law, Ampere's law, Poisson's and Laplace equations	
	1.2	**Maxwell's Equations:** Integral and differential form for static and time varying fields and its interpretations	
	1.3	Boundary conditions for Static electric and magnetic fields	
2.0		**Electromagnetic Waves**	12
	2.1	Wave Equation and its solution in partially conducting media(lossy dielectric), perfect dielectrics, free space and good conductors, Skin Effect and concept of Skin depth	
	2.2	**Polarization of wave:** Linear, Circular and Elliptical	
	2.3	**Electromagnetic Power:** Poynting Vector and Power Flow in free space, dielectric and conducting media	
	2.4	**Propagation in different media:** Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media	

3.0		**Computational Electromagnetics**	**06**
	3.1	**Finite Difference Method (FDM):** Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method	
	3.2	**Finite Element Method (FEM**): triangular mesh configuration, finite element discretization, element governing equations, assembling all equations and solving resulting equations	
	3.3	**Method of Moment (MOM):** Field calculations of conducting wire	
4.0		**Fundamentals of Radiating Systems**	**06**
	4.1	Concept of retarded potentials, Lorentz Condition	
	4.2	Radiation from an alternating current element, half-wave dipole and quarter-wave monopole	
	4.3	**Antenna Parameters:** Radiation Patterns, beam-width, Radiation intensity, directivity, power gain, band-width, radiation resistance and efficiency, effective length and effective area	
5.0		**Radio wave propagation**	**06**
	5.1	**Types of wave propagation:** Ground, space, and surface wave propagation	
	5.2	**Space wave propagation:** Effect of imperfection of earth, curvature of earth, effect of interference zone, Line of sight propagation, troposphere propagation and fading	
	5.3	**Sky wave propagation:** Reflection and refraction of waves, structure of Ionosphere	
	5.4	**Measures of ionosphere propagation:** Critical frequency, Angle of incidence, Maximum usable frequency, Skip distance, Virtual height	
6.0		**Transmission Lines**	**08**
	6.1	Transmission Line parameters and equivalent circuit Transmission line equation and solution	
	6.2	**Secondary Parameters:** Propagation constant, characteristic impedance, reflection and transmission coefficient, Input Impedance, SWR, introduction to Smith chart	
		Total	**48**

Recommended Books:

1. W.H. Hayt, and J.A. Buck, "*Engineering Electromagnetics*", McGraw Hill Publications, 7th Edition, 2006
2. R.K. Shevgaonkar, "*Electromagnetic Waves*", TATA McGraw Hill Companies, 3rd Edition, 2009
3. Edward C. Jordan and Keth G. Balmin, "*Electromagnetic Waves and Radiating Systems*", Pearson Publications, 2nd Edition, 2006
4. Matthew N.D. Sadiku, "*Principles of Electromagnetics*", Oxford International Student 4th Edition, 2007
5. J.D. Kraus, R.J. Marhefka, and A.S. Khan, "*Antennas & Wave Propagation*", McGraw Hill Publications, 4th Edition, 2011

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

Term work is be based on Tutorials conducted and continuous assessment through semester.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pract	Tutorial	Total
ELX504	Design with Linear Integrated Circuits	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks							
		Internal assessment							
		Test 1	Test 2	Avg. of Test 1 and Test 2	End Sem. Exam	Term Work	Prac.	Oral	Total
ELX504	Design with Linear Integrated Circuits	20	20	20	80	--	--	--	100

Course Pre-requisite:

- Electronic Devices and Circuits I and II

Course Objectives:

1. To teach fundamental principles of standard linear integrated circuits.
2. To develop a overall approach for students from selection of integrated circuit, study its specification, the functionality, design and practical applications

Course Outcomes:

After successful completion of the course student will be able to

1. demonstrate an understanding of fundamentals of integrated circuits.
2. analyze the various applications and circuits based on particular linear integrated circuit.
3. select and use an appropriate integrated circuit to build a given application.
4. design an application with the use of integrated circuit

Module No.	Unit No.	Topics	Hrs.
1	**Fundamentals of Operational Amplifier**		04
	1.1	Ideal Op Amp, characteristics of op-amp, op-amp parameters, high frequency effects on op-amp gain and phase, slew rate limitation, practical determination of op-amp parameters, single supply versus dual supply op-amp	
	1.2	Operational amplifier open loop and closed loop configurations, Inverting and non-inverting amplifier	
2	**Applications of Operational Amplifier**		12
	2.1	**Amplifiers:** Adder, subtractor, integrator, differentiator, current amplifier, difference amplifier, instrumentation amplifier and application of Op-Amp in Transducer Measurement System with detail design Procedure. Single supply dc biasing techniques for inverting, non inverting and differential amplifiers.	
	2.2	**Converters:** Current to voltage converters, voltage to current converters, generalized impedance converter	

	2.3	**Active Filters:** First order filters, Second order active finite and infinite gain low pass, high pass, band pass and band reject filters.	
	2.4	**Sine Wave Oscillators:** RC phase shift oscillator, Wien bridge oscillator, Quadrature oscillator.	
3	**Non-Linear Applications of Operational Amplifier**		10
	3.1	**Comparators:** Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector.	
	3.2	**Schmitt Triggers:** Inverting Schmitt trigger, non-inverting Schmitt trigger with adjustable threshold levels.	
	3.3	**Waveform Generators:** Square wave generator and triangular wave generator with duty cycle modulation**.**	
	3.4	**Precision Rectifiers:** Half wave and full wave precision rectifiers and their applications.	
	3.5	Peak Detectors, Sample & Hold Circuits, voltage to frequency converter, frequency to voltage converter, logarithmic converters and antilog converters	
4	**Data Converters**		06
	4.1	**Analog to Digital**: Performance parameters of ADC, Single Ramp ADC, ADC using DAC, Dual Slope ADC, Successive Approximation ADC, Flash ADC, ADC0808/0809 and its interfacing	
	4.2	**Digital to Analog**: Performance parameters of DAC, Binary weighted register DAC, R/2R ladder DAC, Inverted R/2R ladder DAC, DAC0808 and its interfacing	
5	**Special Purpose Integrated Circuits**		08
	5.1	Functional block diagram, working, design and applications of Timer 555.	
	5.2	Functional block diagram, working and applications of VCO 566, PLL 565, multiplier 534, waveform generator XR 2206, power amplifier LM380.	
6	**Voltage Regulators**		08
	6.1	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators.	
	6.2	Functional block diagram, working and design of general purpose 723 (LVLC, LVHC, HVLC and HVHC) with current limit and current fold-back protection, Switching regulator topologies, Functional block diagram and working of LT1070 monolithic switching regulator.	
		Total	**48**

Recommended Books:

1. Sergio Franco, "*Design with operational amplifiers and analog integrated circuits*", Tata McGraw Hill, 3rd Edition.
2. William D. Stanley, "*Operational Amplifiers with Linear Integrated Circuits* ", Pearson, 4th Edition
3. D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition.
4. David A. Bell, "*Operation Amplifiers and Linear Integrated Circuits*", Oxford University Press, Indian Edition.
5. Ramakant A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson Prentice Hall, 4th Edition.
6. R. P. Jain, "*Modern Digital Electronics*," Tata McGraw Hill, 3rd Edition.
7. Ron Mancini, "*Op Amps for Everyone*", Newnes, 2nd Edition.
8. J. Millman and A. Grabel, "*Microelectronics*", Tata McGraw Hill, 2nd Edition.
9. R. F. Coughlin and F. F. Driscoll, "*Operation Amplifiers and Linear Integrated Circuits*", Prentice Hall, 6th Edition.

10. J. G. Graeme, G. E. Tobey and L. P. Huelsman, "*Operational Amplifiers- Design & Applications*", NewYork: McGraw-Hill, Burr-Brown Research Corporation.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final internal assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory preferably objective type and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pract	Tutorial	Total
ELX505	Business Communication & Ethics	02 Class wise	02 Batch wise	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Prac.	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELX505	Business Communication & Ethics	--	--	--	--	50	--	--	50

Course objectives:

To teach the students

- To inculcate professional and ethical attitude.
- To enhance effective communication and interpersonal skills
- To build multidisciplinary approach towards all life tasks

Course outcomes

After successful completion of the course student will be able to

- Design a technical document using precise language, suitable vocabulary and apt style.
- Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
- Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
- Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
- Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module No.	Unit No.	Topics	Hrs.
1.0		**Report Writing**	5
	1.1	Objectives of Report Writing	
	1.2	Language and Style in a report	
	1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
2.0		**Technical Writing**	3
	2.1	Technical paper Writing (IEEE Format)	
	2.2	Proposal Writing	
3.0		**Introduction to Interpersonal Skills**	9
	3.1	Emotional Intelligence	
	3.2	Leadership and Motivation	
	3.3	Team Building	
	3.4	Assertiveness	
	3.5	Conflict Resolution and Negotiation Skills	
	3.6	Time Management	
	3.7	Decision Making	
4.0		**Meetings & Documentations**	2
	4.1	Strategies for conducting effective meetings	
	4.2	Notice, Agenda and Minutes of a meeting	
	4.3	Business meeting etiquettes	
5.0		**Introduction to Corporate Ethics**	2
	5.1	Professional and work ethics (responsible use of social media Facebook, WA, Twitter etc.)	
	5.2	Introduction to Intellectual Property Rights	

	5.3	Ethical codes of conduct in business and corporate activities(Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
6.0		**Employment Skills**	**7**
	6.1	Group Discussion	
	6.2	Resume Writing	
	6.3	Interview Skills	
	6.4	Presentation Skills	
	6.5	Statement of Purpose	
		Total	**28**

References

1. Fred Luthans, "Organizational Behavior", McGraw Hill, edition
2. Lesiker and Petit, "Report Writing for Business", McGraw Hill, edition
3. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw Hill
4. Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th edition
5. Heta Murphy, "Effective Business Communication", Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw-Hill Education
7. Ghosh, B. N., "Managing Soft Skills for Personality Development", Tata McGraw Hill.
8. Lehman, Dufrene, Sinha, ―BCOM‖, Cengage Learning, 2nd edition
9. Bell, Smith, ―Management Communication‖ Wiley India Edition, 3rd edition.
10. Dr. Alex, K., ‖Soft Skills‖, S Chand and Company
11. Subramaniam, R., ―Professional Ethics‖ Oxford University Press.
12. Robbins Stephens P., ―Organizational Behavior‖, Pearson Education
13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

List of Assignments:

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work:

Term work will consist of all assignments from the list. The distribution of marks for term Work willl be as follows:

Book Report……..(10) Marks

Assignments …… (10) Marks

Project Report Presentation…….. (15) Marks

Group Discussion.…… (10) Marks

Attendance …… (05) Marks

TOTAL: ……(50) Marks

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX DLO5011	Database Management System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELX DLO5011	Database Management System	20	20	20	80	--	--	--	100

Prerequisite:

Basic knowledge of Data structure.

Course objectives:

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Apply normalization techniques to normalize the database
4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Course outcomes: On successful completion of course learner will be able to:

1. Understand the fundamentals of a database systems
2. Design and draw ER and EER diagram for the real life problem.
3. Convert conceptual model to relational model and formulate relational algebra queries.
4. Design and querying database using SQL.
5. Analyze and apply concepts of normalization to relational database design.
6. Understand the concept of transaction, concurrency and recovery.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction Database Concepts:**	**4**
	1.1	Introduction, Characteristics of databases File system v/s Database system Users of Database system	4
	1.2	Data Independence DBMS system architecture Database Administrator	
2.0		**Entity–Relationship Data Model**	**8**
	2.1	The Entity-Relationship (ER) Model: Entity types : Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints : Cardinality and Participation, Extended Entity-Relationship (EER) Model : Generalization, Specialization and Aggregation	
3.0		**Relational Model and relational Algebra**	**8**
	3.1	Introduction to the Relational Model, relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model	
	3.2	Relational Algebra – unary and set operations , Relational Algebra Queries.	
4.0		**Structured Query Language (SQL)**	**12**
	4.1	Overview of SQL Data Definition Commands, Data Manipulation commands, Data Control commands, Transaction Control Commands.	
	4.2	Set and string operations, aggregate function - group by, having.Views in SQL, joins , Nested and complex queries, Integrity constraints :- key constraints, Domain Constraints, Referential integrity , check constraints	
	4.3	Triggers	
5.0		**Relational–Database Design**	**8**

	5.1	Pitfalls in Relational-Database designs , Concept of normalization Function Dependencies , First Normal Form, 2nd , 3rd , BCNF, multi valued dependencies , 4NF.	
6.0		**Transactions Management and Concurrency**	**12**
	6.1	Transaction concept, Transaction states, ACID properties Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols.	
	6.2	Recovery System: Failure Classification, Log based recovery, ARIES, Checkpoint, Shadow paging. Deadlock handling	
		Total	**52**

Text Books:

1. G. K. Gupta "Database Management Systems", McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill
3. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson education.
4. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.

Reference Books:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
2. Gillenson, Paulraj Ponniah, " Introduction to Database Management", Wiley Publication.
3. Sharaman Shah, "Oracle for Professional", SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, " Database Management Systems ",TMH.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX DLO5012	Digital Control Systems	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory					Term work	Pract.	Oral	Total
		Internal Assessment			End sem	Duration (hrs)				
		Test 1	Test 2	Avg						
ELX DLO5012	Digital Control Systems	20	20	20	80	03	--	--	--	100

Course Pre-requisite: ELX301: Mathematics III , ELX401: Mathematics IV, ELX406: Linear Control Systems

Course Objectives:

1. To introduce the discrete-time systems theory.
2. To introduce Z-transform methods in digital systems design.
3. To introduce modern state-space methods in digital systems design.

Course Outcomes : At the end of the course, the learner will have the ability to

1. Justify the need for digital control systems as well as understand sampling and reconstruction of analog signals.
2. Model the digital systems using various discretization methods and understand the concept of Pulse Transfer Function.
3. Analyze the digital control systems using classical techniques.
4. Analyze the digital control systems using modern state-space techniques.
5. Understand the concept of controllability and design the state feedback controllers.
6. Understand the concept of observability and design the state observers.

Module		Contents	Time
1.		**Basics of discrete-time signals and discretization**	06
	1.1	Why digital control system? Advantages and limitations, comparison of continuous and discrete data control, block diagram of digital control system.	
	1.2	Impulse sampling. Nyquist-Shannon sampling theorem, reconstruction of discrete-time signals (ideal filter)	
	1.3	Realizable reconstruction methods (ZOH and FOH). Transfer function of ZOH and FOH.	
2.		**Modelling of Digital Control System**	10
	2.1	Discretization Approaches: Impulse invariance, step invariance, bilinear transformation, finite difference approximation of derivative.	
	2.2	Z-transform revision and its equivalence with starred Laplace transform.	
	2.3	The pulse transfer function (PTF) and general procedures to obtain PTF.	
3.		**Stability Analysis and Controller Design via Conventional Methods**	12
	3.1	Mapping between s-plane and z-plane, stability analysis of digital systems	

		in z-plane. Effects of sampling frequency on stability.	
	3.2	Transient and steady-state analysis of time response, digital controller design using root-locus method.	
	3.3	Digital controller design using bode plots, digital PID controller.	
	3.4	Realization of digital controllers: direct programming, standard programming, series programming, parallel programming, ladder programming,	
4.		**State Space Analysis of Discrete-time Systems**	**08**
	4.1	Revision of continuous-time state-space models. Solution of continuous-time state-space equation. Discretization of continuous-time state-space solution and discrete-time state-space model.	
	4.2	Various canonical state-space forms for discrete-time systems and transformations between state-space representations.	
	4.3	Solution of discrete-time state-space equation. Computation of state-transition matrix (z-transforms, Caley-Hamilton theorem, Diagonalization).	
5.		**Controllability and State Feedback Controller Design**	**06**
	5.1	Concept of controllability. Distinction between reachability and controllability in discrete-time systems.	
	5.2	Digital controller design using pole-placement methods. (Similarity transforms, Ackerman's formula).	
6.		**Observability and Observer Design**	**06**
	6.1	Concept of observability. Distinction between detectability and observability in discrete-time systems.	
	6.2	Observer design (prediction observer and current observer). Output feedback controller design. Introduction to separation principle.	
	6.3	Dead-beat controller design, dead-beat observer design.	
Total			**48**

Text books:

1. **Ogata Katsuhiko**, "Discrete-time Control Systems", Pearson, 2nd Edition, 1995.
2. **M. Gopal**, "Digital Control and State Variable Methods", Tata McGrow-Hill, 3rd Edition, 2003.

Reference Books:

1. **Gene Franklin, J. David Powell, Michael Workman**, "Digital Control of Dynamic Systems", Addison Wesley, 3rd Edition, 1998.
2. **B. C. Kuo**, "Digital Control Systems", Oxford University press, 2nd edition, 2007.
3. **Chi-Tsong Chen**, "Linear System Theory and Design", Oxford University Press, USA, 1998.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX DLO5013	ASIC Verification	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme								
		Theory					Term work	Pract.	Oral	Total
		Internal Assessment			End sem	Duration (hrs)				
		Test 1	Test 2	Avg						
ELX DLO5013	ASIC Verification	20	20	20	80	03	--	--	--	100

Course Pre-requisite: EXC303: Digital Circuits and Design, ELXL304: Object Oriented Programming Methodology Laboratory, ELX 404: Digital System Design

Course Objectives

1. To introduce the learner System Verilog concepts for verification.
2. To introduce the learner advanced verification features such as practical use of classes, randomization, checking and coverage.
3. To highlight the significance of verification in VLSI industry.

Course Outcomes

At the end of the course, the learner will have the ability to

1. Demonstrate an understanding of programmable devices and verification methodologies.
2. Exploit new constructs in SV and advanced ASIC verification techniques.
3. Create test benches for digital designs in system verilog.
4. Carry out verification of design successfully using simulators

Module		Contents	Time
1.		**Programmable Devices and Verilog**	08
	1.1	**Programmable Devices:** Architecture of FPGA, CPLD with an example of Virtex-7 and Spartan -6 family devices	
	1.2	**Verilog HDL:** Data types, expressions, assignments, behavioural, gate and switch level modelling, tasks and functions	
2.		**Verification Basics and Data Types**	12
	2.1	**Verification Basics:** Technology challenges, Verification methodology options, Test bench creation, test bench migration, Verification languages, Verification IP reuse, Verification approaches, Layered Testbench, Verification plans	
	2.2	**Data Types:** Built in, Fixed size array, dynamic array, queues, associative array, linked list, array methods, choosing a storage type, creating new types with typedef, creating user defined structures, type conversion, enumerated types, constants, strings, expression width	
3.		**Procedural statements, test bench and Basic OOP**	12
	3.1	**Procedural Statements and Routines:** Procedural statements, tasks, functions and void functions, task and function overview, routine arguments, returning from a	

		routine, local data storage, time values **Connecting the Test bench and Design:** Separating the test bench and design, the interface construct, stimulus timing, interface driving and sampling, connecting it all together, top level scope, program-module interactions	
	3.2	**Basic OOP:** Class, Creating new objects, Object deal location, using objects, variables, class methods, defining methods outside class, scoping rules, using one class inside another, understanding dynamic objects, copying objects, public vs. local, building a test bench	
4.		**Randomization and IPC**	**10**
	4.l	**Randomization:** Randomization in system Verilog, constraint details, solution probabilities, controlling multiple constraint blocks, valid constraints, In-line constraints, The pre-randomize and post-randomize functions, Random number functions, Constraints tips and techniques	
	4.2	**Threads and Inter process Communication:** working with threads, disabling threads, inter process communication, events, semaphores, mailboxes, building a test bench with threads and IPC	
5.		**Assertions and Functional Coverage**	**06**
	5.1	**System Verilog Assertions:** Assertions in verification methodology, Understanding sequences and properties	
	5.2	**Functional Coverage:** Coverage types, strategies, examples, anatomy of a cover group, triggering a cover group, data sampling, cross coverage, generic cover groups, coverage options	
		Total	**48**

Text books:

1. **Chris Spear**, "System Verilog for Verification: A guide to learning the testbench language features", Springer, 3rd Edition.
2. **Janick Bergeron**, "Writing Testbenches Using System Verilog", Springer 2006.
3. **Stuart Sutherland, Simon Davidmann, and Peter Flake**, "System Verilog for Design:

   A guide to using system verilog for hardware design and modeling", Springer, 2nd Edition.

Reference Books:

1. Ben Cohen, Srinivasan Venkataramanan, Ajeetha Kumari and Lisa Piper, "SystemVerilog Assertions Handbook", VhdlCohen Publishing, 3rd edition
2. S Prakash Rashinkar, Peter Paterson and Leena Singh, "System on Chip Verification Methodologies and Techniques", Kluwer Academic, 1st Edition.
3. System Verilog Language Reference manual
4. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis" second edition,Pearson – IEEE 1364-2001 compliant.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX DLO5014	Biomedical Instrumentation	04	02	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELX DLO5014	Biomedical Instrumentation	20	20	20	80	03	--	--	--	--	100

Course Objectives

1. Introduce the learners to basic physiology and function of various systems in human body.

2. Introduce the learners to Diagnostic, Pathology, Life supportive equipment and latest imaging modalities in hospitals and healthcare industry.

3. Motivate learners to take up live projects with medical applications which will benefit the society at large.

Course Outcomes

- Have basic knowledge about the basic structure and functions of parts of cell, generation of action potential and various bioelectric potentials.
- Builds foundation of knowledge of physiological processes such as respiratory, cardiovascular, nervous and muscular systems in human body.
- Compare various methods used for measurement of various cardiac parameters such as blood pressure, blood flow, blood volume, cardiac output and heart sounds.
- Know the basic principle of analytical instruments and will have an over view of pathology laboratory equipments such as colorimeter, spectrophotometer, blood cell counter and auto-analyser.
- Have knowledge of life support equipments such as pacemaker, defibrillator, Heart lung machine, Haemodialysis machine and baby incubator along with safety limits of micro and macro shocks and understand the importance of electrical safety in hospital equipments.
  Have knowledge of imaging modalities such as X-ray, CT, MRI and Ultrasound.

Module		Contents	Time
1.		**Bio-Potential measurements**	06
	1.1	**Human Cell** Structure of Cell, Origin of Bio-potentials, Generation of Action Potentials,.	
	1.2	**Electrodes** Electrode-Electrolyte interface and types of bio-potential electrodes	
2.		**Physiological Systems and Related Measurement**	12
	2.1	**Cardiovascular system** Structure of Heart, Electrical and Mechanical activity of Heart, ECG measurements and Cardiac arrhythmias, Design of ECG amplifier, Heart sounds measurement.	
	2.2	**Nervous system** CNS and PNS: Nerve cell, Neuronal Communication, Generation of EEG and its measurement. Normal and abnormal EEG, Evoked potential. Electroencephalography: EEG measurements, Electrode-placement and Block diagram of EEG machine	
	2.3	**Respiratory system** Physiology of respiration and measurements of respiratory related parameters like respiration rate, Lung Volumes and capacities	
	2.4	**Muscular system** Typical Muscle fibre Action potential Electromyography: EMG measurement and block diagram.	
3.		**Cardio-Vascular measurements**	08
	3.1	Blood Pressure- Direct and Indirect types.	
	3.2	Blood Flow- Electromagnetic and Ultrasonic type.	
	3.3	Blood Volume- Plethysmography: Impedance, Capacitive and Photoelectric type	
	3.4	Cardiac Output- Fick's method, Dye-dilution and Thermo-dilution type.	
4.		**Analytical equipment**	05
	4.1	Beer Lambert's law, Principle of photometry.	
	4.2	Photo-colorimeter : Optical diagram	
	4.3	Spectrophotometer : Optical diagram	
	4.5	Blood cell counter : Coulter's counter	
	4.6	Auto-analyser : Schematic diagram	
5.		**Life-saving and Support equipment**	09
	5.1	Pacemaker- Types of Pacemaker, Modes of pacing and its applications.	
	5.2	Defibrillator-Types of fibrillations, Modes of operation, DC Defibrillators and their applications.	
	5.3	Heart-Lung machine: System-flow diagram and its Application during surgery.	
	5.4	Haemodialysis machine: Principle of operation and System-flow diagram.	

	5.5	Baby Incubator and its applications	
	5.6	**Patient safety** Physiological effects of electrical current, Shock Hazards from electrical equipments and methods of accident prevention	
6.		**Imaging techniques**	**08**
	6.1	X-Ray- Generation, X-ray tube and its control, X-ray machine and its applications	
	6.2	CT Scan- CT Number, Block Diagram, scanning system and applications.	
	6.3	MRI- Concepts and image generation, block diagram and its applications	
	6.4	Ultrasound Imaging- Modes of scanning and their applications	
		Total	**48**

Text books:

1. Handbook of Biomedical Instrumentation: R S. Khandpur. (PH Pub)
2. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley)
3. Introduction to Biomedical Equipment Technology: Carr –Brown. (PH Pub)

Reference Books:

1.Encyclopedia of Medical Devices and Instrumentation: J G. Webster. Vol I- IV (PH Pub)
2.Various Instruments Manuals.
3.Various internet resources.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

Question paper will comprise of 6 questions, each carrying 20 marks.
The Learners need to solve total 4 questions.
Question No.1 will be compulsory and based on entire syllabus.
Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
ELXL 501	Microcontrollers & Applications Laboratory	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
ELXL501	Microcontrollers &Applications Laboratory	--	--	--	--	--	25	--	--	25	50

Assessment:

Term Work:

At least **SIX** experiments based on the entire syllabus of **ELX 501 (Microcontrollers and Applications)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time. Term work must include a mini project in addition to the number of experiments. The course mini-project is to be undertaken in a group of two to three students.**

The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work, mini project and minimum passing marks in term work. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced. Practical and Oral exam will be based on the entire syllabus.

Suggested experiments:

- Maximum three experiments in X – 51 assembly programming involving arithmetic, logical, Boolean, code-conversion etc operations.
- Minimum three experiments on interfacing of X – 51 based system with peripheral IC's (ADCs, DACs etc) peripheral actuators (relays, motors etc.) sensors (temperature, pressure etc.).

Suggested mini projects:

- Interfacing single LED/seven-segment display(SSD)/multiple-SSD with refreshing along-with some additional functional feature.
- Interfacing dot matrix LED for message display/ rolling message display.
- Interfacing IR emitter/receiver pair for time-period/speed calculations.
- Interfacing single key/4 – key/4 X 4 matrix keyboard with some additional functional feature.
- Motors – continuous, stepper, servo interfacing with speed(RPM) indication.
- Multi-function alarm clock using buzzer and LCD.
- Interfacing DAC and generating various waveforms.
- Ambient temperature indicator using LM 35 and 8-bit ADC 0808.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL 502	Digital Communication Laboratory	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXL 502	Digital Communication Laboratory	-	-	-	-	25	--	25	50

Laboratory Experiments:

Lab session includes Seven experiments and a Case study(Power point Presentation) on any one of the suggested topics.

1. The experiments will be based on the syllabus contents.

2. Minimum Seven experiments need to be conducted, out of which at least THREE should be software-based

(Scilab, MATLAB, LabVIEW, etc).

3. Each student (in groups of 3/4) has to present a Case study (Power point Presentation) as a part of the laboratory work.

The topics for Presentation / Case-study may be chosen to be any relevant topic on emerging technology.

("Beyond the scope of the syllabus".) Power point presentation should contain minimum of 15 slides and students should submit a report , (PPT+REPORT carry minimum of 10 marks

The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced.

Suggested experiments based on Laboratory setups:

1. Line codes
2. Binary modulation techniques: BASK,BPSK,BFSK
3. M-ary modulation techniques: QPSK ,QAM
4. MSK

Suggested experiments based on software:

1. Simulation of PDF& CDF of Raleigh / Normal/ Binomial Distributions
2. Simulation of Eye pattern for PAM signal

3. Source encoding: Huffman coding for Binary symbols
4. Simulation of Shannon-Hartley equation to find the upper limit on the Channel Capacity
5. Channel Encoding: Linear Block code : code generation, Syndrome
6. Cyclic code-code generation, Syndrome
7. Channel encoding: Convolutional code-code generation from generator sequences
8. Simulation of BPSK/QPSK/BFSK Modulation
9. Simulation of Duo-binary encoder-decoder
10. Plot and compare BER curves for Binary/ M-ary modulation schemes
11. Simulation of error performance of a QPSK/BPSK/MSK Modulator

Suggested topics for presentation:

1. DTH
2. Digital Multiplexing
3. Satellite Launching vehicles: PSLV, GSLV
4. Digital TV
5. Digital Satellite system: VSAT
6. RFID

Any other related and advanced topics.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL503	Design With Linear Integrated Circuits Laboratory	-	2	--	-	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELXL503	Design With Linear Integrated Circuits Laboratory	--	--	--	--	25	25		50

Term Work:

At least Six experiments based on the entire syllabus of Course ELX504 **(Design with Linear Integrated Circuits)** should be set to have well predefined inference and conclusion. Few computation/simulation based experiments are encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time**. The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

A mini project based on the following topic or additional real time applications are encouraged. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments:

1. Experiment on op amp parameters
2. Experiment on design of application using op amp (Linear)
3. Experiment on implementation of op amp application e.g. oscillator
4. Experiment on non linear application (e.g. comparator) of op amp
5. Experiment on non linear application (e.g. peak detector) of op amp
6. Experiment on ADC interfacing
7. Experiment on DAC interfacing
8. Experiment on IC 555

9. Experiment on voltage regulator (Design)
10. Experiment on implementation of instrumentation system (e.g. data acquisition).

The topic for the mini project in the course based on the syllabus of ELX505(Design with Linear Integrated Circuits)need to be application oriented.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO5011	Database Management Systems Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg						
ELXL DLO5011	Database Management Systems Laboratory	--	--	--	--	25	--	25		50

At least **eight experiments** based on the entire syllabus of **ELXDLO5011 (Data Base Management System)** should be set to have well-defined inference and conclusion. The experiments should be student-centric, and attempt should be made to make experiments more meaningful, interesting and innovative. Experiment must be graded from time to time. Additionally, each student (in group of 2/3) must perform a Mini Project as a part of the laboratory and report of mini project should present in laboratory journal. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced.

Sr. No.	Title of Experiments
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create and populate database using Data Definition Language (DDL) and DML Commands for you're the specified System.

4	Apply Integrity Constraints for the specified system.
5	Perform Simple queries, string manipulation operations.
6	Nested queries and Complex queries
7	Perform Join operations
8	Views and Triggers
9	Functions , cursor and procedure.
10	Transaction and Concurrency control
11	Mini project- Creating a Two-tier client-server database applications using JDBC

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO5012	Digital control system Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg						
ELXL DLO5012	Digital Control System Laboratory	--	--	--	--	25	--	25		50

At least **eight experiments** based on the entire syllabus of **ELXDLO5012 (Digital Control System)** should be set to have well-defined inference and conclusion. The experiments should be student-centric, and attempt should be made to make experiments more meaningful, interesting and innovative. Experiment must be graded from time to time. Additionally, each student (in group of 2/3) must perform a Mini Project as a part of the laboratory and report of mini project should present in laboratory journal. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced.

Suggested List of Experiments

Expt. No.	Title of the Experiments
1	To analyse the sampling and reconstruction of analog signal.
2	To study various discretization approaches (Impulse Invariance, Step Invariance, Bilinear Transformation)
3	Study of time domain transient and steady-state performance and performance specifications.
4	Digital controller design using Root-locus method.
5	Modelling of discrete-time systems in state-space and conversion to various canonical forms.
6	Discrete-time system simulation in Simulink.
7	Study digital PID controller and its implementation in MATLAB and Simulink.
8	Controllability and Observability of discrete-time systems.

9	Pole placement controller design for discrete-time systems.
10	Design of deadbeat controller and observer.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO5013	ASIC Verification	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg						
ELXL DLO5013	ASIC Verification	--	--	--	--	25	--	25		50

At least **eight** experiments based on the entire syllabus of **ELXDLO5013 (ASIC Verification)** should be set to have well-defined inference and conclusion. The experiments should be student-centric and attempt should be made to make experiments more meaningful, interesting and innovative. Experiment must be graded from time to time. Additionally, each student (in group of 2/3) has to perform a Mini Project as a part of the laboratory and report of mini project should present in laboratory journal. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced.

List of Experiments:

1. Implementation of 4:1 Multiplexer in Verilog with
   a. Gate level Modeling
   b. Structural/ Dataflow Modeling
   c. Behavioral Modeling
5. Implementation of D flip flop (Asynchronous/ Synchronous/latch) using Verilog.
6. Experiment to practice creating dynamic arrays, associative arrays, and queues (Test a synchronous 8-bit x64K (512kBit) RAM).
7. Write a test plan and test bench for ALU Design.
8. Experiment to practice Procedural Statements and Routines using tasks, functions and do-while loops.
9. Create Interfaces to connect the Test bench and Design.
10. Threads & IPC: Implement the following counters
    i. UP counter
    ii. DOWN counter
    iii. Divide by 2 count As threads. Use Fork join, fork join_none, fork_joinany.
11. Threads & IPC - create dynamic processes (threads) and get familiar with interprocess communication using events, semaphore and mailb
12. Functional Coverage - write cover groups and get familiar with the coverage report on Verification of FIFO

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO5013	Biomedical Instrumentation	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory				Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem					
		Test 1	Test 2	Avg						
ELXL DLO5013	Biomedical Instrumentation	--	--	--	--	25	--	25		50

At least **eight** experiments based on the entire syllabus of **ELXDLO5014 (Biomedical Instrumentation)** should be set to have well-defined inference and conclusion. The experiments should be student-centric and attempt should be made to make experiments more meaningful, interesting and innovative. Experiment must be graded from time to time. Additionally, each student (in group of 2/3) has to perform a Mini Project as a part of the laboratory and report of mini project should present in laboratory journal. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed students well in advanced.

Suggested List of Experiments

Expt. No.	Title of the Experiments
1	Study of X-ray Tubes
2	Design of active notch filter for line frequency
3	Design of general purpose amplifier for Bio potential measurement.
4	Design of Pacemaker using 555 timer.
5	Demonstration of Blood pressure measurement.
6	Demonstration of Electrocardiogram recording.
7	Demonstration of Electroencephalogram recording.
8	Demonstration of Electromyogram recording.
9	Demonstration of Photo-Colorimeter.
10	Demonstration of Spectrophotometer.

11	Demonstration of Auto-analyser.
12	Demonstration of Blood Cell counter.
13	Demonstration of D C Defibrillator (proto type).
14	Demonstration of Baby Incubator.
15	Demonstration of X Ray machine.
16	Demonstration of CT scanner.
17	Demonstration of MRI machine.
18	Demonstration of Ultrasound machine.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX 601	Embedded Systems& Real Time Operating System	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELX 601	Embedded Systems& Real Time Operating System	20	20	20	80	03	--	--	--	--	100

Course Objectives

To study concepts involved in embedded hardware and software for systems realisation.

Course Outcomes At the end of the course, the learner will have the ability to

1. Identify and describe various characteristic features and applications of embedded systems.
2. Analyse and identify hardware for embedded systems implementation.
3. Analyse and identify various software issues involved in Embedded systems for real time requirements.
4. Analyse and explain the design life-cycle for embedded system implementation.

Module		Contents	Time
1.		**Introduction to Embedded Systems**	**04**
	1.1	Characteristics and Design metrics of Embedded system.	
	1.2	Real time systems:Need for Real-time systems, Hard-Soft Real-time systems.	
	1.3	Challenges in Embedded system Design: Power, Speed and Code density.	
		Embedded Hardware	**12**
2.	2.1	Embedded cores, Types of memories, Sensors (Optical encoders, Resistive) and Actuators (Solenoid valves, Relay/switch, Opto-couplers)	
	2.2	Power supply considerations in Embedded systems: Low power features- Idle & Power down mode, Sleep mode, Brown-out detection.	
	2.3	Communication Interfaces: Comparative study of serial communication interfaces (RS-232, RS-485), I2C, CAN, USB (v2.0), Bluetooth, Zig-Bee. Selection criteria of above interfaces. **(Frame formats of above protocols are not expected)**	
3.		**Embedded Software**	**14**
	3.l	Program Modelling concepts: DFG,FSM,UML	
	3.2	Embedded C-programming concepts (from Embedded system point of view): Data types, Modifiers, Qualifiers, Functions, Macros, Interrupt service routine, Device drivers.	
	3.3	Real-time Operating system: Need of RTOS in Embedded system software and comparison with GPOS, Foreground/Background processes, Interrupt latency, Task, Task states, Multi-tasking, Context switching, Task scheduling, Scheduling algorithms-Rate Monotonic Scheduling, Earliest Deadline First (with numericals), Inter-process communication: Semaphore, Mailbox, Message queues, Event timers, Task synchronisation- Shared data, Priority inversion, Deadlock. Memory Management	
	3.4	Introduction to µCOS II RTOS: Study of Kernel structure of µCOS II, µCOS II functions for Initialisation, Task creation, Inter-task communication and Resource management, Memory management	**08**
4.		**System Integration , Testing and Debugging Methodology**	**04**
	4.1	Embedded Product Design Life-Cycle (EDLC)	
	4.2	Hardware-Software Co-design	
	4.3	Testing & Debugging: Boundary-scan/JTAG interface concepts, Black-Box testing, White-Box testing, Hardware emulation, Logic analyser.	
5.		**Case Studies**	**06**
	5.1	Soft Real-time: Automatic Chocolate Vending machine using µCOS II RTOS- Requirements study, Specification study using UML, Hardware architecture, Software architecture	
	5.2	Hard Real-time: Car Cruise-Control using µCOS II RTOS- Requirements study, specification study using UML, Hardware architecture, Software Architecture	

Text books:

1.Dr. K.V. K. K. Prasad, "Embedded Real Time System: Concepts, Design and Programming", Dreamtech, New Delhi, Edition 2014.
2.Jean J. Labrosse,"MicroC / OS-II The Real-Time Kernel", CMP Books, 2011, Edition 2nd.
3. Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education (India) Private Limited, New Delhi, 2015, Edition 3rd.
4. SriramIyer, Pankaj Gupta,"Embedded Real Time Systems Programming", Tata McGraw Hill Publishing Company ltd., 2003.

Reference Books:

1.DavidSimon,"An Embedded Software Primer", Pearson, 2009.
2.Jonathan W. Valvano, "Embedded Microcomputer Systems – Real Time Interfacing", Publisher - Cengage Learning, 2012 Edition 3rd.
3.AndrewSloss, DomnicSymes, Chris Wright,"ARM System Developers Guide Designing and Optimising System Software", Elsevier, 2004
4.FrankVahid, Tony Givargis,"Embedded System Design – A Unified Hardware/Software Introduction", John Wiley & Sons Inc., 2002.
5.Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, New Delhi, 2009.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total of 4 questions.
3. Question No.1 will be compulsory and based on the entire syllabus.
4. Remaining question (Q.2 to Q.6) will be set from all the modules.
5. Weightage of marks, commensurate with the time allocated to the respective module.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 602	Computer Communication and Networks	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX 602	Computer Communication and Networks	20	20	20	80	-	--	--	100

Course Pre-requisite: ELX405 Principles of Communication Engineering
ELX502 Digital Communication

Course Objectives:

The objectives of this course are to:

1. Introduce networking architecture and protocols
2. Understand the various layers and protocols in the TCP/IP model
3. Recognize different addressing schemes, connecting devices and routing protocols
4. Select the required protocol from the application layer protocols

Course Outcomes:

On successful completion of the course the students will be able to:

1.Demonstrate understanding of networking concepts and required protocols
2. Analyze the various layers and protocols of the layered architecture
3. Evaluate different addressing schemes, connecting devices and routing protocols
4.Appreciate the application layer protocols

Module No.	Unit No.	Topics	Hrs.
1.		**Introduction to Network Architectures, Protocol Layers, and Service models**	06
	1.1	Uses of computer networks. Topologies, LAN, MAN, WAN, Network topologies, **Addressing :** Physical / Logical /Port addressing, Protocols and Standards.	
	1.2	**Protocol Architecture:** Need of layered protocol architecture, Layers details of OSI, , Protocol Layers and Their Service Models	
	1.3	TCP/IP Model: Protocol suite, Comparison of OSI and TCP/IP	
2.		**Physical Layer**	08
	2.1	**Transmission Media:** Guided media like Coaxial, fiber, twisted pair, and Wireless media, Transmission Impairments. Interconnecting Devices: Hub, Bridges, Switches, Router, Gateway	
	2.2	**Data communication model :** DTE, DCE, RS-232D Interface , Null Modem , **Multiplexing :** FDM , Synchronous TDM , Statistical TDM, ADSL , xDSL, Cable Modem	
3.		**Data Link Control**	08
	3.1	**Data link services:** Framing, Flow control, Error control, ARQ methods, Piggybacking	
	3.2	**High Level Data Link Control (HDLC):** HDLC configurations, Frame formats, Typical frame exchanges.	
	3.3	**Medium Access Control Protocols**: ALOHA, Slotted ALOHA, CSMA, CSMA/CD	
4.		**Network Layer**	14
	4.1	**Switching**: Switched Communication networks, Circuit switching Networks, , Circuit switching Concepts, Packet switching Principles: Virtual circuit switching and Datagram switching	
	4.2	**Routing in Packet Switching Networks:** Characteristics, Routing strategies, Link state Routing versus Distance vector Routing. Least-Cost Routing Algorithms: Dijkstra's Algorithm, Bellman Ford Algorithm.	
	4.3	**Internet Protocol:** Principles of Internetworking: Requirements, Connectionless Operation Internet Protocol Operation: IP packet, IP addressing, subnet addressing , IPv4, ICMP, ARP, RARP IPv6 (IPv6 Datagram format, comparison with IPv4, and transition from IPv4 to IPv6)	
5.		**Transport Layer & Application Layer**	08
	5.1	**Connection –oriented Transport Protocol Mechanisms: Transmission Control Protocol (TCP):** TCP Services, TCP Header format, TCP three way handshake, TCP state transition diagram.	

		User datagram Protocol (UDP)	
	5.2	**Congestion:** Effects of congestion, Congestion control methods, Traffic management, Congestion control in Packet switching Networks	
	5.3	**Application layer Protocols** : HTTP, FTP, DNS,SMTP, SSH	
6.		**LANs.** High speed Ethernet	**04**
	6.1	LAN Protocol architecture , LAN topologies, Hub, Bridges, Virtual LANs **Traditional Ethernet and IEEE 802.3 LAN Standard**: Ethernet protocol, Frame structure, Physical layers,	
	6.2	**High Speed Ethernet** : Fast Ethernet, Gigabit Ethernet & 10- Gigabit Ethernet	
		Total	**48**

Recommended Text Books

1. William Stallings, "Data and Computer communications", Pearson Education, 10th Edition.
2. Behrouz A. Forouzan, "Data communication and networking ", McGraw Hill Education, Fourth Edition.
3. Alberto Leon Garcia, "Communication Networks" , McGraw Hill Education, Second Edition

Reference books :

1. S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition.
2. J. F. Kurose and K. W. Ross ,"Computer Networking: A Top-Down Approach", Addison Wesley, 5th Edition.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 603	VLSI Design	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX 603	VLSI Design	20	20	20	80	-	--	--	100

Prerequisite Subject:

- ELX302: Electronics Devices and Circuits- I
- ELX304: Digital Circuit Design
- ELX404: Digital System Design
- ELX504: Design with Linear Integrated Circuits

Course Objectives:

1. To study MOS based circuit realization using different design styles
2. To highlight the fundamental issues in data path and system level design

Course Outcomes: After successful completion of the course student will be able to …

1. Demonstrate a clear understanding of choice of technology, scaling, MOS models and system level design issues.
2. Design and analyze MOS based inverters.
3. Design MOS based circuits with different design styles.
4. Design semiconductor memories, adders and multipliers.

Unit No.	Details	Teaching Hours
1	**Technology Trend :** **1.1 Technology Comparison:** Comparison of BJT and MOS technology **1.2 MOSFET Scaling:** Types of scaling, Level 1 and Level 2 MOSFET Models, MOSFET capacitances	06
2	**MOSFET Inverters:** **2.1 Types of MOS inverters:** Active and passive load and their comparison. **2.2 Circuit Analysis of MOS Inverters:** Static Analysis resistive and CMOS inverter: Calculation of all critical voltages and noise margins. Design of symmetric CMOS inverter. Dynamic Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay **2.3Logic Circuit Design:** Analysis and design of 2-I/P NAND,NOR and complex Boolean function using equivalent CMOS inverter for simultaneous switching.	10

3	**MOS Circuit Design Styles:** **3.1 Design Styles:** Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, C^2MOS, Dynamic, Domino,NORA and Zipper. **3.2Circuit Realization:** Basic gates,SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX using above design styles.	10
4	**Semiconductor Memories:** **4.1 SRAM:** 6T SRAM, operation, design strategy, leakage currents, read/write circuits, sense amplifier. **4.2DRAM**: 1T_DRAM, operation modes, leakage currents, refresh operation, physical design. 4.3 **ROM Array**: NAND and NOR PROM, Nonvolatile read/write memories-classification and programming techniques	08
5	**Data Path Design:** **5.1 Adder:** CLA adder, MODL, Manchester carry chainand high speed adders like carryskip, carry select and carry save. **5.2 Multipliers and shifter:** Array multiplier and barrel shifter	04
6	**VLSI Clocking and System Design:** **6.1Clocking:** CMOS clocking styles, Clock generation, stabilization and distribution **6.2Low Power CMOS Circuits:** Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling **6.3I/O pads and Power Distribution:** ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme **6.4Interconnect:** Interconnect delay model, interconnect scaling and crosstalk.	10

Text and Reference Books

1.Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition.

2. John P. Uyemura, "Introduction to VLSI CIRCUITS AND SYSTEMS",Wiley India Pvt. Ltd.

3. Jan M. Rabaey, Anantha Chandrakasan and BorivojeNikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.

4. Etienne Sicard and Sonia Delmas Bendhia, "*Basics of CMOS Cell Design*", Tata McGraw Hill, First Edition.

5. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.

6. Debaprasad Das, "*VLSI Design*", Oxford, 1st Edition.

7. Kaushik Roy and Sharat C. Prasad, "*Low-Power CMOS VLSI Circuit Design*", Wiley, Student Edition.

8. David A Hodges, Horace G Jackson and Resve A Saleh, "Analysis and Design of Digital Integrated Circuits", TMH, 3rd Edition

Additional Study Material & e-Books

1.Douglas A Pucknell, Kamran Eshraghian , "Basic VLSI Design", Prentice Hall of India Private Ltd.

2.Samir Palnitkar, " A Guide to Digital Design and Synthesis", Pearson Education

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX604	Signals and Systems	04	--	#01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX604	Signals and Systems	20	20	20	80	25	-	--	125

#Class wise

Course Objectives:

1. To provide a comprehensive coverage of continuous time and discrete time Signals and Systems.
2. To introduce various time domain and frequency domain methods for analysis of Signals and systems.

Course Outcomes:

After successful completion of this course student will be able to

1. Differentiate between continuous time and discrete time Signals and Systems.
2. Understand various transforms for time domain to frequency domain conversion
3. Apply frequency domain techniques for analysis of LTI systems
4. Apply frequency domain techniques for analysis of continuous and discrete signals

Module No.	Unit No.	Topics	Hrs.
1.		**Continuous and Discrete Time Signals**	**8**
	1.1	Mathematical Representation and Classification of CT and DT signals, Orthogonality of signals	
	1.2	Arithmetic operations on the signals, Time Shifting, Time scaling, Time Reversal of signals	
	1.3	Sampling and Reconstruction, Aliasing effect	
2		**Continuous and Discrete Systems**	**8**
	2.1	Mathematical Representation and classification of CT and DT systems	
	2.2	Properties of LTI systems, impulse and step response.	
	2.3	Use of convolution integral, convolution sum and correlation for analysis of LTI systems	
	2.4	Properties of convolution integral and convolution sum	
3		**Frequency Domain Analysis of Continuous Time System using Laplace Transform**	**6**
	3.1	Concept of Complex frequency, Region of Convergence for Causal, Non-causal and Anti-causal systems, Poles and Zero of transfer function	
	3.2	Unilateral Laplace Transform	
	3.3	Analysis and characterization of LTI system using Laplace Transform: Impulse and Step Response, Causality, Stability, Stability of Causal system	
4		**Frequency Domain Analysis of Discrete Time System using Z Transform**	**12**
	4.1	Need for Z transform, definition, properties of unilateral and bilateral Z Transform, mapping with s plane, relationship with Laplace transform	
	4.2	Z transform of standard signals, ROC, poles and zeros of transfer function, Inverse Z transform	
	4.3	Analysis and characterization of LTI system using Z transform: impulse and step response, causality, stability, stability of causal system	
	4.4	System realization-Direct, Direct Canonic, Cascade and Parallel forms	
5		**Frequency Domainc Analysis of Continuous Signals**	6
	5.1	Frequency Domain Analysis of periodic non-sinusoidal signals	
	5.2	Frequency Domain Analysis of aperiodic Signals-Introduction, Properties of Fourier Transform, Fourier Transform based amplitude and phase response of standard signals, Relationship with Laplace and Z transform, Energy Spectral	
6		**Frequency Domain Analysis of Discrete Signals**	8
	6.1	Discrete Time Fourier Series, Evaluation of DTFS coefficients, Magnitude and Phase Spectrum of Discrete time periodic signals, Power Spectral Density	
	6.2	Discrete Time Fourier Transform – Concept of discrete time signal in frequency domain, definition of DTFT, determination of magnitude and phase functions using DTFT	
		Total	**48**

Text Books:

1. Tarun Kumar Rawat, "*Signals and Systems*", Oxford University*Press 2016.*
2. A. NagoorKani, *"Signals and Systems"*, Tata McGraw-Hill Education

Reference Books:

1. John Proakis and DimitrisMonolakis, "*Digital Signal Processing*", Pearson Publication, 4th Edition
2. Alan V. Oppenheim, AlanS. Willsky, and S.Hamid Nawab, "*Signals and Systems*", 2nd Edition, PHIlearning,2010.
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press,

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX DLO6021	Microwave Engineering	04	--	#01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX6021	Microwave Engineering	20	20	20	80	25	-	-	125

Prerequisites: Knowledge of basic Engineering Electromagnetics

Course Objectives:

1. To introduce the students to various concepts of Microwave Engineering.
2. To teach the students the working principles and applications of different microwave devices.

Course Outcomes (CO):

After successful completion of the course, students will be able to:

1. Understand the importance and applications of microwaves.
2. Explain the process of generation and amplification of microwaves.
3. Analyse the electromagnetic field distribution in various microwave components.
4. Measure various microwave parameters.

Module	Contents	Hours
1	**Introduction to microwave communication** 1.1 Microwave spectrum and bands 1.2 Limitations of conventional circuit theory concepts at microwave frequencies 1.3 Applications of microwaves 1.4 Limitations of conventional vacuum tubes at microwave frequencies	4
2	**Generation and amplification of microwaves** 2.1 **Two cavity Klystron amplifiers:** Construction , Process of velocity modulation and bunching , Apple gate diagram Output power and efficiency , Applications 2.2 **Reflex Klystron:** Construction ,Process of velocity modulation and bunching	12

	Apple gate diagram , Output power and efficiency Applications 2.3 **Cylindrical Magnetron** Construction and working principle Hull cut-off magnetic equation , Cyclotron angular frequency Applications 2.4 **Traveling wave tube**: construction and working principle applications 2.5 numerical examples based on the above topics	
3	**Waveguides:** 3.1 Rectangular and circular waveguides 3.2 solution of Maxwell's equation for distribution of fields in the waveguides 3.3 characteristic equation 3.4 Dominant and degenerate modes 3.5 group and phase velocities 3.6 cut-off frequency 3.7 numerical examples based on the above topics	10
4	**Waveguide components and analysis**: 4.1 Definition and significance of s-parameters 4.2 Properties of s-parameters 4.3 Construction, working principle and s-matrix representation of cavity resonators, waveguide attenuators, waveguide phase shifters, waveguide multiport junctions, E-plane and H-plane Tees, Magic Tee, Hybrid Ring, direction couplers 4.4 Microwave ferrite components: Faraday rotation isolator, Circulator, Gyrator Numerical examples based on the above topics	12
5	Microwave solid state devices: 5.1Principle of operation and characteristics of: Gunn Diode, TRAPATT and IMPATT diodes, Microwave Transistors 5.2 Introduction to Strip Lines	5
6	Microwave Measurement: Measurement of 6.1 Power 6.2 Attenuation 6.3 Frequency 6.4 VSWR 6.5 Cavity Q 6.6 Impedance	5

Text Books:

1. " Microwave Devices and Circuits" by Samuel Liao, PHI
2. "Microwave circuits and Passive Devices" by M L Sisodia, G S Raghuvanshi, New Age International(P) Ltd

Reference Books:

1. " Electronic Communication Systems" by Kennedy, Davis, 4e TMH
2. " Microwave Engineering: Passive Circuits" by Peter Rizzi, PHI
3. " Foundations for Microwave Engineering" by Robert E Collin, 2e, John Wiley
4. " Basic Microwave Techniques & Laboratory Manual" by M L Sisodia, G S Raghuvanshi, 2001 New Age International(P) Ltd
5. Microwave Engineering, Annapurna Das, TMH\

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX DLO6022	Electronic Product Design	04	---	---	04	---	---	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELX DLO6022	Electronic Product Design (EPD)	20	20	20	80	---	---	100

Rationale :- The aim of this course is to enable students to gain practical experience & nurture their creativity in electronic product design & the objective is to provide students with a clear understanding of the practical design problems of the electronic products at an introductory level. With this course, students are expected to become familiar with the concept of designing a product as per the requirements (non-technical) & given specifications (technical), component tolerances, production constraints, safety requirements & EMC standards.

Course Objectives:-

1. To understand the stages of product (hardware / software) design & development
2. To learn different considerations of analog, digital & mixed circuit design
3. To be acquainted with methods of PCB design & different tools used for the same
4. To be aware of the importance of testing in product design cycle
5. To gain knowledge about various processes & importance of documentation

Course Outcomes :-

At the end of the course, students should gain the ability to :-

- **CO-1 :-** Design electronic products using user-centered designing processes
- **CO-2 :-** Identify & recognize essential design & production procedures of electronic products
- **CO-3 :-** Implement a prototype for meeting a particular requirement / specification
- **CO-4 :-** Demonstrate problem solving & troubleshooting skills in electronic product design
- **CO-5 :-** Prepare the relevant set of design documentation & present it as a case study

Module No.	Topics	Hours
1	**INTRODUCTION TO ELECTRONIC PRODUCT DESIGN** Man-machine dialog & industrial design, user-centered design, elements of successful design, cognition, ergonomics, packaging & factors; design for manufacture, assembly & disassembly wiring, temperature, vibration & shock; safety, noise, energy coupling, grounding, earthing, filtering & shielding	06
2	**HARDWARE DESIGN & TESTING METHODS** Design process, identifying the requirements, formulating specifications, design specifications, system partitioning, functional design, architectural design, functional model v/s architectural model, prototyping, performance & efficiency measures, formulating a test plan, writing all the specifications, test procedures & test cases, design reviews, module debug & testing – black box testing, white box testing, grey box testing	10
3	**SOFTWARE DESIGN & TESTING METHODS** Types of software, the waterfall model of software development, models, metrics & software limitations, risk abatement & failure prevention, software bugs & testing, good programming practice, user interface, embedded & real-time software	10
4	**PRINTED CIRCUIT BOARD (PCB) DESIGNING** Fundamental definitions, standards, routing topology configuration, layer stack up assignment, grounding methodologies, aspect ratio, image planes, functional partitioning, critical frequency & bypassing, decoupling; design techniques for ESD protection, guard-band & guard-rings	08
5	**PRODUCT DEBUGGING & TESTING** Steps of debugging, the techniques for troubleshooting, characterization, electromechanical components, passive components, active components, active devices, operational amplifier, analog-to-digital conversion, digital components, inspection & testing of components, process of simulation, prototyping & testing, integration, validation & verification, EMI & EMC issues	08
6	**THE DOCUMENTATION PROCESS** Definition, needs & types of documentation, records, accountability & liability, audience, steps in preparation, presentation & preservation of documents, methods of documentation, visual techniques, layout of documentation, bills of materials, manuals – instructional or operating manual, service and maintenance manual, fault finding tree, software documentation practices	06
1 – 6	**TOTAL**	48

Recommended Books :-

1. R. G. Kaduskar & V. B. Baru, Electronic Product Design, 3rd edition, Wiley India
2. Kim Fowler, Electronic Instrument Design, 2nd edition, Oxford University Press
3. Robert J. Herrick, PCB Design Techniques for EMC Compliance, 2nd edition, IEEE Press
4. G. C. Loveday, Electronic Testing & Fault Diagnosis, 4th edition, A. H. Wheeler Publishing
5. James K. Peckol, Embedded Systems – A Contemporary Design Tool, 1st edition, Wiley Publication
6. J. C. Whitaker, The Electronics Handbook, CRC Press

Internal Assessment (IA) :-

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination :-

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. The students need to solve total 4 questions.

3. Q.1 will be compulsory and based on entire syllabus.

4. Remaining questions (Q.2 to Q.6) will be set from all modules.

5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX DLO6023	Wireless Communication	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX DLO6023	Wireless Communication	20	20	20	80	-	--	--	100

Course Objectives:

The objectives of this course are to:

1. To introduce the Concepts of basic Cellular communication systems , mobile Radio propagation
2. To understand the various Cellular processes such as handoff strategies, interference, Trunking theory
3. To study the features and services of 2G cellular technologies: GSM and CDMA
4. To study the features of evolving technological advances in 2G, 3G & 4G Cellular systems.

Course Outcomes:

After successful completion of the course, students will be able to:

1.Understand the concepts of basic cellular system, frequency reuse, channel assignment
2. Understand the fundamentals radio propagation , Path loss and comprehend the effect of Fading .
3. Acquire the Knowledge about multiple access technologies and different of different spread spectrum techniques.
4. Acquire the Knowledge about overall GSM cellular concept and analyse its services and features
5. Comprehend the features of CDMA technology
6. Analyse the evolution of cellular technology from 2G to 4G Cellular systems .

Module No.	Unit No.	Topics	Hrs.
1.		**Concept of Cellular Communication**	**08**
	1.1	Introduction to cellular communications, Frequency reuse, Channel assignment strategies	
	1.2	**Cellular Processes:** Call setup, Handoff strategies, interference and system capacity, Co-channel Interference reduction with the use of Directional Antenna	
	1.3	**Traffic Theory:** Trunking and Grade of service, Improving Coverage and capacity in Cellular systems: Cell splitting, Sectoring, Micro-cell Zone concept	
2.		**Mobile Radio Propagation**	**08**
	2.1	Introduction to Radio wave propagation, Free space propagation model, the three basic Propagation mechanisms, The Ground Reflection (two-ray) model, Practical Link	

		budget design using Path-Loss models:Log-distance Path –loss model.	
	2.2	Small scale Multipath Propagation: Factors influencing small scale fading, Doppler shift, Parameters of mobile multipath channels,	
	2.3	Types of small scale fading, Fading effects due to Doppler spread, Fading effects due to Multipath Time delay spread, Raleigh and Rician distributions	
3.0		Multiple access techniques & Spread spectrum Modulation	**08**
	3.1	Multiplexing and Multiple Access:Time Division Multiple Access, Frequency Division Multiple Access, Spread-spectrum multiple-access:Code Division Multiple Access	
	3.2	Spread spectrum Modulation :Need for and concept of spread spectrum modulation, PN-sequence generation, properties of PN-sequence, Gold sequence generation, Direct-sequence SS, Frequency-hopping SS,	
4.0		**GSM**	**12**
	4.1	GSM network architecture, Signalling protocol architecture, Identifiers, Physical and Logical Channels, Frame structure, Speech coding, Authentication and security, Call procedure, Hand-off procedure, Services and features	
5.0		**IS-95**	**06**
	5.1	Frequency and channel specifications of IS-95, Forward and Reverse CDMA channel, Packet and Frame formats, Mobility and Resource management	
6.0		**Evolution from 2G to 4G**	**06**
	6.1	GPRS, EDGE technologies, 2.5G CDMA-One cellular network, W-CDMA (UMTS), CDMA2000, LTE, Introduction to 5G Networks	
		Total	**48**

Recommended Books:

6. Theodore Rappaport, "Wireless Communications: Principles and Practice, 2nd Edition, Pearson Publication
7. ITI Saha Misra, "Wireless Communication and Networks: 3G and Beyond", Publication
8. Vijay Garg, "IS-95 CDMA and cdma 2000: Cellular/PCS System Implementation", Pearson Publication.

Reference Books:

1. T.L Singal , "Wireless Communication", Tata McGraw Hill ,2010
2. Upena Dalal , "Wireless Communication", Oxford University Press, 2009
3. Andreas F Molisch, "Wireless Communication", John Wiley, India 2006.
4. Vijay Garg, "Wireless communication and Networking", Pearson Publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to marks will be asked.
4: Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELX DLO6024	Computer Organization and Architecture	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELX DLO6024	Computer Organization and Architecture	20	20	20	80	03	--	--	--	--	100

Course Objectives	1. To introduce the learner to the design aspects which can lead to maximized performance of a Computer. 2. To introduce the learner to various concepts related to Parallel Processing 3.To highlight the various architectural enhancements in modern processors.
Course Outcomes	At the end of the course, the learner will have the ability to 1. Define the performance metrics of a Computer 2.Explain the design considerations of Processor, Memory and I/O in Computer systems 3. Explain the advantages and limitations of Parallelism in systems 4. Explain the various architectural enhancements in modern processors

Module		Contents	Time
1.		**Introduction to Computer Organization**	**[06]**
	1.1	Fundamental Units of a Computer	01
	1.2	Introduction to Buses	01
	1.3	Number Representation methods- Integer and Floating-point, Booth's Multiplier, Restoring and Non-Restoring Division	03
	1.4	Basic Measures of Computer Performance - Clock Speed, CPI, MIPs and MFlops	01
2.		**Processor Organization and Architecture**	**10**
	2.1	CPU Architecture , Register Organization, Instruction cycle, Instruction	04

		Formats	
	2.2	Control Unit Design- Hardwired and Micro-programmed Control: Vertical and Horizontal Micro-Instructions, Nano-programming	04
	2.3	Comparison between CISC and RISC architectures	02
3.		**Memory Organization**	**12**
	3.l	Classification of Memories-Primary and Secondary Memories, RAM (SRAM and DRAM) and ROM (EPROM , EEPROM), Memory Inter-leaving	02
	3.2	Memory Hierarchy, Cache Memory Concepts, Mapping Techniques, Write Policies, Cache Coherency (* Numerical Problems expected)	06
	3.3	Virtual Memory Management-Concept, Segmentation , Paging, Page Replacement policies	04
4.		**Input/Output Organization**	**06**
	4.1	Types of I/O devices and Access methods, Types of Buses , Bus Arbitration	03
	4.2	Expansion Bus Concept, PCI Bus	03
5.		**Parallelism**	**06**
	5.1	Introduction to Parallel Processing Concepts, Flynn's classification, Amdahl's law	02
	5.2	Pipelining - Concept, Speedup, Efficiency , Throughput, Types of Pipeline hazards and solutions (* Numerical Problems expected)	04
6.		**Architectural Enhancements**	**08**
		Superscalar Architectures, Out-of-Order Execution, Multi-core processors, Clusters, Non-Uniform Memory Access (NUMA) systems, Vector Computation , GPU	08

Text books:

1.William Stallings, "*Computer Organization and Architecture: Designing for Performance*", Eighth Edition, Pearson.

2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill, 2002.

Reference Books:

1. J.P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.

2. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", Second Edition, Tata McGraw-Hill.

3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann,1998.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:
Question paper will comprise of 6 questions, each carrying 20 marks.

The Learner need to solve total 4 questions.

Question No.1 will be compulsory and based on entire syllabus. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL 601	Embedded Systems& Real Time Operating System Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory									
		Internal Assessment			End sem	Duration (hrs)	Term work	Pract.	Oral	Pract. / Oral	Total
		Test 1	Test 2	Avg							
ELXL 601	Embedded Systems& Real Time Operating System Laboratory	--	--	--	--	--	25	--	--	25	50

Assessment:

Term Work:

At least **SIX** experiments based on the entire syllabus of **ELX 601 (Embedded System & Real Time Operating System)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time. Term work must include a mini project in addition to the number of experiments. The course mini-project is to be undertaken in a group of two to three students.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work, mini project and minimum passing marks in term work.

Practical and Oral exam will be based on the entire syllabus.

Suggested Experiments:

- Simulation experiments using KeilC–cross complier to: evaluate basic C program for X-51 assembly; evaluating various C data types; evaluating and understanding iterative C constructs translated into x51's assembly; evaluating and understanding interrupt implementation.
- Simulate and understand working of µCOS-II functions using example programs from recommended text,"MicroC / OS-II The Real-Time Kernel", by Jean J. Labrosse.
- Porting of µCOS-II on X-51/AVR/CORTEX M3 platform.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL 602	Computer Communication and Networks Laboratory	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXL 602	Computer Communication and Networks Laboratory	-	-	-	-	25	--	25	50

Laboratory Experiments:

Lab session includes Seven experiments and a Case study(Power point Presentation) on any one of the suggested topics.

1. The experiments will be based on the syllabus contents.

2. Minimum **Seven experiments** need to be conducted, out of which **at least Four Experiments** should be software-based (C/C++ , Scilab, MATLAB, LabVIEW, etc).

3. Each student (in groups of 3/4) has to present a Case study (Power point Presentation) as a part of the laboratory work. The topics for Presentation / Case-study may be chosen to be any relevant topic on emerging technology. ("Beyond the scope of the syllabus".)

Power point presentation should contain minimum of 15 slides and students should submit a report (PPT+Report)carry minimum of 10 marks . The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested List of experiments:

1. Study of transmission media and interconnecting devices of communication networks.
2. Implementation of serial transmission using RS232
3. Implementing bit stuffing algorithm of HDLC using C/C++
4. Implementation of Routing protocols using C/C++
5. Study of NS2 simulation software
6. Implementation of TCP/UDP session using NS2
7. Implementation of ARQ methods using NS2
8. Study of WIRESHARK and analyzing Packet using WIRESHARK
9. Study and implementation of IP commands
10. Study of GNS software and implementation of routing protocols using GNS

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL 603	VLSI Design Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELXL 603	VLSI Design Laboratory	--	--	--	--	--	25	--	--	25	50

Assessment:

Term Work:

At least **SIX** experiments based on the entire syllabus of **ELX 603 (VLSI Design)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time. Term work must include a mini project in addition to the number of experiments. The course mini-project is to be undertaken in a group of two to three students.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work, mini project and minimum passing marks in term work.

Practical and Oral exam will be based on the entire syllabus.

Suggested Experiments:

MOSFET Scaling using circuit simulation software like Ngspice
Static and transient performance analysis of various inverter circuits
Implementation of NAND and NOR gate using various logic design styles
Design and verification of CMOS Inverter for given static and transient performance
Implementation of ROM, SRAM, DRAM
Interconnect analysis

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO6021	Microwave Engineering Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELXL DLO6021	Microwave Engineering Laboratory	--	--	--	--	--	25	--	--	25	50

Assessment:

Term Work:

At least **SIX** experiments based on the entire syllabus of **ELXDLO 6021 (Microwave Engineering)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time. Term work must include a mini project in addition to the number of experiments. The course mini-project is to be undertaken in a group of two to three students.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work, mini project and minimum passing marks in term work.

Practical and Oral exam will be based on the entire syllabus.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO6022	Electronic Product Design	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELXL DLO6022	Electronic Product Design	--	--	--	--	--	25	--	--	25	50

At least **Six** experiments based on the entire syllabus of **ELXDLO6022 (**Electronic Product Design**)** should be set to have well-defined inference and conclusion. The experiments should be student-centric and attempt should be made to make experiments more meaningful, interesting and innovative. Experiment must be graded from time to time. Additionally, each student (in group of 2/3) has to perform a Mini Project as a part of the laboratory and report of mini project should present in laboratory journal. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Lab session includes **six experiments plus one presentation on case study.**

Suggested Experiments:

1. Experiment based on Ground and Supply bounce
2. PCB design steps involved in product design
3. Simulation based on use of Simulator software
4. Working of an Emulator in Design step
5. Role of Pattern Generator in Design step
6. Debugging of the digital circuit based on Logic Analyzer
7. Application of the Spectrum analyzer
8. Demonstration of usefulness of the Arbitrary waveform generator
9. Setup for EMI and EMC test
10. Experiment based on calibration of the product.

Suggested topics for Case Study:

Faculty members can suggest topics pertaining above syllabus and ask students to submit complete report covering design issues, hardware and software details and applications.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL DLO6023	Wireless Communication Laboratory	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXL DLO6023	Wireless Communication Laboratory	-	-	-	-	25	--	25	50

Laboratory Experiments:

Lab session includes seven experiments and a Case study(Power point Presentation)on any one of the suggested topics.

Note:

1. The experiments will be based on the syllabus contents.

2. Minimum seven experiments need to be conducted.(Scilab, MATLAB, LabVIEW, NS2/NS3 etc can be used for simulation).

3. Each student (in groups of 3/4) has to present a Case study (Power point Presentation) as a part of the laboratory work.

The topics for Presentation / Case-study may be chosen to be any relevant topic on emerging technology.

("Beyond the scope of the syllabus".)

Power point presentation should contain minimum of 15 slides and students should submit a report , (PPT+Report) carry minimum of 10 marks The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ELXL DLO6024	Computer Organization and Architecture	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract.	Oral	Pract. / Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg							
ELXL DLO6024	Computer Organization and Architecture	--	--	--	--	--	25	--	--	25	50

At least **six** experiments based on the entire syllabus of **ELX DLO6024 (Computer Organization and Architecture)** should be set to have well-defined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be student-centric and attempt should be made to make experiments more meaningful, interesting and innovative. Additionally, a **Seminar on IEEE/ACM paper** focussing on key areas of research in Computer Architecture/Organization to be part of the term-work which is duly graded.

Suggested List of Experiments:

Expt. No.	Title of the Experiments
1	Implementation of Booth's Algorithm (using VHDL)
2	To create a control store for micro-programmed control unit (using VHDL)
3	Using a cache simulator , calculate the cache miss-rate for various mapping schemes
4	Implement various page replacement policies (LRU, FIFO,LFU)
5	Program to detect the type of hazard (RAW,WAR,WAW)for a set of instructions
6	Using a performance analyzer tool, extract various performance metrics

B.E. (Electronics Engineering)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX701	Instrumentation System Design	04	--	---	04	---	---	04
ELX702	Power Electronics	04	--	---	04	---	---	04
ELX703	Digital signal processing	04	--	---	04	---	---	04
ELXDLO703X	Department Level Optional course III	04	--	---	04	---	---	04
ILO701X	Institute Level Optional Course I#	03	---	---	03	---	---	03
ELXL701	Instrumentation System Design Lab.		02			01	---	01
ELXL702	Power Electronics Lab.		02			01	---	01
ELXL703	Digital signal processing Lab.		02			01	---	01
ELXL704	Project-I	---	06	---	---	03	---	03
ELXLDLO703X	Dept. Level Optional course III Lab.		02			01	---	01
	TOTAL	**19**	**14**	**---**	**19**	**07**	**---**	**26**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX801	Internet of Things	04	--	---	04	---	---	04
ELX 802	Analog and Mixed VLSI Design	04	--	---	04	---	---	04
ELXDLO804X	Department Level Optional course IV	04	--	---	04	---	---	04
ILO802X	Institute Level Optional course II#	03	---	---	03	---	---	03
ELX801	Internet of Things Lab.		02			01	---	01
ELXL802	Analog and Mixed VLSI Design Lab.		02			01	---	01
ELXL803	Project-II	---	12	---	---	06	---	06
ELXLDLO804X	Department Level Optional Courses IV Lab.		02			01	---	01
	TOTAL	**15**	**18**	**---**	**15**	**9**	---	**24**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 701	Instrumentation System Design	04	---	---	04	---	---	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELX 701	Instrumentation System Design (ISD)	20	20	20	80	---	---	100

Rationale :- For optimum operation & satisfactory performance of any industrial process control system, it is necessary to have a reliably engineered system with a thorough knowledge of the process conditions & requirements as per the system or design specifications. This subject introduces various nuances in the design of instrumentation systems, which is itself a synergy of sensors, transducers, actuators, process control & electronic systems to achieve the desired operation of a plant or the proper control of an industrial process. Students are exposed to principles of designing which enable them to design, build & implement such electronically controlled systems for measurement, signal conditioning & final control.

Course Objectives :-

1. To learn basic functions & working of pneumatic, hydraulic & electrical components used in process control
2. To understand principles of process parameter conversion & transmission in various forms
3. To gain familiarity with control system components & their applications in process control
4. To study various types of controllers used in process control & their tuning for different applications
5. To be aware of recent advances & technological developments in industrial instrumentation & process control

Course Outcomes:-

At the end of the course, students should gain the ability to :-

- **ELX 701.1 :-** Demonstrate the needs of advancement in instrumentation systems
- **ELX 701.2 :-** Select the proper components for pneumatic & hydraulic systems
- **ELX 701.3 :-** Choose the transmitter / controller for given process application
- **ELX 701.4 :-** Analyze the controller parameters for discrete or continuous type
- **ELX 701.5 :-** Design the controller (electronic) for a given process or application

Module No.	Topics	Hours
1	**ACTUATORS & PROCESS CONTROL VALVES**	**08**
1.1	Electrical actuators – relays, solenoids & electrical motors (DC, AC & stepper motor)	
1.2	Pneumatic actuators – basic pneumatic system, pneumatic compressors (piston, vane, screw) flapper nozzle, single & double acting cylinder, rotary actuator, filter-regulator-lubricator (FRL)	
1.3	Hydraulic actuator – hydraulic pumps, control valves types (globe, ball, needle, butterfly, gate, diaphragm & pinch), cavitation & flashing with their remedies, pressure drop across valve & leakage, valve noise, flow characteristics on load changes, control valves parameters, control valves sizing, valve calibration, digital control valves, selecting control valves & applications	
2	**DESIGN OF SIGNAL CONDITIONING CIRCUITS**	**08**
2.1	Principles of analog & digital signal conditioning – signal level & bias change, linearization, conversion, filtering & impedance matching, concept of loading, comparators & converters	
2.2	Design of operational amplifier based circuits in instrumentation – analysis of voltage divider circuits, bridge circuits, RC filters, inverting & non-inverting amplifier, instrumentation amplifier, V to I & I to V converter, integrator, differentiator & linearization (with numerical examples)	
2.3	Transmitters – Introduction to telemetry & its basic block diagram, 2 wire, 3 wire & 4 wire transmitters, 4 mA to 20 mA current transmitter, electronic transmitters for temperature, level, pressure & flow, current to pressure (I to P) & pressure to current (P to I) converters	
3	**PROCESS CONTROLLER PRINCIPLES**	**08**
3.1	Discontinuous controller – two position mode, multi-position mode & floating mode	
3.2	Continuous controller – single mode (P, I & D) & composite mode (PD, PI & PID), split range, auto select, ratio & cascaded controllers, selection criterion of controller for a process mode	
3.3	Tuning of PID controller – process loop tuning, open loop transient response method, Ziegler – Nichols tuning method, frequency response methods (numerical examples on PID tuning)	
4	**PROGRAMMABLE LOGIC CONTROLLERS (PLC)**	**10**
4.1	Discrete state process controller – discrete state variables, process specifications & event sequence description	
4.2	Relay controller & ladder diagram – introduction to relay ladder diagram logic, ladder diagram elements & ladder diagram programming examples	

4.3	PLC – relay sequencers, programmable logic controller design, PLC operation, programming the PLC, PLC software functions (application examples on relay ladder logic programming)	
5	**DIGITAL BASED PROCESS CONTROL**	**08**
5.1	Data acquisition system (DAS) – objectives, signal conditioning of inputs, single channel DAS, multi-channel DAS, computer based DAS, data logger, difference between DAS & data logger	
5.2	Computer aided process control – architecture, human machine interface (HMI), supervisory control & data acquisition (SCADA), standard interfaces (RS-232C, RS-422A & RS-485)	
5.3	Supervisory control system (SCS), introduction to the Fieldbus & Profibus process controlled networks, overview of distributed control system (DCS), features & advantages of DCS	
6	**CALIBRATION STANDARDS & ADVANCES IN INSTRUMENTATION**	**06**
6.1	PC & microcomputer based instrumentation, virtual instrumentation & LabVIEW introduction	
6.2	Calibration of instrumentation systems, representation of instrumentation control process with SAMA & ISA symbols, ISO/IEC 17025 General requirements for calibration standards	
6.3	Instrumentation standards, ISA S82.01 – Safety Standard for Electrical and Electronic Test, Measuring, Controlling Related Equipment, ISA S84.01 – Application of Safety Instrumented Systems for the Process Industries, ANSI/NEMA 250 – Enclosures for Electrical Equipment	
1 – 6	**TOTAL**	**48**

Recommended Books :-

1. Curtis D. Johnson, Process Control Instrumentation Technology, 7th edition, PHI
2. S. K. Singh, Industrial Instrumentation & Control, 3rd edition, McGraw Hill
3. B.C. Nakra & K. K. Chaudhary, Instrumentation Measurement & Analysis, 3rd edition, McGraw Hill
4. Andrew Parr, Pneumatics & Hydraulics, 2nd edition, Jaico Publishing Co.
5. B. G. Liptak, Handbook of Process Control & Instrumentation, 4th edition, CRC Press
6. William C. Dunn, Fundamentals of Industrial Instrumentation & Process Control, 1st edition, McGraw Hill

Internal Assessment (IA) :-Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination :-

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Q.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX702	Power Electronics	04	02	--	04	--	--	04

Subject Code	Subject Name	ExaminationScheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours				
		Test 1	Test 2	Avg of Test 1 and Test 2						
ELX702	Power Electronics	20	20	20	80	03	--	--	--	100

\Course Pre-requisite:

1. ENAS
2. EDC-1
3. EDC-2

Course Objectives:

1. To teach power electronic devices and their characteristics.
2. To highlight power electronics based rectifiers, inverters and choppers.

Course Outcomes:

After successful completion of the course students will be able to:

1. Discuss trade-offs involved in power semiconductor devices.
2. Design of triggering, commutation and protection circuits for SCRs.
3. Analyse different types of single-phase rectifiers and DC-DC converters.
4. Analyse different types of DC-AC converters (inverters).
5. Analyse different types of AC Voltage Controllers and Cycloconvertors.

Module No.	Unit No.	Contents	Hrs.
1		**Power semiconductor devices**	8
	1.1	Principle of operation of SCR, static and dynamic characteristics, gate Characteristics,	
	1.2	Principle of operation, characteristics, ratings and applications of: TRIAC, DIAC, MOSFET and power BJT. IGBT: basic structure, principle of operation, equivalent circuit, latch-up in IGBT's and V-I characteristics.	
2		**SCR: Triggering, commutation and Protection Circuits**	8
	2.1	Methods of turning ON SCR (types of gate signal), firing circuits (using R, RC, UJT, Ramp and pedestal, inverse cosine),	
	2.2	Design of commutation circuits,	
	2.3	Protection of SCR	
3		**Single-phase Controlled Rectifiers**	8
	3.1	Introduction to uncontrolled rectifiers, Half wave controlled rectifiers with R, RL load, effect of free-wheeling diode	
	3.2	Full wave fully controlled rectifiers (centre-tapped, bridge configurations), full-wave half controlled (semi-converters) with R, RL load, effect of freewheeling diode and effect of source inductance.	
	3.3	Calculation of performance parameters, input performance parameters (input power factor, input displacement factor (DF), input current distortion factors (CDF), input current harmonic factor (HF/THD), Crest Factor (CF)), output performance parameters.	
4		**Inverters**	10
	4.1	Introduction to basic and improved series/parallel inverters, limitations.	
	4.2	Introduction, principle of operation, performance parameters of Single phase half / full bridge voltage source inverters with R and R-L load,	
	4.3	Voltage control of single phase inverters using PWM techniques, harmonic neutralization of inverters, applications	
5		**DC-DC converters**	8
	5.1	Basic principle of step up and step down DC-DC converters, DC-DC switching mode regulators: Buck, Boost, Buck-Boost, Cuk Regulators (CCM mode only)	
	5.2	Voltage commutated, current commutated and load commutated DC-DC	

		converters	
	5.3	Applications in SMPS, Battery charging systems.	
6		**AC Voltage Controllers and Cycloconvertors**	**6**
	6.1	Principle of On-Off control, principle of phase control, single phase bidirectional control with R and RL load	
	6.2	Introduction, single phase and three phase Cyclo-converters, applications	
		Total	**48**

Recommended Books:

1. M. H. Rashid, "*Power Electronics*", Prentice-Hall of India
2. Ned Mohan, "*Power Electronics*", Undeland, Robbins, John Wiley Publication
3. P. S. Bhimbra, "Power Electronics", Khanna Publishers, 2012
4. M.D. Singh and K. B. Khanchandani, "*Power Electronics*", Tata McGraw Hill
5. Ramamurthy, " *Thyristors and Their Applications*"
6. P. C. Sen, "*Modern Power Electronics*", Wheeler Publication
7. S. Shrivastava, "Power Electronics", Nandu Publication, Mumbai.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 and Test 2					
EXC703	Digital Signal Processing	20	20	20	80	--	--	--	100

Prerequisite Courses: Signals and Systems

Course Objectives:

1. To teach the design techniques and performance analysis techniques of digital filters
2. To introduce the students to advanced signal processing techniques, digital signal processors and applications

Course Outcomes:

After successful completion of this course students will be able to

1. Demonstrate an understanding of the discrete-time Fourier transform and the concept of digital frequency.
2. Design FIR and IIR digital filters to meet arbitrary specifications and Develop algorithms for implementation
3. Understand the effect of hardware limitations on performance of digital filters
4. Use advanced signal processing techniques and digital signal processors in various applications

Module No.	Unit No.	Topics	Hrs.
1.0		**Discrete Fourier Transform and Fast Fourier Transform**	10
	1.1	Definition and Properties of DFT,IDFT, circular convolution of sequences using DFT and IDFT, Relation between Z-transform and DFT Filtering of long data sequences: Overlap Save and Overlap Add Method Computation of DFT	
	1.2	Fast Fourier transforms(FFT),Radix-2decimationintime and decimation in frequency FFT algorithms, inverse FFT, and Introduction to composite FFT	
2.0		**IIR Digital Filters**	10
	2.1	Types of IIR Filters (Low Pass, High Pass, Band Pass, Band stop and All Pass) Analog filter approximations: Butterworth, Chebyshev I and II	
	2.2	MappingofS-planetoZ-plane,impulseinvariancemethod,bilineartransformation method, Design of IIR digital filters from analog filters with examples	
	2.3	Analog and digital frequency transformations with design examples	
3.0		**FIR Digital Filters**	10
	3.1	Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters Frequency response, location of the zero sof linear phase FIR filters	

	3.2	Design of FIR filter susing window techniques (Rectangular, Hamming, Hanning,Blackmann, Barlet) Design of FIR filter susing Frequency Sampling technique Comparison of IIR and FIR filters	
4.0		**Finite Word Length Effects in Digital Filters**	**06**
	4.1	Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Co-efficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling	
	4.2	Quantization in Floating Point realization of IIR digital filtersFinite word length effects in FIR digital filters	
5.0		**Multirate DSPand FilterBanks**	**06**
	5.1	Introduction and concept of Multirate Processing, Block Diagram of Decimator and Interpolator, Decimation and Interpolation by Integer numbers Multistage Approach to Sampling rate converters	
	5.2	Sample rate conversion using Polyphase filter structure, Type I and Type II Polyphase Decomposition	
6.0		**DSP Processors and Applications**	**06**
	6.1	Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator(MAC), Special Instructions, Replication, On-chip memory, Extended Parallelism	
	6.2	General purpose digital signal processors, Selecting digital signal processors, Special purpose DSP hardware	
	6.3	Applications of DSP: Radar Signal Processing and Speech Processing	
Total			**48**

Text Books:

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing"*, A Practical Approach by, Pearson Education
2. Tarun Kumar Rawat, " *Digital Signal Processing"*, Oxford University Press, 2015

Reference Books:

1. ProakisJ., Manolakis D., "*Digital Signal Processing*", 4th Edition, Pearson Education
2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – edition 4e
3. McGraw Hill Education (India) Private Limited
4. OppenheimA.,SchaferR.,BuckJ.,"*DiscreteTimeSignalProcessing*",2ndEdition, Pearson Education..
5. B. VenkataRamaniand, M. Bhaskar, "*Digital Signal Processors, Architecture, Programming andApplications*", Tata McGraw Hill, 2004.
6. L.R.RabinerandB.Gold,"*TheoryandApplicationsofDigitalSignalProcessing*",Prentice-HallofIndia, 2006.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5markswill be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO7031	NEURAL NETWORKS & FUZZY LOGIC	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXDLO7031	NEURAL NETWORKS & FUZZY LOGIC	20	20	20	80	-	--	--	100

Pre-requisite

- Knowledge of linear algebra, multivariate calculus, and probability theory
- Knowledge of a programming language (MATLAB /C/C ++ recommended)

Course Objectives:

- To study basics of biological Neural Network.
- To understand the different types of Artificial Neural Networks
- To know the applications of ANN .
- To study fuzzy logic and fuzzy systems.

Course outcomes:

At the end of completing the course of Neural Networks & Fuzzy Logic, a student will be able to:

1. Choose between different types of neural networks
2. Design a neural network for a particular application
3. Understand the applications of neural networks
4. Appreciate the need for fuzzy logic and control

Module	Contents	Hours
1	**Introduction:**1.1 Biological neurons, McCulloch and Pitts models *of* neuron, Types of activation function, Network architectures, Knowledge representation, Hebb net 1.2 Learning processes: Supervised learning, Unsupervised learning and Reinforcement learning 1.3 Learning Rules : Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Correlation Learning Rule, Winner-Take-All Learning Rule 1.4 Applications and scope of Neural Networks	**10**
2	**Supervised Learning Networks :** 2.1 Perception Networks – continuous & discrete, Perceptron convergence theorem, Adaline, Madaline, Method of steepest descent, – least mean square algorithm, Linear & non-linear separable classes & Pattern classes, 2.2 Back Propagation Network, 2.3 Radial Basis Function Network.	**12**
3	**Unsupervised learning network:** 3.1 Fixed weights competitive nets, 3.2 Kohonen Self-organizing Feature Maps, Learning Vector Quantization, 3.3 Adaptive Resonance Theory – 1	**06**
4	**Associative memory networks:** 4.1 Introduction, Training algorithms for Pattern Association, 4.2 Auto-associative Memory Network, Hetero-associative Memory Network, Bidirectional Associative Memory, 4.3 Discrete Hopfield Networks.	**08**
5	Fuzzy Logic: 5.1 Fuzzy Sets, Fuzzy Relations and Tolerance and Equivalence 5.2 Fuzzification and Defuzzification 5.3 Fuzzy Controllers	**12**

TOTAL	**48**

Text- Books:

- Dr. S. N. Sivanandam, Mrs S.N. Deepa, *"Principles of Soft computing"*, Wiley Publication.
- Jacek M. Zurada, *"Introduction to Artificial Neural Systems,* Jaico publishing house.

Reference books :

- Simon Haykin, "*Neural Network* a - *Comprehensive Foundation",* Pearson Education.
- S. Rajsekaran, Vijaylakshmi Pai, *"Neural Networks, Fuzzy Logic, and Genetic Algorithms"*, PHI.
- Thimothy J. Ross, "*Fuzzy Logic with Engineering Applications",* Wiley Publication.
- Christopher M Bishop, *"Neural Networks For Pattern Recognition"* ,Oxford Publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of total 6 questions, each of 20 marks.
2. Only 4 questions need to be solved.
3. Question number 1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.
5. No question should be asked from pre-requisite module

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO7032	Advanced Networking Technologies	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXDLO7032	Advanced Networking Technologies	20	20	20	80	-	--	--	100

Course Pre-requisite: ELX405 Principles of Communication Engineering
ELX602 Computer Communication Network
ELXDLO-2 Wireless Communication

Course Objectives:

The objectives of this course are to:

1. Understand the characteristic features of Various Wireless networks
2. Understand Optical networking and significance of DWDM.
3. Introduce the need for network security and safeguards
4. Understand the principles of network management

Course Outcomes:

On successful completion of the course the students will be able to:

1. Appreciate the need for Wireless networks and study the IEEE 802.11 Standards
2. Comprehend the significance of Asynchronous Transfer Mode(ATM)
3. Understand the features of emerging wireless Networks: Bluetooth Networks,ZIGBEE, WSN
4. Analyze the importance of Optical networking
5. Demonstrate knowledge of network design and security and management
6. Understand the concept of Cloud Computing and its applications.

Module No.	Unit No.	Topics	Hrs.
1.		**Wireless LAN and WAN technologies**	**08**
	1.1	Introduction to Wireless networks : Infrastructure networks, Ad-hoc networks, IEEE 802.11 architecture and services, Medium Access Control sub-layers, CSMA/CA Physical Layer, 802.11 Security considerations .	
	1.2	Asynchronous Transfer Mode (ATM): Architecture, ATM logical connections, ATM	

		cells , ATM Functional Layers, Congestion control and Quality of service	
2.		**Emerging Wireless Technologies**	**10**
	2.1	**Wireless Personnel Area Network(WPAN):** WPAN 802.15.1 architecture ,Bluetooth Protocol Stack, Bluetooth Link Types, Bluetooth Security, Network Connection Establishment in Bluetooth, Network Topology in Bluetooth, Bluetooth Usage Models	
	2.2	802.15.3- Ultra Wide Band , 802.15.4- Zigbee , RFID	
	2.3	**Wireless Sensor Networks: Introduction and Applications,** Wireless Sensor Network Model, Sensor Network Protocol Stack,	
3.0		**Optical Networking**	**08**
	3.1	SONET : SONET/SDH, Architecture, Signal, SONET devices, connections, SONET layers, SONET frames, STS Multiplexing, SONET Networks	
	3.2	DWDM: Frame format, DWDM architecture ,Optical Amplifier , Optical cross connect Performance and design considerations	
4.0		**Network Design, Security and Management**	**10**
	4.1	3 tier Network design layers: Application layer, Access layer, Backbone layers, Ubiquitous computing and Hierarchical computing	
	4.2	Network Security: Security goal, Security threats, security safeguards, firewall types and design.	
	4.3	Network management definitions, functional areas (FCAPS), SNMP,RMON	
5.0		**Routing in the Internet:**	**06**
	5.1	Intra and inter domain Routing, Unicast Routing Protocols: RIP, OSPF, BGP	
	5.2	Multicast Routing Protocols ,Drawbacks of traditional Routing methods	
6.0		**Cloud computing:**	**06**
	6.1	Cloud Computing Evolution, Definition, SPI framework of Cloud Computing, Cloud service delivery models,	
	6.2	Cloud deployment models, key drivers to adoption of cloud, impact of cloud computing on users, examples of cloud service providers: Amazon, Google, Microsoft, Salesforce etc.	
		Total	**48**

Recommended Text Books:

1. Behrouz A. Forouzan, "Data communication and networking ", McGraw Hill Education, Fourth Edition.
2. Darren L. Spohn , "Data Network Design" , McGraw Hill Education ,Third edition
3. William Stallings, "Data and Computer communications", Pearson Education, 10th Edition.
4. Tim Mather , Subra Kumaraswamy & Shahed Latif, "Cloud security & Privacy: an enterprise Perspective", O'Reilly Media Inc.Publishers

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Pearson Ed., 2nd Edition.

2. Vijay Garg ,"Wireless Communication and networking" , Morgan Kaufmann Publishers
3. Carr and Snyder, " Data communication and network security" , McGraw Hill ,1ST edition.
4. Upena Dalal & Manoj Shukla , " Wireless Communication and Networks", Oxford Press
5. Deven Shah , Ambavade, "Advanced Communication Networking"
6. Beherouz A Forouzan , "TCP /IP Protocol Suite" , Tata McGraw Hill Education ,4th edition.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO7033	Robotics	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXDLO7033	Robotics	20	20	20	80	-	--	--	100

Pre-requisite: Applied Mathematics III, Applied Mathematics IV ,Linear Control Systems

Course Objectives:

1. To study basics of robotics
2. To familiarize students with kinematics & dynamics of robots
3 To familiarize students with Trajectory & task planning of robots.
4 To familiarize students with robot vision

Course outcomes:

At the end of completing the course of Robotics, a student will be able to:

1. understand the basic concepts of robotics
2. perform the kinematic and the dynamic analysis of robots
3. perform trajectory and task planning of robots
4. describe importance of visionary system in robotic manipulation

Module	Contents	Hours
1	**Fundamentals of Robotics:** 1.1 Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Languages, Applications.	**04**
2	**Kinematics of Robots:** 2.1 Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation 2.2 Denavit-Hatenberg representation of forward kinematics, Forward and inverse kinematic solutions of three and four axis robot	**10**
3	**Velocity Kinematics & Dynamics:** 3.1 **Differential motions and velocities :** Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities, 3.2 **Dynamic Analysis of Forces :** Lagrangian mechanics, Newton Euler formulation, Dynamic equations of two axis robot	**10**
4	**Trajectory planning:** 4.1 Basics of Trajectory planning , Joint-space trajectory planning, Cartesian-space trajectories	**08**
5	**Robot Vision:** 5.1 Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform, Camera Calibration	**08**
6	**Task Planning:** 6.1 Task level programming, Uncertainty, Configuration Space, Gross motion Planning; Grasp planning, Fine-motion Planning, Simulation of Planer motion, Source and goal scenes, Task planner simulation.	**08**
	TOTAL	**48**

Text- Books :

- Robert Shilling, “Fundamentals of Robotics - Analysis and contro”l, Prentice Hall of India, 2009
- Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

Reference books :

- John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
- Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006
- Mikell P. Groover et.al, ”Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO7034	IC Technology	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELXDLO7034	IC Technology	20	20	20	80	--	--	--	100

Course Pre-requisite:

- ELX302:Electronic Devices and Circuits I
- ELX303:Digital Circuit Design
- ELX603:VLSI Design

Course Objectives:

1. To provide knowledge of IC fabrication processes and advanced IC technologies.
2. To disseminate knowledge about novel VLSI devices and materials.

Course Outcomes:

After successful completion of the course student will be able to

1. Demonstrate a clear understanding of various MOS fabrication processes & CMOS fabrication flow.
2. Design layout of MOS based Circuits.
3. Demonstrate a clear understanding of Semiconductor Measurements & Testing.
4. Understand advanced technologies, Novel Devices and materials in Modern VLSI Technology.

Module No.	Unit No.	Topics	Hrs.
1. 0		**Crystal Growth, Wafer preparation and fabrication for VLSI Technology**	8
	1.1	**Semiconductor Manufacturing:** Semiconductor technology trend, Clean rooms, Wafer cleaning and Gettering.	
	1.2	**Semiconductor Substrate:** Crystal structure, Crystal defects, Czochralski growth, Float Zone growth, Bridgman growth of GaAs, Wafer Preparation and specifications	
2.0		**Fabrication Processes Part 1**	12
	2.1	**Epitaxy:** Classification**,** Molecular Beam Epitaxy	
	2.2	**Silicon Oxidation:** Thermal oxidation process, Kinetics of growth, Properties of	
		Silicon Dioxide, Oxide Quality.	
	2.3	**Device Isolation:** LOCOS, Shallow Trench Isolation (STI).	
	2.4	**Deposition: Physical Vapor Deposition**-Evaporation and Sputtering, **Chemical Vapor Deposition:** APCVD, LPCVD,PECVD	
	2.4	**Diffusion:** Nature of diffusion, Diffusion in a concentration gradient, diffusion Equation, diffusion systems, problems in diffusion.	
	2.5	**Ion Implantation:** Penetration range-Nuclear& Electronic stopping and Range, implantation damage, Annealing-Rapid thermal annealing, ion implantation systems.	
3.0		**Fabrication Process Part 2**	12
	3.1	**Etching &Lithography:** **Etching:** Basic concepts and Classification **Lithography:** Introduction to Lithography process, Types of Photoresist, Types of Lithography: Electron beam, Ion beam and X-ray lithography	
	3.2	**Metallization and Contacts:** Introduction to Metallization, Schottky contacts and Ohmic contacts.	
	3.3	**CMOS Process Flow:** N well, P-well and Twin tub, CMOS Latch Up	
	3.4	Design rules, Layout of MOS based circuits (gates and combinational logic), Buried	

		and Butting Contact	
4.0		**Measurement and Testing**	06
	4.1	**Semiconductor Measurements:** Conductivity type, Resistivity, Hall Effect Measurements, Drift Mobility,	
	4.2	**Testing:** Technology trends affecting testing, VLSI testing process and test	
		equipment, test economics and product quality	
		VLSI Technologies	05
	5.1	**SOI Technology:** SOI fabrication using SIMOX, Bonded SOI and Smart Cut ,PD SOI and FD SOI Device structure and their features	
	5.2	**Advanced Technologies:** low κ and high κ, BiCMOS, HκMG Stack, Strained Silicon.	
	5.3	**GaAs Technologies:** MESFET Technology, MMIC technologies, MODFET	
		Novel Devices and Materials	
	6.1	**Multigate Devices*:***Various multigate device configurations-double gate, triple gate (FinFET) and Gate All Around (Nanowire). **Nanowire:** Concept, VLS method of fabrication, Nanowire FET, Types: Horizontal and Vertical Nanowires, III-V compound Materials in Nanowires.	05
	6.2	**2-D Materials and FET:**Graphene& CNT FET, MOS2 and Black Phosphorous.	
		Total	**48**

Recommended Books:

1. James D. Plummer, Michael D. Deal and Peter B. Griffin, "*Silicon VLSI Technology*", Pearson, Indian Edition.

2. Stephen A. Campbell, "*The Science and Engineering of Microelectronic Fabrication"*, Oxford University Press, 2nd Edition.

3. Sorab K. Gandhi, "*VLSI Fabrication Principles*", Wiley, Student Edition.
4. G. S. May and S. M. Sze, "*Fundamentals of Semiconductor Fabrication*", Wiley, First Edition.

5. Kerry Bernstein and N. J. Rohrer, "*SOI Circuit Design Concepts",* Kluwer Academic Publishers, 1st edition.

6. Jean-Pierre Colinge, "*FinFETs and Other Multigate Transistors",* Springer, 1st edition

7. M. S. Tyagi, "*Introduction to Semiconductor Materials and Devices*", John Wiley and Sons, 1st edition.

8. James E. Morris and KrzysztolIniewski, "*Nanoelectronic Device ApplicationsHandbook*", CRC Press
9. Glenn R. Blackwell, "*The electronic packaging*", CRC Press

10. Michael L. Bushnell and Vishwani D. Agrawal, "*Essentials of Electronic Testing fordigital, memory and mixed-signal VLSI circuits*", Springer

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.
End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Course Code	Course Name	Credits
ILO7011	Product Life Cycle Management	03

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:**Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**ProductDesign:**Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09

03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:**For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:**Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:**Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper.Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", TataMcGrawHill,2006,ISBN:0070636265

Course Code	Course Name	Credits
ILO7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.	08

	System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud	6

	computing model.	
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO7014	**Design of Experiments**	**03**

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08

03	**Two-Level Factorial Designs and Analysis** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs and Analysis** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	**Conducting Tests** 5.1 Testing Logistics 5.2 Statistical aspects of conducting tests 5.3 Characteristics of good and bad data sets 5.4 Example experiments 5.5 Attribute Vs Variable data sets	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Phillip J Ross, "Taguchi Technique for Quality Engineering," McGrawHill
7. Madhav S Phadke, " Quality Engineering using Robust Design," Prentice Hall

Course Code	Course Name	Credits
ILO7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem,	14

	Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime andinformation security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation ofMobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed byMobile Devices, Registry Settings for Mobile Devices, AuthenticationService Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures forHandling Mobile, Devices-Related Security Issues, OrganizationalSecurity Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law	8

	,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	
05	**Indian IT Act.** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security* &*Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication

8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	**Natural Disaster and Manmade disasters:** 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	**Disaster Management, Policy and Administration** 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.	06

	3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
04	**Institutional Framework for Disaster Management in India:** 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	**Financing Relief Measures:** 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control;	10

	Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL701	Instrumentation System Design Laboratory	---	02	---	04	---	---	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELXL701	Instrumentation System Design Laboratory	---	---	---	---	25	25	50

Term Work :-

At least 06 experiments covering entire syllabus of ELX 701 (Instrumentation System Design) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments :-

1. Study of pneumatic single acting & double acting cylinder
2. Study of hydraulic process control valves
3. Design of stepper motor interface & controller
4. Design of instrumentation amplifier for variable voltage gain
5. Design of signal conditioning circuits for LDR / thermistor / RTD / strain gauge
6. Design of linearization circuits for transducers
7. Design of temperature P+I+D controller
8. Tuning of P+I+D controller using MATLAB / Simulink
9. Implementation of PLC ladder diagram for given application
10. Study of SCADA & HMI
11. Designing of data acquisition system (DAS)
12. Simulating a simple process using LabVIEW

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL702	Power Electronics	---	02	---	04	---	---	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELXL702	Power Electronics	---	---	---	---	25	25	50

Term Work :-

At least 06 experiments covering entire syllabus of ELX 702 (Power Electronics) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested List of Experiments

1. Characteristics of SCR, DIAC, TRAIC.
2. Characteristics of IGBT, MOSFET and Power BJT.
3. Firing circuit for SCR using UJT.
4. Study of Half wave and Full wave rectifiers using diodes.

5. Study of Half wave and Full wave controlled rectifiers.
6. Buck converter, Boost converter and Buck-Boost converter.
7. Study of Cycloconverter.
8. Simulation of single phase Half wave and Full wave rectifier circuit.
9. Simulation of controlled rectifier with R and RL load.
10. Simulation of controlled rectifier with (i) Source Inductance (ii) Freewheeling diode.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL703	Digital Signal Processing	---	02	---	04	---	---	04

Course Code	Course Name	Examination Scheme			
		Theory Marks	Term	Oral &	Total

		Internal Assessment (IA)			End Semester Examination	Work	Practical	
		Test I	Test II	Average				
ELXL703	Digital Signal Processing	---	---	---	---	25	25	50

Instructions

1. Minimum 6 experiments and one course project must be submitted by each student.
2. Simulation tools like Matlab/Scilab can be used.
3. Processor based experiments/mini projects can be included.
   The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced

Tentative List of Experiments:

1. Study of Convolution, Series and Parallel Systems
2. Generation of Basic Signals
3. Computation of DFT and it's inverse
4. Computation of FFT and comparison of frequency response of DFT and FFT
5. Computation of DFT
6. IIR Butterworth filter design using IIT technique
7. IIR Chebyshev filter design using BLT technique
8. Design of FIR filter using hamming and hanning window, low pass and high pass filter

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDOLO7031	NEURAL NETWORKS & FUZZY LOGIC	---	02	---	04	---	---	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELXDOLO7031	NEURAL NETWORKS & FUZZY LOGIC	---	---	---	---	25	25	50

Term Work:

The term work shall consist of

1. At least ***six experiments*** using MATLAB Or C/C++ or Java covering the whole of syllabus, duly recorded and graded.
2. ***One seminar and Two assignments*** to be included covering at least 60% of the syllabus.

The distribution of marks for term work shall be as follows:

The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced *The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.*

Suggested List of experiments: using C/C++ or Matlab or java

- Activation functions
- McCulloch Pitts Neuron Model
- Hebbian learning
- Single layer perceptron neural network
- Multi-layer perceptron neural network
- Error Back propagation neural network
- Kohonen Self-organizing Feature Maps
- Associative memory network
- Fuzzy relations
- Defuzzification methods

Suggested List of seminar :

- Classification of upper case and lower case letters.
- Classification of numbers 0-9.
- BPN for training a hidden layer.
- Implement a heteroassociative memory network to implement any pattern.
- Implement discrete Hopfield network for letters A-E.
- Implement BAM for a pattern of 5X3 array.
- Fuzzy Logic controller design – washing machine / vehicle speed control.

Oral Examination:

Oral will be based on any experiment performed from the list of experiment given in the syllabus and the entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXLDLO7032	Advanced Networking Technologies Laboratory	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXLDLO7032	Advanced Networking Technologies Laboratory	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation** on any one of the suggested topics The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced

Suggested Experiments:

1. Evaluation of home/campus network
2. GSM-GPS protocol implementation
3. Bluetooth protocol implementation
4. ZigBee protocol implementation
5. Wi-Fi protocol implementation
6. Study of NMAP
7. Study of SNMP
8. Study of Ethernet.

Suggested topics for presentation:

1. MANET
2. VOFR
3. VOIP
4. X.25
5. Body area network
6. RFID
7. Web Security
8. Compression Techniques
9. Security attacks
10. NAT
11. College campus network

12. Fiber Optics types, advantages disadvantages
13. WSN

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXLDLO7033	Robotics	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXLDLO7033	Robotics	-	-	-	-	25	--	25	50

Term Work:

The term work shall consist of

3. At least ***eight experiments*** using MATLAB / Scilab covering the whole of syllabus, duly recorded and graded.
4. ***Two assignments*** to be included covering at least 60% of the syllabus.

The distribution of marks for term work shall be as follows:

The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced *The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.*

Suggested List of experiments: using Matlab / Scilab

- Forward kinematics
- Inverse kinematic
- Dynamic analysis
- Joint-space trajectory
- Cartesian-space trajectory
- Template matching
- Iterative processing
- Segmentation

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXLDLO7034	IC Technology	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXLDLO7034	IC Technology	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation** on any one of the suggested topics. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced

Suggested Experiments:

Following list of experiments covers the complete syllabus prescribed in IC Technology course. It is formulated in such a way that it allows student to explore various process, layout and device simulation tools. Detail analysis of observations should be recorded in the project book. Tools to be used are Microwind, SUPREME, Electric, Visual TCAD, Mentor Graphics Pyxis and tools available on nanohub. Linux based operating system is preferred to do simulations.

1. Draw and simulate layout for the CMOS inverter. Carry out static as well as transient simulation. Analyze CMOS inverter for i) $(W/L)_{pmos}>(W/L)_{nmos}$ ii) $(W/L)_{pmos}=(W/L)_{nmos}$ iii) $(W/L)_{pmos}<(W/L)_{nmos}$. Do parasitic extraction. Feed these parasitic in circuit simulator and do layout versus schematic verification.

2. Draw and simulate layout for the following circuits. Size them with respect to reference inverter.

   a. CMOS NAND
   b. CMOS NOR

Also observe the effect of different types of design rules on above circuits and tabulate the comparative results.

3. Draw and simulate layout for the given equation (each student will get different equation [$y=\overline{A.B+C.D}$]) with the following design style

   a. Static CMOS
   b. Transmission gate
   c. Dynamic Logic

4. Draw and simulate layout for 6T SRAM cell. Size the SRAM cell for 1) lowest area 2) high reliability

5. Draw and simulate layout for the following circuits.

a. SR latch

b. D flip Flop

6. Simulate oxidation process with Deal-Grove model for different conditions (e.g. oxidation type, orientation, time, temperature, thickness etc.) and comment on the results obtained.

7. Simulate diffusion process for different conditions (e.g. source, time, temperature, dopant etc.) and comment on the results obtained.

8. Simulate Si PN junction for various structure and environmental conditions and comment on the results obtained. Repeat the entire simulation for Ge diode.

9. Simulate MOS capacitor (Classical Simulation) for single gate device for a typical value of fixed charge density and interface trap charge density in gate insulator. Do the AC analysis and comment on the results obtained.

10. Simulate MOS capacitor (Quantum Simulation) for single gate device for a typical value of fixed charge density and interface trap charge density in gate insulator. Do the AC analysis and comment on the results obtained.

Suggested topics for presentation:

Presentation on any Novel device or process.

B.E. (Electronics Engineering) – Semester VIII

`Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX 801	Internet of Things	4	2	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELX 801	Internet of Things	20	20	20	80	-	--	--	100

Course Pre-requisite: ELX 501 :- Micro-controllers and Applications
ELX 601:- Embedded System and RTOS
ELX602:- Computer Communication Network
ELXDLO-2 Wireless Communication

Course Objectives:

The objectives of this course are to:

1. Understand the design features of Internet of Things(IoT)
2. Understand importance of data handling in IoT Way.
3. Introduce multiple way of data communication and networking.
4. Understand design issue in IoT

Course Outcomes:

On successful completion of the course the students will be able to:

1. Understand the concepts of Internet of Things
2. Analyze basic web connectivity in IoT
3. Understand Data handling in IoT
4. Design basic applications based on IoT using specific components

Module No.	Unit No.	Topics	Hrs.
1.		**Introduction to IoT**	**08**
	1.1	**Introduction;**-Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Sources of IoT, and M2MCommunication.	
	1.2	**Iot and M2m:-** IoT/M2M System layers and Design Standardization, Difference between IoT and M2M	
2.		**Network & Communication aspects**	**10**

	2.1	**Design Principles & Web Connectivity:-** Web Communication Protocols for connected devices, Web connectivity using Gateway, SOAP, REST, HTTP, RESTful and WebSockets (Publish –Subscribe),MQTT, AMQP, CoAP Protocols	
	2.2	**Internet Connectivity: -** Internet connectivity, Internet based communication, IP addressing in IoT, Media Access Control, Application Layer Protocols. LPWAN Fundamentals :LORA ,NBIoT,CAT LTE M1,SIGFOX	
3.0		**IoT Platforms and Design Methodology**	**08**
	3.1	**Defining Specifications About:-** Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, (case studies)	
	3.2	**IoT Levels:-**IoT Levels and Deployment Templates	
4.0		**Data Handling in IoT**	**10**
	4.1	**Data Acquiring, Organizing, Processing:-** Data acquiring and storage, Organizing the data, Transactions, Business Processes, Integration and Enterprise Systems, Analytics.	
	4.2	**Data Collection and Storage:-** Cloud Computing Paradigm for Data Collection, storage and computing, Cloud Service Models, Xively Cloud for IoT (AWS ,Google APP engine ,Dweet.IO, Firebase)	
5.0		**Components of IoT**	**06**
	5.1	**Exemplary Devices:-** Raspberry Pi, R-Pi Interfaces, Programming R-Pi, Sensor Technology, Sensor Data Communication Protocols, RFID, WSN Technology, Intel Galileo	
6.0		**IoT Case Studies**	**06**
	6.1	Design Layers, complexity, IoT Applications in Premises, Supply Chain and Customer Monitoring.	
	6.2	Home Automation, Smart Cities, Environment, Agriculture, IoT Printer	
		Total	**48**

Recommended Text Books:

5. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach, Universities Press.
6. Raj Kamal, " Internet of Things: Architecture and Design Principles", McGraw Hill Education ,First edition
7. David Hanes ,Gonzalo salgueiro"IoT Fundamentals Networking Technologies,Protocols and Use Cases for Internet of Things", Cisco Press, Kindle 2017 Edition
8. Andrew Minteer ,"Analytics for the Internet of Things(IoT)",Kindle Edition

Reference Books:

1. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things", Paperback, First Edition
2. Yashavant Kanetkar , Shrirang Korde :Paperback "21 Internet of Things (IOT) Experiments"
    a. BPB Publications

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of thesyllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	T/W Practical	Tutorial	Total
ELX802	Analog and Mixed VLSI Design	04	02	-	04	-	-	04

		Examination Scheme								
		Theory Marks				Exam Duration (Hrs)	Term work	Practical	Oral	Total
		Internal Assessment Marks			End Sem Exam (Marks)					
		Test 1	Test 2	Average						
ELX802	Analog and Mixed VLSI Design	20	20	20	80	03	-	-	-	100

Course Pre-requisite:

- ELX302: Electronic Devices and Circuits I
- ELX303: Digital Circuit Design
- ELX402: Electronic Devices and Circuits II
- ELX504: Design With Linear Integrated Circuits
- ELX603: VLSI Design
- ELX DLO-3: IC Technology

Course Objectives:

1. To teach analysis and design of building blocks of CMOS Analog VLSI Circuits.
2. To highlight the issues associated with the CMOS analog VLSI circuit design.
3. To emphasize upon the issues related to mixed signal layout design.

Course Outcomes:

After successful completion of the course student will be able to

1. Discuss tradeoffs involved in analog VLSI Circuits.
2. Analyze building blocks of CMOS analog VLSI circuits.
3. Design building blocks of CMOS analog VLSI circuits
4. Carry out verifications of issues involved in analog and mixed signal circuits

Module No	Unit No	Topics	Hrs
1. 0		**Analog building blocks**	8
	1.1	Need for CMOS analog and mixed signal designs, MOS Transistor as sampling switch, active resistances, current source and sinks,current mirror.	
	1.2	**Voltage References:** Band Gap References, General Considerations, Supply-independent biasing, Temperature independent references, PTAT	

		current generation and Constant Gm biasing	
2.0		**Amplifier Fundamentals**	
	2.1	**Single Stage Amplifiers**: Basic concepts, Gain Bandwidth (GBW), Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascade stage.	12
	2.2	**Differential Amplifiers:** Single ended and differential operation, Basic differential pair, large signal and small signal behaviours, Common-mode response, Differential pair with MOS loads.	
	2.3	**Noise:** Statistical Characteristics of Noise, Types of Noise, Representation of Noise in circuits, Noise in Single stage amplifiers (CS, CD, CG stages), noise in differential pairs, noise bandwidth, noise figure, noise temperature.	
3.0		**MOS Operational Amplifiers**	
	3.1	**Stability and Frequency Compensation:** General Considerations, Multipole systems, Phase margin, Frequency compensation, compensation of two stage op- amps	8
	3.2	**Op-amp Design:** General Considerations, performance parameters, One-stage op- amps, Two-stage op-amps, Gain Boosting, Common-mode feedback, Input range limitations(ICMR), Slew Rate, Power supply rejection, Noise in op-amps. Design of single ended and double ended two stage Op-amps	
4.0		**Mixed Signal Circuits**	
	4.1	**Basic Concepts:** AMS design flow, ASIC, Full custom design, Semi-custom design, System on Chip, System in package, Hardware software co-design, and mixed signal layout issues.	8
	4.2	**Oscillators:** General considerations, Ring oscillators, LC oscillators, VCO,	
	4.3	**Phase-Locked Loop:** Simple PLL, Charge pump PLL, Non-ideal effects in PLL, Delay locked loops and applications of PLL in integrated circuits	
5.0		**Data Converter Fundamentals**	
	5.1	**Switch Capacitor Circuits:** MOSFETs as switches, Speed considerations, Precision Considerations, Charge injection cancellation, Unity gain buffer, Non- inverting amplifier and integrator.	4
	5.2	Basic CMOS comparator Design, Adaptive biasing, Analog multipliers.	
6.0		**Data Converter Fundamentals and Architectures**	
	6.1	**Fundamentals:** Analog versus discrete time signals, converting analog signals to data signals, sample and hold characteristics. DAC specifications, ADC specifications.	8
	6.2	**DAC architectures:** Digital input code, resistors string, R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC **ADC architectures:** Flash, Two Step Flash, Pipeline ADC, Integrating ADCs, Successive approximation ADCs	
		Total	**48**

Recommended Books:

1. B Razavi, "*Design of Analog CMOS Integrated Circuits*", Tata McGraw Hill, 1st Edition.
2. R. Jacaob Baker, Harry W. Li, David E. Boyce, "*CMOS Circuit Design, Layout, and Simulation*", Wiley, Student Edition
3. P. E. Allen and D. R. Holberg, "*CMOS Analog Circuit Design*", Oxford University Press, 3rd Edition.
4. Gray, Meyer, Lewis, Hurst, "*Analysis and design of Analog Integrated Circuits*", Willey, 5th Edition

Internal Assessment (IA)

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX DLO8041	Advanced Power Electronics	04	02	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours				
		Test 1	Test 2	Avg of Test 1 and Test 2						
ELX DLO8041	Advanced Power Electronics	20	20	20	80	03	--	--	--	100

Course Pre-requisite:

4. Power Electronics.
5. Linear Control System.
6. BEE

Course Objectives:

3. To enhance the ideas of students for more complex power electronic system.
4. To teach the analytical methods in power electronic systems.
5. To expose the students to various applications of power electronics in electronics equipment, drives and non-conventional energy systems.

Course Outcomes:

After successful completion of the course students will be able to:

1. Thoroughly understand the modern methods of analysis and control of power electronic systems.
2. Carry out the theoretical analysis of the power electronic systems from the 'Systems Theory' point of view.
3. Appreciate the ubiquity of power electronic systems in engineering fields.
4. Simulate and analyse power electronic systems.

Module No.	Unit No.	Contents	Hrs.
1		**Three-phase Rectifiers**	8
	1.1	3-phase half-wave and full-wave controlled rectifiers with R and RL load, Effect of source inductance,	
	1.2	Distortion in line current, calculation of performance parameters.	
2		**Three-phase inverters and control**	8
	2.1	Three phase bridge inverters (120° and 180° conduction mode) with R and RL load	
	2.2	PWM for 3-phase voltage source inverters, Space Vector Modulation (SVM) technique for 3-phase voltage source inverters, hysteresis control.	
3		**DC-DC Converters**	10
	3.1	Average model, linearized and transfer function models, state-space average models of basic buck, boost and buck-boost converters.	
	3.2	Feedback control of these converters (PI and PID).	
4		**Power Electronic Applications in DC Drives**	8
	4.1	Introduction to DC motors, speed control of DC motor, drives with semi converters, full converters and dual converters.	
	4.2	Chopper-based drive.	
	4.3	Electric braking of DC motors.	
5		**Power Electronic Applications in AC Drives**	10
	5.1	Introduction to three-phase induction motor, speed control methods for three-phase induction motor : i) Stator voltage ii) Variable frequency iii) Rotor resistance iv) V/f control v) Slip power recovery schemes	
6		**Power Electronic Applications**	4
	6.1	Induction heating, dielectric heating, solid state relays,	

	6.2	Energy conversion interface in renewable energy system.	
Total			**48**

Recommended Books:

1. M. Rashid, Power Electronics: Circuits, Devices, and Applications, PHI, 3rd Edition.
2. R. W. Erickson, D. Maksimovic, Fundamentals of Power Electronics, Springer, 2nd Edition.
3. Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design, Wiley (Student Edition), 2nd Edition.
4. P. S. Bimbhra, Power Electronics, Khanna Publishers, 2012.
5. M. D. Singh, K. B. Khanchandani, Power Electronics, Tata McGraw Hill, 2nd Edition.
6. J. P. Agrawal, Power Electronics Systems: Theory and Design, Pearson Education, 2002.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX DLO8042	MEMS Technology	04	02	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours				
		Test 1	Test 2	Avg of Test 1 and Test 2						
ELX DLO8042	MEMS Technology	20	20	20	80	03	--	--	--	100

Course Pre –requisite: VLSI Design an IC Technology

Course Objectives:

1. To provide knowledge of MEMS processing steps and processing modules
2. To provide knowledge of MEMS Materials with respect to applications.
3. To demonstrate the use of semiconductor based processing modules used in the fabrication of variety of sensors and actuators (e.g. pressure sensors, accelerometers, etc.) at the micro-scale.
4. To provide an understanding of basic design and operation of MEMS sensors, actuators and structures.

Course Outcomes:

1. Understand the underlying fundamental principles of MEMS devices including physical operation and material properties.
2. Design and simulate MEMS devices using standard simulation tools.
3. Develop different concepts of micro system sensors and actuators for real-world applications.
4. Understand the rudiments of Micro-fabrication techniques.

Module No.	Unit No.	Contents	Hrs.
1		**Introduction to MEMS**	4
	1.1	Introduction to MEMS, Comparison with Micro Electronics Technology,	
	1.2	Real world examples (Air-Bag, DMD, Pressure Sensors), MEMS Challenges, MEMS Sensors in Internet of Things (IoT), Bio-medical applications	
2		**MEMS Materials and Their Properties**	8
	2.1	Materials (eg. Si, SiO_2, SiN, SiC, Cr, Au, Al, Ti, SU8, PMMA, Pt)	
	2.2	Important properties: Young modulus, Poisson's ratio, density, piezoresistive coefficients, TCR, Thermal Conductivity, Material Structure.	
3		**MEMS Sensors, Actuators and Structures**	8
	3.1	MEMS Sensing (Capacitive, Piezo electric Piezo resistive)	
	3.2	Micro Actuation Techniques (Thermal, Piezo electric, Electro static, Shape Memory Alloys, **LORENTZ FORCE ACTUATION**), Micro Grippers, Micro Gears, Micro Motors, Micro Valves, Micro Pumps.	
4		**MEMS Fab Processes**	10
	4.1	MEMS Processes & Process parameters: Bulk & Surface Micromachining, High Aspect Ratio Micro	
	4.2	Machining (LIGA, Laser), X-Ray Lithography, Photolithography, PVD techniques, Wet, Dry, Plasma	
	4.3	etching, DRIE, Etch Stop Techniques. Die, Wire & Wafer Bonding, Dicing, Packaging(with Metal	
5		**MEMS Devices**	12
	5.1	Architecture, working and basic behaviour of Cantilevers, Micro heaters, Accelerometers, Pressure Sensor types, Micromirrors in DMD, Inkjet printer-head. Steps involved in Fabricating above devices	
6		**MEMS Device Characterization**	6

	6.1	Piezo-resistance, TCR, Stiffness, Adhesion, Vibration, Resonant frequency, & importance of these measurements in studying device behavior	
	6.2	MEMS Failure Mechanisms and Reliability.	
Total			**48**

Recommended Books:

1. MEMS and MICROSYSTEMS Design and Manufacture by Tai Ran Hsu : McGraw Hill Education
2. An Introduction to Micro-electromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc
3. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill
4. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing
5. Micro-system Design - by S. Senturia; Publisher: Springer
6. Analysis and Design Principles of MEMS Devices - MinhangBao; Publisher: Elsevier Science
7. Fundamentals of Micro-fabrication - by M. Madou; Publisher: CRC Press; 2 edition
8. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4.Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO 8043	Virtual Instrumentation	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELXDLO8043	Virtual Instrumentation	20	20	20	80	-	-	100

Rationale :- Virtual instrumentation combines mainstream commercial technologies such as the PC, with flexible software and a wide variety of measurement hardware, so one can create user-defined systems that meet their exact application needs. Virtual instrumentation has led to a simpler way of looking at measurement systems. Instead of using several stand-alone instruments for multiple measurement types and performing rudimentary analysis by hand, engineers now can quickly and cost-effectively create a system equipped with analysis software and a single measurement device that has the capabilities of a multitude of instruments for various applications & measurements.

Course Objectives :-

1. To understand virtual instrumentation (VI) & to realize its architecture

2. To familiarize with VI software & learn programming in VI

3. To study various instruments interfacing & data acquisition methods

4. To understand various analysis tools & develop programs for different measurement applications

Course Outcomes :-

At the end of the course, students should gain the ability to :-

- **CO-1 :-** Explain the concepts of virtual instrumentation
- **CO-2 :-** Select the proper data acquisition hardware
- **CO-3 :-** Configure the data acquisition hardware using LabVIEW
- **CO-4 :-** Use LabVIEW to interface related hardware like transducers
- **CO-5 :-** Design virtual instruments for practical applications

Module No.	Topics	Hours
1	**INTRODUCTION TO VIRTUAL INSTRUMENTATION (VI)**	06
1.1	Historical perspective – Need for VI – Advantages of VI – Definition of VI – Block diagram & architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming	
2	**PROGRAMMING TECHNIQUES**	08
2.1	VI & sub-VI – Loops & charts – Arrays – Clusters – Graphs – Case & sequence structures – Formula nodes – Local & global variables – String & files inputs	
3	**APPLICATION DEVELOPMENT SOFTWARE (LabVIEW)**	10
3.1	Creating virtual instrument in LabVIEW – Implementing dataflow programming in LabVIEW – VI, sub-VI & modular code creation in LabVIEW – Arrays & file I/O in LabVIEW – Textual math integration in LabVIEW – Interfacing external instruments to PC using LabVIEW	
4	**DATA ACQUISITION BASICS**	08
4.1	Digital I/O – Counters & timers – PC hardware structure – Timing – Interrupts – DMA – Software & hardware installation – IEEE GPIB 488 concepts – Embedded system buses – PCI – EISA – CPCI	
5	**COMMON INSTRUMENT INTERFACES**	08
5.1	Current loop – RS 232C / RS 485 – Interface basics – USB – PCMCIA – VXI – SCXI – PXI – Networking basics for office & industrial application VISA & IVI – Image acquisition & process – Motion control – Digital multimeter (DMM) – Waveform generator	
6	**USING ANALYSIS TOOLS & APPLICATION OF VI**	08
6.1	Fourier transform – Power spectrum – Correlation method – Windowing & filtering – Pressure control system – Flow control system – Level control system – Temperature control system – Motion control employing stepper motor – PID controller toolbox	
1 – 6	**TOTAL**	48

Recommended Books :-

1. Dr. Sumathi S. & Surekha P, LabVIEW Based Advanced Instrumentation System, PHI, 2nd edition (2007)
2. Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, 2nd edition (2006)
3. Lisa K. Wells & Jeffrey Travis, LabVIEW for Everyone, PHI, 3rd edition (2009)

4. Robert H. Bishop, Learning with LabVIEW 7 Express, Pearson Education, 1st edition (2005)
5. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI, 2nd edition (2010)

Internal Assessment (IA) :-

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination :-

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. The students need to solve total 4 questions.

3. Q.1 will be compulsory and based on entire syllabus.

4. Remaining questions (Q.2 to Q.6) will be set from all modules.

5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO 8044	Digital Image Processing	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Examination			
		Test I	Test II	Average				
ELXDLO 8044	Digital Image Processing	20	20	20	80	-	-	100

Course Pre-requisite:

- Applied Mathematics
- Signals and Systems

Course Objectives:

1. To learn the fundamental concepts of Digital Image Processing through basic spatial and frequency domain techniques.
2. To learn Image Compression and Decompression Techniques and compression standards.

Course Outcomes:

After successful completion of the course student will be able to

1. Understand the fundamentals of Digital Image representation and simple pixel relations.
2. Explain spatial domain and frequency domain techniques for digital image enhancement.
3. Perform segmentation and morphological operations.
4. Apply compression and decompression techniques to different digital images.

Module No.	Unit No.	Topics	Hrs.
1		**Digital Image Processing Fundamentals**	04
	1.1	**Introduction:** Background, Representation of a Digital Image, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System	
	1.2	**Digital Image Fundamentals:** Elements of Visual Perception, A Simple Image Model, Two dimensional Sampling and Quantization, Tonal and Spatial Resolutions, Some Basic Relationships between Pixels, Image File Formats : BMP, TIFF and JPEG. Color Models (RGB, HSI, YUV)	
2		**Image Enhancement in Spatial Domain**	08
	2.1	Enhancement in the spatial domain: Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Spatial domain filters: Smoothing Filters, Sharpening Filters,High boost filter	
3		**Image Segmentation and Representation**	08
	3.1	Detection of Discontinuities, Edge Linking using Hough Transform, Thresholding, Region based Segmentation, Split and Merge Technique	
	3.2	Image Representation and Description, Chain Code, Polygonal Representation, Shape Number, Two Dimensional Moments.	
4		**Binary Image Processing**	06
	4.1	Binary Morphological Operators, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation, Boundary Extraction, Region Filling, Thinning and Thickening, Medial Axis Transform, Connected Component Labeling	
5		**Image Transforms and frequency domain processing**	12
	5.1	Introduction to 2 Dimensional Fourier Transform, Discrete Fourier Transform, Properties of the Two-Dimensional Fourier Transform, Fast Fourier Transform(FFT), Computation of 2 DFFT	
	5.2	Discrete Hadamard Transform(DHT), Fast Hadamard Transform(FHT), Discrete	

		Cosine Transform(DCT), Introduction to Discrete Wavelet Transform (DWT)	
	5.3	Enhancement in the frequency domain: Frequency Domain Filtering Lowpass Filtering, Highpass Filtering, Homomorphic Filtering, Generation of Spatial Masks from Frequency Domain Specifications	
6		**Image Compression:**	10
	6.1	Fundamentals :Coding Redundancy, Interpixel Redundancy, Psycho visual	
		Redundancy	
	6.2	Image Compression Models :The Source Encoder and Decoder, Lossless	
		Compression Techniques : Run Length Coding, Arithmetic Coding, Huffman	
		Coding, Differential PCM,	
	6.3	Lossy Compression Techniques: Predictive Coding, Delta modulation, Improved Gray Scale Quantization, Transform Coding, JPEG, MPEG-1. , Fidelity Criteria.	
Total			**48**

Text Books:

1. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,
2. Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition

Reference Books:

1. S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,
2. Milan Sonka, Vaclav Hlavac, and Roger Boyle, "Image Processing, Analysis, and Machine Vision", Second Edition, Thomson Learning, 2001
3. William K. Pratt, "Digital Image Processing", Third Edition, John Wiley & Sons, Inc., 2001

Internal Assessment (IA) :-

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination :-

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. The students need to solve total 4 questions.

3. Q.1 will be compulsory and based on entire syllabus.

4. Remaining questions (Q.2 to Q.6) will be set from all modules.

5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

e Code	Course Name	Credits
ILO8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM,	8

	GANTT chart. Introduction to Project Management Information System (PMIS).	
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	8
06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Credits
ILO8022	**Finance Management**	**03**

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis;	09

	Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO8023	Enterpreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc.,	08

	Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ILO8024	**Human Resource Management**	**03**

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-	7

	making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	10

	Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship	08

	Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ILO8026	**Research Methodology**	**03**

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**

03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2^{nd}ed), Singapore, Pearson Education

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:**Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method	07

	of getting a patent	
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignments on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books

9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
ILO8028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06

3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL 801	Internet of Things Laboratory	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXL 801	Internet of Things Laboratory	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation on case study.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested Experiments:
(Programming using C, Embedded C, Pyhton is to be encouraged)

1. Minimum two Experiments using any hardware platform (Arduino/Raspberry Pi/BeagleBone/Galileo) for data handling and storage.
2. Minimum three experiments using any hardware platform (Arduino/Raspberry Pi/BeagleBone/Galileo) for interfacing various sensors and communicating data using Internet using various Protocols.
3. Minimum two experiments using any hardware platform (Arduino/Raspberry Pi/BeagleBone/Galileo) and wireless communication protocol (802.11 and 802.14.5 IEEE standard)
4. Minimum one experiment using Cloud Storage.

Suggested topics for Case Study:
Faculty members can suggest topics pertaining above syllabus and ask students to submit complete report covering design issues, hardware and software details and applications.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL 802	Analog and Mixed VLSI Design	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXL 802	Analog and Mixed VLSI Design	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation on case study.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested Experiments:

Use of Online Tools to study analog VLSI circuits

2. Analysis of MOSFETs for analog performance

3. Design and simulate various types of current mirror circuits

4. Design and simulate various common source amplifier circuits

5. Design and simulate various types of single stage amplifiers

6. Design and simulate differential amplifier

7. Design and simulate operational tran-sconductance amplifier

8. Design and simulate switch capacitor circuits

9. Design and simulate various types of oscillators

10. Design and simulate mixed mode circuit

11. Generate layout for the simple and cascode current mirror

12. Generate layout for common source amplifier

13. Generate layout for the differential amplifier

14. Generate layout for the Oscillator

15. Generate layout for Phase Detector

Suggested topics for Case Study:
Faculty members can suggest topics pertaining above syllabus and ask students to submit proper report covering the latest advances in the field of Mixed VLSI Design.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO 8041	Advanced Power Electronics Lab.	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXDLO 8041	Advanced Power Electronics Lab.	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation on case study.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested Experiments:

1. Single Phase Full Controlled Bridge Rectifier.
2. Speed control of Separately excited DC motor using Armature Voltage Control
3. Speed control of 3-phase Induction Motor using V/F control.
4. Simulation of 3-phase fully controlled Bridge rectifier with R and RL load.
5. Simulation of 1-phase fully controlled Bridge rectifier and study of various parameters.
6. Simulation of 1-phase Inverter and study of various Performance parameters.
7. Simulation of SVM Inverter.
8. Simulation of Closed loop dc-dc converter
9. Study High Frequency Induction heating & Dielectric heating.
10. Study of operation and control of solid state relays.

Suggested topics for Case Study:

Faculty members can suggest topics pertaining above syllabus and ask students to submit complete report covering design issues, hardware and software details and applications.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO 8042	MEMS Technology Lab.	-	2	--	-	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELXDLO 8042	MEMS Technology Lab.	-	-	-	-	25	--	25	50

Course Objectives:

Lab session includes **seven experiments plus one presentation on case study.** The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Suggested Experiments:

1. Design electro-statically actuated cantilever
2. Design bimorph cantilever which act as pressure sensor.
3. Dynamic analysis of Beam
4. Find the tip deflection of the cantilever with different types of load
5. Find the tip deflection of the cantilever in sweep analysis
6. Model and simulate Electro-mechanical actuator. Do dc and transient analysis
7. Design the geometry of MEMS and find performance characteristics such as resonant frequency, deflection per voltage or temperature
8. Simulate the harvested electrical power from mechanical vibrations using piezoelectric cantilever beam
9. Model and simulate of accelerometer
10. Case study of MEMS based device

Suggested topics for Case Study:
Faculty members can suggest topics pertaining above syllabus and ask students to submit complete report covering fabrication issues, materials, characterization and applications of the MEMS devices.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO8043	Virtual Instrumentation Laboratory	--	02	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Exam			
		Test I	Test II	Average				
ELXDLO8043	Virtual Instrumentation Laboratory	--	--	--	--	25	25	50

Term Work :-

At least 6 experiments covering entire syllabus of ELXDLO8043 (Virtual Instrumentation) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. One presentation on a case study based on the topic in Virtual Instrumentation need to be submitted. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced

Suggested List of Experiments :-

1. Verification of arithmetic operations
2. Verification of Boolean Expressions / half-adder & full-adder
3. Implementation of array functions
4. Program to convert Celsius into Fahrenheit & vice-versa
5. Program for implementing seven segment display
6. Program for calculating body mass index (BMI) using cluster

7. Program to control temperature using thermistor / RTD & DAQ
8. Program to control liquid flow using DAQ
9. Program to control liquid level using DAQ
10. Program to control pressure using DAQ
11. Program for DC motor speed control using PID toolbox

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXDLO8044	Digital Image Processing	--	02	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal Assessment (IA)			End Semester Exam			
		Test I	Test II	Average				
ELXDLO8044	Digital Image Processing	--	--	--	--	25	25	50

Term Work :-

At least 7 experiments covering entire syllabus of ELXDLO8044 (Digital Image Processing) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. One presentation on a case study based on the topic in Digital Image Processing need to be submitted. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. The Term work assessment can be carried out based on the different tools and the rubrics decided by the concerned faculty members and need to be conveyed to the students well in advanced.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL704 ELXL803	Project I Project II	-	06 12	--	-	03 06	--	09

Objectives:

1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
2. To familiarize the process of problem solving in a group
3. To acquaint with the process of applying basic engineering fundamental in the domain of practical applications
4. To inculcate the process of research Outcomes

Outcome:

Learner will be able to:

1. Do literature survey/industrial visit and identify the problem
2. Apply basic engineering fundamental in the domain of practical applications
3. Cultivate the habit of working in a team
4. Attempt a problem solution in a right approach
5. Correlate the theoretical and experimental/simulations results and draw the proper inferences
6. Prepare report as per the standard guidelines.

Students should do literature survey/visit industry/analyse current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by experimental/simulation methods. The solution is to be validated with proper justification and the report needs to be compiled in standard format.

Guidelines for Assessment of Project I

Project I should be assessed based on following points

a) Quality of problem selected
b) Clarity of Problem definition and Feasibility of problem solution
c) Relevance to the specialization
d) Clarity of objective and scope
e) Breadth and depth of literature survey

Project I should be assessed through a presentation by the student project group to a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Project II

Project II should be assessed based on following points

a) Quality of problem selected
b) Clarity of Problem definition and Feasibility of problem solution
c) Relevance to the specialization / Industrial trends
d) Clarity of objective and scope
e) Quality of work attempted
f) Validation of results
g) Quality of Written and Oral Presentation

Project Report has to be prepared strictly as per University of Mumbai report writing guidelines. Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiner approved by the University of Mumbai Students should be motivated to publish a paper in Conferences/students competitions based on the work

UG: Computer Engineering

Sr No	Subject Code	Subject Name	Count
1	CSC303, CSL301	Data Structure, Data Structure Lab	2
2	CSC304, CSL302	Digital Logic & Computer Architecture, Digital Logic & Computer Architecture Lab	2
3	CSC305, CSL303	Computer Graphics, Computer Graphics Lab	2
4	CSL304	Skill base Lab course: Object Oriented Programming with Java	1
5	CSM301	Mini Project – 1 A	1
6	CSC402, CSL401	Analysis of Algorithm, Analysis of Algorithm Lab	2
7	CSC403, CSL402	Database Management System, Database Management System Lab	2
8	CSC404, CSL403	Operating System, Operating System Lab	2
9	CSC405, CSL404	Microprocessor, Microprocessor Lab	2
10	CSL405	Skill Base Lab Course: Python Programming	1
11	CSM401	Mini Project 1-B	1
12	CSC501, CSL501	Microprocessor, Microprocessor Lab	2
13	CSC502, CSL503	Database Management System, Database & Info. System Lab	2
14	CSC503, CSL502	Computer Network, Computer Network Lab	2
15	CSC504	Theory of Computer Science	1
16	CSL504	Web Design Lab	1
17	CSC601, CSL601	Software Engineering, Software Engineering Lab	2
18	CSC602, CSL602	System Programming & Complier Construction, System software Lab	2

19	CSC603, CSL603	Data Warehousing & Mining, Data Warehousing & Mining Lab	2
20	CSC604, CSL604	Cryptography & System Security, System Security Lab	2
21	CSP605	Mini-Project	1
22	CSC701, CSL701	Digital Signal & Image Processing, Digital Signal & Image Processing Lab	2
23	CSC702, CSL702	Mobile Communication & Computing, Mobile App. Development. Tech. Lab	2
24	CSC703, CSL703	Artificial Intelligence & Soft Computing, Artificial Intelligence & Soft Computing Lab	2
25	CSL704	Computational Lab-I	1
26	CSP705	Major Project-I	1
27	CSC801, CSL801	Human Machine Interaction, Human Machine Interaction Lab	2
28	CSC802, CSL802	Distributed Computing, Distributed Computing Lab	2
29	CSL803	Cloud Computing Lab	1
30	CSL804	Computational Lab-II	1
31	CSP805	Major Project-II	1
		Total	**50**

AC: 23/7/2020

Item No. 127

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Computer Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC: 23/7/2020
Item No. 127

UNIVERSITY OF MUMBAI

Syllabus for Approval

Date

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year B.E. Computer Engineering**
2	Eligibility for Admission	**After Passing First Year Engineering as per the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	**New** / ~~Revised~~ (Strike out which is not applicable)
9	To be implemented from Academic Year	**With effect from Academic Year: 2020-2021**

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability.
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Board of Studies in Computer Engineering

Prof. Sunil Bhirud : Chairman

Prof. Madhumita Chatterjee : Member

Prof. Sunita Patil : Member

Prof. Leena Raga : Member

Prof. Subhash Shinde : Member

Prof. Meera Narvekar : Member

Prof. Suprtim Biswas : Member

Prof. Sudhir Sawarkar : Member

Prof. Dayanand Ingle : Member

Prof. Satish Ket : Member

Program Structure for Second Year Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC301	Engineering Mathematics-III	3	--	1*	3	--	1	4
CSC302	Discrete Structures and Graph Theory	3	--	--	3	--	--	3
CSC303	Data Structure	3	--	--	3	--	--	3
CSC304	Digital Logic & Computer Architecture	3	--	--	3	--	--	3
CSC305	Computer Graphics	3	--	--	3	--	--	3
CSL301	Data Structure Lab	--	2	--	--	1	--	1
CSL302	Digital Logic & Computer Architecture Lab	--	2	--	--	1	--	1
CSL303	Computer Graphics Lab	--	2	--	--	1	--	1
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	2+2*	--	--	2	--	2
CSM301	Mini Project – 1 A	--	4$	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**07**	**1**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg					
CSC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
CSC302	Discrete Structures and Graph Theory	20	20	20	80	3	--	--	100
CSC303	Data Structure	20	20	20	80	3	--	--	100
CSC304	Digital Logic & Computer Architecture	20	20	20	80	3	--	--	100
CSC305	Computer Graphics	20	20	20	80	3	--	--	100
CSL301	Data Structure Lab	--	--	--	--	--	25	25	50
CSL302	Digital Logic & Computer Architecture Lab	--	--	--	--	--	25	--	25
CSL303	Computer Graphics Lab	--	--	--	--	--	25	25	50
CSL304	Skill base Lab course: Object Oriented Programming with Java	--	--	--	--	--	50	25	75
CSM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**175**	**100**	**775**

*Should be conducted batch wise and

$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups

Program Structure for Second Year Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CSC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4
CSC402	Analysis of Algorithm	3	--	--	3	--	--	3
CSC403	Database Management System	3	--	--	3	--	--	3
CSC404	Operating System	3	--	--	3	--	--	3
CSC405	Microprocessor	3	--	--	3	--	--	3
CSL401	Analysis of Algorithm Lab	--	2	--	--	1	--	1
CSL402	Database Management System Lab	--	2	--	--	1	--	1
CSL403	Operating System Lab	--	2	--	--	1	--	1
CSL404	Microprocessor Lab	--	2	--	--	1	--	1
CSL405	Skill Base Lab Course: Python Programming	--	2*+2	--	--	2	--	2
CSM401	Mini Project 1-B	--	4$	--	--	2	--	2
Total		**15**	**16**	**1**	**15**	**7**	**1**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
CSC402	Analysis of Algorithm	20	20	20	80	3	--	--	100
CSC403	Database Management System	20	20	20	80	3	--	--	100
CSC404	Operating System	20	20	20	80	3	--	--	100
CSC405	Microprocessor	20	20	20	80	3	--	--	100
CSL401	Analysis of Algorithm Lab	--	--	--	--	--	25	25	50
CSL402	Database Management System Lab	--	--	--	--	--	25	25	50
CSL403	Operating System Lab	--	--	--	--	--	25	25	50
CSL404	Microprocessor Lab	--	--	--	--	--	25	--	25
CSL405	Skill Base Lab Course: Python Programming	--	--	--	--	--	25	--	25
CSM401	Mini Project 1-B	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**175**	**100**	**775**

*Should be conducted batchwise and

$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four), Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Credits
CSC301	Engineering Mathematics-III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II	
Course Objectives: The course aims:	
1	To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2	To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills.
3	To understand the concept of complex variables, C-R equations with applications.
4	To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
5	To understand some advanced topics of probability, random variables with their distributions and expectations.
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2	Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3	Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
4	Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
6	Understand the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.

Module		Detailed Contents	Hours
1	**Laplace Transform**		7
	1.1	Definition of Laplace transform, Condition of Existence of Laplace transform.	
	1.2	Laplace Transform (L) of standard functions like $e^{at}, sin(at), cos(at), sinh(at), cosh(at)$ and $t^n, n \geq 0$.	
	1.3	Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, Change of Scale, Multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof).	
	1.4	Evaluation of real improper integrals by using Laplace Transformation.	
	1.5	**Self-learning Topics:** Laplace Transform: Periodic functions, Heaviside's Unit Step function, Dirac Delta Function, Special functions (Error and Bessel)	
2	**Inverse Laplace Transform**		7
	2.1	Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, Inverse Laplace transform using derivatives.	
	2.2	Partial fractions method to find Inverse Laplace transform.	
	2.3	Inverse Laplace transform using Convolution theorem (without proof)	
	2.4	**Self-learning Topics:** Applications to solve initial and boundary value	

		problems involving ordinary differential equations.	
3	**Fourier Series:**		7
	3.1	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	
	3.2	Fourier series of periodic function with period 2π and $2l$.	
	3.3	Fourier series of even and odd functions.	
	3.4	Half range Sine and Cosine Series.	
	3.5	**Self-learning Topics:** Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms.	
4	**Complex Variables:**		7
	4.1	Function *f(z)*of complex variable, Limit, Continuity and Differentiability of*f(z)*, Analytic function: Necessary and sufficient conditions for *f(z)* to be analytic (without proof).	
	4.2	Cauchy-Riemann equations in Cartesian coordinates (without proof).	
	4.3	Milne-Thomson method: Determine analytic function *f(z)*when real part (u), imaginary part (v) or its combination (u+v / u-v) is given.	
	4.4	Harmonic function, Harmonic conjugate and Orthogonal trajectories.	
	4.5	**Self-learning Topics:** Conformal mapping, Linear and Bilinear mappings, cross ratio, fixed points and standard transformations.	
5	**Statistical Techniques**		6
	5.1	Karl Pearson's coefficient of correlation (r)	
	5.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	
	5.3	Lines of regression	
	5.4	Fitting of first- and second-degree curves.	
	5.5	**Self-learning Topics:** Covariance, fitting of exponential curve.	
6	**Probability**		6
	6.1	Definition and basics of probability, conditional probability.	
	6.2	Total Probability theorem and Bayes' theorem.	
	6.3	Discrete and continuous random variable with probability distribution and probability density function.	
	6.4	Expectation, Variance, Moment generating function, Raw and central moments up to 4^{th} order.	
	6.5	**Self-learning Topics:** Skewness and Kurtosis of distribution (data).	

References:	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication.
4	Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
5	Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
6	Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Term Work:	
General Instructions:	
1	Batch wise tutorials have to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows:		
1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

Assessment:	
Internal Assessment Test:	
The assessment consists of two class tests of 20 marks each. The 1stclass test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Course Code	Course Name	Credits
CSC302	Discrete Structures and Graph Theory	3

Pre-requisite: Basic Mathematics	
Course Objectives: The course aims:	
1	Cultivate clear thinking and creative problem solving.
2	Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3	To apply graph theory in solving practical problems.
4	Thoroughly prepare for the mathematical aspects of other Computer Engineering courses
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2	Ability to reason logically.
3	Ability to understand relations, functions, Diagraph and Lattice.
4	Ability to understand and apply concepts of graph theory in solving real world problems.
5	Understand use of groups and codes in Encoding-Decoding
6	Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions

Module	Detailed Contents		Hours
1	**Logic**		6
	1.1	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	
2	**Relations and Functions**		**6**
	2.1	Basic concepts of Set Theory	
	2.2	**Relations:** Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	
	2.3	**Function**s: Definition, Types of functions, Composition of functions, Identity and Inverse function	
3	**Posets and Lattice**		**5**
	3.1	Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice	
4	**Counting**		**6**
	4.1	Basic Counting Principle-Sum Rule, Product Rule, Inclusion-Exclusion Principle, Pigeonhole Principle	
	4.2	Recurrence relations, Solving recurrence relations	
5	**Algebraic Structures**		**8**
	5.1	**Algebraic structures with one binary operation:** Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism	
	5.2	**Algebraic structures with two binary operations:** Ring	
	5.3	**Coding Theory**: Coding, binary information and error detection, decoding and error correction	
6	**Graph Theory**		**8**
		Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex,	

		Applications.	

Textbooks:	
1	Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.
2	C. L. Liu "Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company. Reprinted 2000.
3	K. H. Rosen, "Discrete Mathematics and applications", fifth edition 2003, Tata McGraw Hill Publishing Company
References:	
1	Y N Singh, "Discrete Mathematical Structures", Wiley-India.
2	J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India.
3	J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publishing Company
4	Seymour Lipschutz, Marc Lars Lipson, "Discrete Mathematics" Schaum"s Outline, McGraw Hill Education.
5	Narsing Deo, "Graph Theory with applications to engineering and computer science", PHI Publications.
6	P. K. Bisht, H. S. Dhami, "Discrete Mathematics", Oxford press.

Assessment:	
Internal Assessment Test:	
The assessment consists of two class tests of 20 marks each. The 1st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 40% syllabus is completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Useful Links	
1	https://www.edx.org/learn/discrete-mathematics
2	https://www.coursera.org/specializations/discrete-mathematics
3	https://nptel.ac.in/courses/106/106/106106094/
4	https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Credit
CSC303	Data Structure	03

Pre-requisite: C Programming	
Course Objectives: The course aims:	
1	To understand the need and significance of Data structures as a computer Professional.
2	To teach concept and implementation of linear and Nonlinear data structures.
3	To analyze various data structures and select the appropriate one to solve a specific real-world problem.
4	To introduce various techniques for representation of the data in the real world.
5	To teach various searching techniques.
Course Outcomes:	
1	Students will be able to implement Linear and Non-Linear data structures.
2	Students will be able to handle various operations like searching, insertion, deletion and traversals on various data structures.
3	Students will be able to explain various data structures, related terminologies and its types.
4	Students will be able to choose appropriate data structure and apply it to solve problems in various domains.
5	Students will be able to analyze and Implement appropriate searching techniques for a given problem.
6	Students will be able to demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions.

Module		Detailed Content	Hours
1		**Introduction to Data Structures**	2
	1.1	Introduction to Data Structures, Concept of ADT, Types of Data Structures-Linear and Nonlinear, Operations on Data Structures.	
2		**Stack and Queues**	8
	2.1	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion.	
	2.2	Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.	
3		**Linked List**	10
	3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.	
4		**Trees**	11
	4.1	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.	
5		**Graphs**	4

	5.1	Introduction, Graph Terminologies, Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting.	
6		**Searching Techniques**	4
	6.1	Linear Search, Binary Search, Hashing-Concept, Hash Functions, Collision resolution Techniques	

Textbooks:	
1	Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
2	Reema Thareja, "Data Structures using C", Oxford Press.
3	Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2nd Edition, CENGAGE Learning.
4	Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education
5	Data Structures Using C, ISRD Group, 2nd Edition, Tata McGraw-Hill.
References:	
1	Prof. P. S. Deshpande, Prof. O. G. Kakde, "C and Data Structures", DreamTech press.
2	E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.
3	Rajesh K Shukla, "Data Structures using C and C++", Wiley-India
4	GAV PAI, "Data Structures", Schaum's Outlines.
5	Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://nptel.ac.in/courses/106/102/106102064/
2	https://www.coursera.org/specializations/data-structures-algorithms
3	https://www.edx.org/course/data-structures-fundamentals
4	https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Credit
CSC304	Digital Logic & Computer Organization and Architecture	3

Pre-requisite: Knowledge on number systems	
Course Objective:	
1	To have the rough understanding of the basic structure and operation of basic digital circuits and digital computer.
2	To discuss in detail arithmetic operations in digital system.
3	To discuss generation of control signals and different ways of communication with I/O devices.
4	To study the hierarchical memory and principles of advanced computing.
Course Outcome:	
1	To learn different number systems and basic structure of computer system.
2	To demonstrate the arithmetic algorithms.
3	To understand the basic concepts of digital components and processor organization.
4	To understand the generation of control signals of computer.
5	To demonstrate the memory organization.
6	To describe the concepts of parallel processing and different Buses.

Module		Detailed Content	Hours
1		**Computer Fundamentals**	**5**
	1.1	Introduction to Number System and Codes	
	1.2	Number Systems: Binary, Octal, Decimal, Hexadecimal,	
	1.3	Codes: Grey, BCD, Excess-3, ASCII, Boolean Algebra.	
	1.4	Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR	
	1.5	Overview of computer organization and architecture.	
	1.6	Basic Organization of Computer and Block Level functional Units, Von-Neumann Model.	
2		**Data Representation and Arithmetic algorithms**	**8**
	2.1	Binary Arithmetic: Addition, Subtraction, Multiplication, Division using Sign Magnitude, 1's and 2's compliment, BCD and Hex Arithmetic Operation.	
	2.2	Booths Multiplication Algorithm, Restoring and Non-restoring Division Algorithm.	
	2.3	IEEE-754 Floating point Representation.	
3		**Processor Organization and Architecture**	**6**
	3.1	Introduction: Half adder, Full adder, MUX, DMUX, Encoder, Decoder(IC level).	
	3.2	Introduction to Flip Flop: SR, JK, D, T (Truth table).	
	3.3	Register Organization, Instruction Formats, Addressing modes, Instruction Cycle, Interpretation and sequencing.	
4		**Control Unit Design**	**6**
	4.1	Hardwired Control Unit: State Table Method, Delay Element Methods.	
	4.2	Microprogrammed Control Unit: Micro Instruction-Format, Sequencing and execution, Micro operations, Examples of microprograms.	
5		**Memory Organization**	**6**
	5.1	Introduction and characteristics of memory, Types of RAM and ROM, Memory Hierarchy, 2-level Memory Characteristic,	
	5.2	Cache Memory: Concept, locality of reference, Design problems based on	

		mapping techniques, Cache coherence and write policies. Interleaved and Associative Memory.	
6		**Principles of Advanced Processor and Buses**	**8**
	6.1	Basic Pipelined Data path and control, data dependencies, data hazards, branch hazards, delayed branch, and branch prediction, Performance measures-CPI, Speedup, Efficiency, throughput, Amdhal's law.	
	6.2	Flynn's Classification, Introduction to multicore architecture.	
	6.3	Introduction to buses: ISA, PCI, USB. Bus Contention and Arbitration.	

Textbooks:	
1	R. P. Jain, "Modern Digital Electronic", McGraw-Hill Publication, 4thEdition.
2	William Stalling, "Computer Organization and Architecture: Designing and Performance", Pearson Publication 10TH Edition.
3	John P Hayes, "Computer Architecture and Organization", McGraw-Hill Publication, 3RD Edition.
4	Dr. M. Usha and T. S. Shrikanth, "Computer system Architecture and Organization", Wiley publication.
References:	
1	Andrew S. Tanenbaum, "Structured Computer Organization", Pearson Publication.
2	B. Govindarajalu, "Computer Architecture and Organization", McGraw-Hill Publication.
3	Malvino, "Digital computer Electronics", McGraw-Hill Publication, 3rdEdition.
4	Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw-Hill Publication.

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://nptel.ac.in/courses/106/103/106103068/
3	https://www.coursera.org/learn/comparch
4	https://www.edx.org/learn/computer-architecture

Course Code	Course Name	Credits
CSC305	Computer Graphics	3

Prerequisite: Knowledge of C Programming and Basic Mathematics**.**	
Course Objectives	
1	To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics.
2	To emphasize on implementation aspect of Computer Graphics Algorithms.
3	To prepare the student for advance areas and professional avenues in the field of Computer Graphics
Course Outcomes: At the end of the course, the students should be able to	
1	Describe the basic concepts of Computer Graphics.
2	Demonstrate various algorithms for basic graphics primitives.
3	Apply 2-D geometric transformations on graphical objects.
4	Use various Clipping algorithms on graphical objects
5	Explore 3-D geometric transformations, curve representation techniques and projections methods.
6	Explain visible surface detection techniques and Animation.

Module		Detailed Content	Hours
1		**Introduction and Overview of Graphics System:**	**02**
	1.1	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, rasterization and rendering.	
	1.2	Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems.	
2		**Output Primitives:**	**10**
	2.1	Scan conversions of point, line, circle and ellipse: DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	
	2.2	Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing).	
	2.3	Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm.	
3		**Two Dimensional Geometric Transformations**	**6**
	3.1	Basic transformations: Translation, Scaling, Rotation	
	3.2	Matrix representation and Homogeneous Coordinates	
	3.3	Composite transformation	
	3.4	Other transformations: Reflection and Shear	
4		**Two-Dimensional Viewing and Clipping**	**7**
	4.1	Viewing transformation pipeline and Window to Viewport coordinate transformation	
	4.2	Clipping operations: Point clipping, Line clipping algorithms: Cohen-Sutherland, Liang: Barsky, Polygon Clipping Algorithms: Sutherland-Hodgeman, Weiler-Atherton.	
5		**Three Dimensional Geometric Transformations, Curves and Fractal Generation**	**8**
	5.1	3D Transformations: Translation, Rotation, Scaling and Reflection	

	5.2	Composite transformations: Rotation about an arbitrary axis	
	5.3	Projections – Parallel, Perspective. (Matrix Representation)	
	5.4	Bezier Curve, B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve.	
6		**Visible Surface Detection and Animation**	**6**
	6.1	Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method	
	6.2	Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture	

Textbooks:	
1	Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication
2	James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication
3	Samit Bhattacharya, "Computer Graphics", Oxford Publication
References:	
1	D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications.
2	Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum"s Outlines McGraw-Hill Education
3	Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.
4	F. S. Hill, "Computer Graphics using OpenGL", Third edition, Pearson Publications.

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules

Useful Links	
1	https://www.classcentral.com/course/interactivegraphics-2067
2	https://swayam.gov.in/nd2_ntr20_ed15/preview
3	https://nptel.ac.in/courses/106/106/106106090/
4	https://www.edx.org/course/computer-graphics-2

Lab Code	Lab Name	Credit
CSL301	Data Structures Lab	1

Prerequisite: C Programming Language.	
Lab Objectives:	
1	To implement basic data structures such as arrays, linked lists, stacks and queues
2	Solve problem involving graphs, and trees
3	To develop application using data structure algorithms
4	Compute the complexity of various algorithms.
Lab Outcomes:	
1	Students will be able to implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them.
2	Students will be able to implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them
3	Students will be able to choose appropriate data structure and apply it in various problems
4	Students will be able to select appropriate searching techniques for given problems.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Implement Stack ADT using array.
2*	Convert an Infix expression to Postfix expression using stack ADT.
3*	Evaluate Postfix Expression using Stack ADT.
4	Applications of Stack ADT.
5*	Implement Linear Queue ADT using array.
6*	Implement Circular Queue ADT using array.
7	Implement Priority Queue ADT using array.
8*	Implement Singly Linked List ADT.
9*	Implement Circular Linked List ADT.
10	Implement Doubly Linked List ADT.
11*	Implement Stack / Linear Queue ADT using Linked List.
12*	Implement Binary Search Tree ADT using Linked List.
13*	Implement Graph Traversal techniques:) Depth First Search b) Breadth First Search
14	Applications of Binary Search Technique.

Useful Links:	
1	www.leetcode.com
2	www.hackerrank.com
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html
4	www.codechef.com

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus of CSL301and CSC303

Lab Code	Lab Name	Credit
CSL302	Digital Logic & Computer Organization and Architecture Lab	1

Prerequisite: C Programming Language.	
Lab Objectives:	
1	To implement operations of the arithmetic unit using algorithms.
2	Design and simulate different digital circuits.
3	To design memory subsystem including cache memory.
4	To demonstrate CPU and ALU design.
Lab Outcomes:	
1	To understand the basics of digital components
2	Design the basic building blocks of a computer: ALU, registers, CPU and memory
3	To recognize the importance of digital systems in computer architecture
4	To implement various algorithms for arithmetic operations.

List of Experiments:	
Sr. No.	**Name of the Experiment**
1	To verify the truth table of various logic gates using ICs.
2	To realize the gates using universal gates
3	Code conversion.
4	To realize half adder and full adder.
5	To implement logic operation using MUX IC.
6	To implement logic operation decoder IC.
7	Study of flip flop IC.
8	To implement ripple carry adder.
9	To implement carry look ahead adder.
10	To implement Booth's algorithm.
11	To implement restoring division algorithm.
12	To implement non restoring division algorithm.
13	To implement ALU design.
14	To implement CPU design.
15	To implement memory design.
16	To implement cache memory design.

Note:	
1	Any Four experiments from Exp. No. 1 to Exp. No. 7 using hardware.
2	Any Six experiments from Exp. No. 8 to Exp. No. 16 using Virtual Lab, expect Exp. No 10,11 and 12.
3	Exp. No. 10 to Exp. No. 12 using Programming language.
Digital Material:	
1	Manual to use Virtual Lab simulator for Computer Organization and Architecture developed by the Department of CSE, IIT Kharagpur.
2	Link http://cse10-iitkgp.virtual-labs.ac.in/

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of "Digital Logic &Computer Organization and Architecture"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

Course Code	Lab Name	Credits
CSL303	Computer Graphics Lab	1

Prerequisite: C Programming Language.	
Lab Objectives:	
1	Understand the need of developing graphics application
2	Learn algorithmic development of graphics primitives like line, circle, polygon etc.
3	Learn the representation and transformation of graphical images and pictures
Lab Outcomes: At the end of the course, the students should be able to	
1	Implement various output and filled area primitive algorithms
2	Apply transformation, projection and clipping algorithms on graphical objects.
3	Perform curve and fractal generation methods.
4	Develop a Graphical application/Animation based on learned concept

Content:

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation Curves Visible surface determination. Simple animations Application of these through exercises in C/C++

List of Suggested Experiments:

Sr. No.	Name of the Experiment
1	Implement DDA Line Drawing algorithm (dotted/dashed/thick)
2	Implement Bresenham's Line algorithm(dotted/dashed/thick)
3	Implement midpoint Circle algorithm.
4	Implement midpoint Ellipse algorithm.
5	Implement Area Filling Algorithm: Boundary Fill, Flood Fill.
6	Implement Scan line Polygon Filling algorithm.
7	Implement Curve: Bezier for n control points, B Spline (Uniform)(at least one)
8	Implement Fractal generation method (anyone)
9	Character Generation: Bit Map method and Stroke Method
10	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.
11	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.
12	Implement polygon clipping algorithm (at least one)
13	Program to perform 3D transformation.
14	Perform projection of a 3D object on Projection Plane: Parallel and Perspective.
15	Perform Animation (such as Rising Sun, Moving Vehicle, Smileys, Screen saver etc.)

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments
3	Mini Project to perform using C /C++/Java/OpenGL/Blender/ any other tool (2/3 students per group). Possible Ideas: Animation using multiple objects, Game development, Graphics editor: Like Paint brush, Text editor etc.
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks)
Oral & Practical exam	
	Based on the above contents and entire syllabus of CSC305

Lab Code	Lab Name	Credits
CSL304	Skill based Lab Course: Object Oriented Programming with Java	2

Prerequisite: Structured Programming Approach	
Lab Objectives:	
1	To learn the basic concepts of object-oriented programming
2	To study JAVA programming language
3	To study various concepts of JAVA programming like multithreading, exception Handling, packages, etc.
4	To explain components of GUI based programming.
Lab Outcomes: At the end of the course, the students should be able to	
1	To apply fundamental programming constructs.
2	To illustrate the concept of packages, classes and objects.
3	To elaborate the concept of strings, arrays and vectors.
4	To implement the concept of inheritance and interfaces.
5	To implement the concept of exception handling and multithreading.
6	To develop GUI based application.

Module		Detailed Content	Hours
1		**Introduction to Object Oriented Programming**	**2**
	1.1	OOP concepts: Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing.	
	1.2	Java Virtual Machine	
	1.3	Basic programming constructs: variables, data types, operators, unsigned right shift operator, expressions, branching and looping.	
2		**Class, Object, Packages and Input/output**	**6**
	2.1	Class, object, data members, member functions Constructors, types, static members and functions Method overloading Packages in java, types, user defined packages Input and output functions in Java, Buffered reader class, scanner class	
3		**Array, String and Vector**	**3**
	3.1	Array, Strings, String Buffer, Vectors	
4		**Inheritance**	**4**
	4.1	Types of inheritance, Method overriding, super, abstract class and abstract method, final, Multiple inheritance using interface, extends keyword	
5		**Exception handling and Multithreading**	**5**
	5.1	Exception handling using try, catch, finally, throw and throws, Multiple try and catch blocks, user defined exception Thread lifecycle, thread class methods, creating threads using extends and implements keyword.	
6		**GUI programming in JAVA**	**6**
	6.1	Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and color class. Event handling using event class AWT: working with windows, using AWT controls for GUI design Swing class in JAVA	

		Introduction to JDBC, JDBC-ODBC connectivity, JDBC architecture.	

Textbooks:	
1	Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2	E. Balagurusamy, 'Programming with Java', McGraw Hill Education.
References:	
1	Ivor Horton, "Beginning JAVA", Wiley India.
2	Dietal and Dietal, "Java: How to Program", 8th Edition, PHI .
3	"JAVA Programming", Black Book, Dreamtech Press.
4	"Learn to Master Java programming", Staredu solutions
Digital material:	
1	www.nptelvideos.in
2	www.w3schools.com
3	www.tutorialspoint.com
4	https://starcertification.org/Certifications/Certificate/securejava

Suggested List of Programming Assignments/laboratory Work:	
Sr. No.	**Name of the Experiment**
1	Programs on Basic programming constructs like branching and looping
2	Program on accepting input through keyboard.
3	Programs on class and objects
4	Program on method and constructor overloading.
5	Program on Packages
6	Program on 2D array, strings functions
7	Program on String Buffer and Vectors
8	Program on types of inheritance
9	Program on Multiple Inheritance
10	Program on abstract class and abstract methods.
11	Program using super and final keyword
12	Program on Exception handling
13	Program on user defined exception
14	Program on Multithreading
15	Program on Graphics class
16	Program on applet class
17	Program to create GUI application
18	Mini Project based on the content of the syllabus (Group of 2-3 students)

Term Work:	
1	Term work should consist of 15 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 50-Marks (Experiments: 15-marks, Attendance: 05-marks, Assignments: 05-marks, Mini Project: 20-marks, MCQ as a part of lab assignments: 5-marks)

Oral & Practical exam
Based on the entire syllabus of CSL 304: **Skill based Lab Course: Object Oriented Programming with Java**

Course code	Course Name	Credits
CSM301	Mini Project A	02

Objectives	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
Outcome: Learner will be able to…	
1	Identify problems based on societal /research needs.
2	Apply Knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/ experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9	Demonstrate project management principles during project work.
Guidelines for Mini Project	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Term Work

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

	Distribution of Term work marks for both semesters shall be as below:	**Marks**
1	Marks awarded by guide/supervisor based on logbook	10
2	Marks awarded by review committee	10
3	Quality of Project report	05

Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines

One-year project:

1	In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group. • First shall be for finalization of problem • Second shall be on finalization of proposed solution of problem.
2	In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

1	In this case in one semester students' group shall complete project in all aspects including, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1	Quality of survey/ need identification
2	Clarity of Problem definition based on need.
3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution
5	Cost effectiveness
6	Societal impact
7	Innovativeness
8	Cost effectiveness and Societal impact
9	Full functioning of working model as per stated requirements

10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individual's as member or leader
13	Clarity in written and oral communication
	In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
	In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

Course Code	Course Name	Credits
CSC401	Engineering Mathematics-IV	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution.	
Course Objectives: The course aims to learn:	
1	Matrix algebra to understand engineering problems.
2	Line and Contour integrals and expansion of a complex valued function in a power series.
3	Z-Transforms and Inverse Z-Transforms with its properties.
4	The concepts of probability distributions and sampling theory for small samples.
5	Linear and Non-linear programming problems of optimization.
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Apply the concepts of eigenvalues and eigenvectors in engineering problems.
2	Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
3	Apply the concept of Z- transformation and inverse in engineering problems.
4	Use the concept of probability distribution and sampling theory to engineering problems.
5	Apply the concept of Linear Programming Problems to optimization.
6	Solve Non-Linear Programming Problems for optimization of engineering problems.

Module	Detailed Contents		Hours
1	**Linear Algebra (Theory of Matrices)**		7
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof)	
	1.2	Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials	
	1.3	Similarity of matrices, diagonalizable and non-diagonalizable matrices	
	1.4	**Self-learning Topics:** Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	
2	**Complex Integration**		7
	2.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).	
	2.2	Taylor's and Laurent's series (without proof).	
	2.3	Definition of Singularity, Zeroes, poles of*f(z)*, Residues, Cauchy's Residue Theorem (without proof)	
	2.4	**Self-learning Topics:** Application of Residue Theorem to evaluate real integrations.	
3	**Z Transform**		5
	3.1	Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}, \{a^{\lvert k\rvert}\}, \{{}^{k+n}_{n}C.\, a^k\}, \{c^k \sin(\alpha k+\beta)\}, \{c^k \sinh \alpha k\}, \{c^k \cosh \alpha k\}$.	
	3.2	Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem.	
	3.3	Inverse Z transform: Partial Fraction Method, Convolution Method.	
	3.4	**Self-learning Topics:** Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion	
4	**Probability Distribution and Sampling Theory**		7
	4.1	Probability Distribution: Poisson and Normal distribution	

	4.2	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.	
	4.3	Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table.	
	4.4	**Self-learning Topics:** Test significance for Large samples, Estimate parameters of a population, Yate's Correction.	
5	**Linear Programming Problems**		6
	5.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.	
	5.2	Artificial variables, Big-M method (Method of penalty)	
	5.3	Duality, Dual of LPP and Dual Simplex Method	
	5.4	**Self-learning Topics:** Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	
6	**Nonlinear Programming Problems**		7
	6.1	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers	
	6.2	NLPP with two equality constraints	
	6.3	NLPP with inequality constraint: Kuhn-Tucker conditions	
	6.4	**Self-learning Topics:** Problems with two inequality constraints, Unconstrained optimization: One-dimensional search method (Golden Search method, Newton's method). Gradient Search method	

References:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons.
2	R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa.
3	Brown and Churchill, "Complex Variables and Applications", McGraw-Hill Education.
4	T. Veerarajan, "Probability, Statistics and Random Processes", McGraw-Hill Education.
5	Hamdy A Taha, "Operations Research: An Introduction", Pearson.
6	S.S. Rao, "Engineering Optimization: Theory and Practice", Wiley-Blackwell.
7	Hira and Gupta, "Operations Research", S. Chand Publication.

Term Work:		
General Instructions:		
1	Batch wise tutorial shave to be conducted. The number of students per batch will be as per University pattern for practical.	
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.	
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.	
The distribution of Term Work marks will be as follows:		
1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

<u>Assessment</u>:
Internal Assessment Test:
The assessment consists of two class tests of 20 marks each. The 1stclass test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is

completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Course Code	Course Name	Credit
CSC402	Analysis of Algorithms	3

Prerequisite: Data structure concepts, Discrete structures	
Course Objectives:	
1	To provide mathematical approaches for Analysis of Algorithms
2	To understand and solve problems using various algorithmic approaches
3	To analyze algorithms using various methods
Course Outcomes: At the end of the course learner will be able to	
1	Analyze the running time and space complexity of algorithms.
2	Describe, apply and analyze the complexity of divide and conquer strategy.
3	Describe, apply and analyze the complexity of greedy strategy.
4	Describe, apply and analyze the complexity of dynamic programming strategy.
5	Explain and apply backtracking, branch and bound.
6	Explain and apply string matching techniques.

Module		Detailed Contents	Hours
1		**Introduction**	8
	1.1	Performance analysis, space, and time complexity Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis. Complexity class: Definition of P, NP, NP-Hard, NP-Complete Analysis of selection sort, insertion sort.	
	1.2	Recurrences: The substitution method, Recursion tree method, Master method	
2		**Divide and Conquer Approach**	6
	2.1	General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search.	
3		**Greedy Method Approach**	6
	3.1	General Method, Single source shortest path: Dijkstra Algorithm Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms	
4		**Dynamic Programming Approach**	9
	4.1	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm All pair shortest path: Floyd Warshall Algorithm, Assembly-line scheduling Problem0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence	
5		**Backtracking and Branch and bound**	6
	5.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring	
	5.2	Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem	
6		**String Matching Algorithms**	4
	6.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	

Textbooks:	
1	T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.

References:	
1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw-Hill Edition.
2	S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Useful Links	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms

Course Code:	Course Title	Credit
CSC403	Database Management System	3

Prerequisite: Data Structures	
Course Objectives:	
1	Develop entity relationship data model and its mapping to relational model
2	Learn relational algebra and Formulate SQL queries
3	Apply normalization techniques to normalize the database
4	Understand concept of transaction, concurrency control and recovery techniques.
Course Outcomes:	
1	Recognize the need of database management system
2	Design ER and EER diagram for real life applications
3	Construct relational model and write relational algebra queries.
4	Formulate SQL queries
5	Apply the concept of normalization to relational database design.
6	Describe the concept of transaction, concurrency and recovery.

Module		Content	Hrs
1		**Introduction Database Concepts**	**3**
	1.1	Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Database Administrator	
2		**Entity–Relationship Data Model**	**6**
	2.1	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation	
3		**Relational Model and relational Algebra**	**8**
	3.1	Introduction to the Relational Model, relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model, Relational Algebra-operators, Relational Algebra Queries.	
4		**Structured Query Language (SQL)**	**6**
	4.1	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity , check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers	
5		**Relational-Database Design**	**6**
	5.1	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.	
6		**Transactions Management and Concurrency and Recovery**	**10**
	6.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling	

Textbooks:	
1	Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
References:	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5thEdition.
2	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3	G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Useful Links	
1	https://nptel.ac.in/courses/106/105/106105175/
2	https://swayam.gov.in/nd1_noc19_cs46/preview
3	https://www.classcentral.com/course/swayam-database-management-system-9914
4	https://www.mooc-list.com/tags/dbms

Course Code	Course Name	Credit
CSC404	Operating System	03

Prerequisites: Data structures and Computer architecture	
Course Objectives:	
1	1. To introduce basic concepts and functions of operating systems.
2	2. To understand the concept of process, thread and resource management.
3	3. To understand the concepts of process synchronization and deadlock.
4	4. To understand various Memory, I/O and File management techniques.
Course Outcome:	
1	Understand the objectives, functions and structure of OS
2	Analyze the concept of process management and evaluate performance of processscheduling algorithms.
3	Understand and apply the concepts of synchronization and deadlocks
4	Evaluate performance of Memory allocation and replacement policies
5	Understand the concepts of file management.
	Apply concepts of I/O management and analyze techniques of disk scheduling.

Module	Detailed Content		Hours
1	**Operating system Overview**		**4**
	1.1	Introduction, Objectives, Functions and Evolution of Operating System	
	1.2	Operating system structures: Layered, Monolithic and Microkernel	
	1.3	Linux Kernel, Shell and System Calls	
2	**Process and Process Scheduling**		**9**
	2.1	Concept of a Process, Process States, Process Description, Process Control Block.	
	2.2	Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)	
	2.3	Threads: Definition and Types, Concept of Multithreading	
3	**Process Synchronization and Deadlocks**		**9**
	3.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization.	
	3.2	Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem.	
	3.3	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker‟s Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem.	
4	**Memory Management**		**9**
	4.1	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB	
	4.2	Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing	
5		**File Management**	**4**

	5.1	Overview, File Organization and Access, File Directories, File Sharing	
6		**I/O management**	**4**
	6.1	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK.	

Textbooks:	
1	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0
References:	
1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rdEdition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rdEdition.
3	Maurice J. Bach, "Design of UNIX Operating System", PHI
4	Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4thEdition

Assessment:
Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
End Semester Theory Examination:

1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules

Useful Links	
1	https://swayam.gov.in/nd1_noc19_cs50/preview
2	https://nptel.ac.in/courses/117/106/117106113/
3	https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559

Course Code	Course Name	Credits
CSC405	Microprocessor	3

Prerequisites: Digital Logic and Computer Architecture	
Course objectives:	
1	To equip students with the fundamental knowledge and basic technical competence in thefield of Microprocessors.
2	To emphasize on instruction set and logic to build assembly language programs.
3	To prepare students for higher processor architectures and embedded systems
Course outcomes: On successful completion of course, learner will be able to:	
1	Describe core concepts of 8086 microprocessor.
2	Interpret the instructions of 8086 and write assembly and Mixed language programs.
3	Identify the specifications of peripheral chip.
4	Design 8086 based system using memory and peripheral chips.
5	Appraise the architecture of advanced processors
6	Understand hyperthreading technology

Module	Detailed Contents		Hours
1	**The Intel Microprocessors 8086 Architecture**		8
	1.1	8086CPU Architecture,	
	1.2	Programmer's Model	
	1.3	Functional Pin Diagram	
	1.4	Memory Segmentation	
	1.5	Banking in 8086	
	1.6	Demultiplexing of Address/Data bus	
	1.7	Functioning of 8086 in Minimum mode and Maximum mode	
	1.8	Timing diagrams for Read and Write operations in minimum and maximum mode	
	1.9	Interrupt structure and its servicing	
2	**Instruction Set and Programming**		**6**
	2.1	Addressing Modes	
	2.2	Instruction set-Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions	
	2.3	Assembler Directives and Assembly Language Programming, Macros, Procedures	
3	**Memory and Peripherals interfacing**		**8**
	3.1	Memory Interfacing - RAM and ROM Decoding Techniques – Partial and Absolute	
	3.2	8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086.	
	3.3	8257-DMAC-Block diagram, DMA operations and transfer modes.	
	3.4	Programmable Interrupt Controller 8259-Block Diagram, Interfacing the 8259 in single and cascaded mode.	
4	**Intel 80386DX Processor**		**7**
	4.1	Architecture of 80386 microprocessor	
	4.2	80386 registers–General purpose Registers, EFLAGS and Control	

		registers	
	4.3	Real mode, Protected mode, virtual 8086 mode	
	4.4	80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism	
5	**Pentium Processor**		**6**
	5.1	Pentium Architecture	
	5.2	Superscalar Operation,	
	5.3	Integer &Floating-Point Pipeline Stages,	
	5.4	Branch Prediction Logic,	
	5.5	Cache Organization and	
	5.6	MESI protocol	
6	**Pentium 4**		**4**
	6.1	Comparative study of 8086, 80386, Pentium I, Pentium II and Pentium III	
	6.2	Pentium 4: Net burst micro architecture.	
	6.3	Instruction translation look aside buffer and branch prediction	
	6.4	Hyper threading technology and its use in Pentium 4	

Textbooks:	
1	John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI.
2	Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design", Prentice Hall
3	Walter A. Triebel, "The 80386DX Microprocessor: hardware, Software and Interfacing", Prentice Hall
4	Tom Shanley and Don Anderson, "Pentium Processor System Architecture", Addison-Wesley.
5	K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hill
References:	
1	Barry B. Brey, "Intel Microprocessors", 8thEdition, Pearson Education India
2	Douglas Hall, "Microprocessor and Interfacing", Tata McGraw Hill.
3	Intel Manual
4	Peter Abel, "IBM PC Assembly language and Programming", 5th Edition, PHI
5	James Antonakons, "The Pentium Microprocessor", Pearson Education

Assessment:
Internal Assessment Test:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.
End Semester Theory Examination:
1 Question paper will comprise of 6 questions, each carrying 20 marks.
2 The students need to solve total 4 questions.
3 Question No.1 will be compulsory and based on entire syllabus.
4 Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://swayam.gov.in/nd1_noc20_ee11/preview
2	https://nptel.ac.in/courses/108/105/108105102/
3	https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4	https://www.mooc-list.com/tags/microprocessors

Course Name	Lab Name	Credit
CSL401	Analysis of Algorithms Lab	1

Prerequisite: Basic knowledge of programming and data structure	
Lab Objectives:	
1	To introduce the methods of designing and analyzing algorithms
2	Design and implement efficient algorithms for a specified application
3	Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
4	Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.
Lab Outcomes: At the end of the course, the students will be able to	
1	Implement the algorithms using different approaches.
2	Analyze the complexities of various algorithms.
3	Compare the complexity of the algorithms for specific problem.

Description		
Implementation can be in any language.		
Suggested Practical List:		
Sr No		**Suggested Experiment List**
1		**Introduction**
	1.1	Selection sort, Insertion sort
2		**Divide and Conquer Approach**
	2.1	Finding Minimum and Maximum, Merge sort, Quick sort, Binary search
3		**Greedy Method Approach**
	3.1	Single source shortest path- Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm
4		**Dynamic Programming Approach**
	4.1	Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Travelling salesperson problem Longest common subsequence
5		**Backtracking and Branch and bound**
	5.1	N-queen problem Sum of subsets Graph coloring
6		**String Matching Algorithms**
	6.1	The Naïve string-matching Algorithms The Rabin Karp algorithm The Knuth-Morris-Pratt algorithm

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of "Analysis of Algorithms"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus of CSC402: Analysis of Algorithms

Lab Code	Lab Name	Credit
CSL402	Database Management system Lab	1

Prerequisite: Discrete Structures	
Lab Objectives:	
1	To explore design and develop of relational model
2	To present SQL and procedural interfaces to SQL comprehensively
3	To introduce the concepts of transactions and transaction processing
Lab Outcomes: At the end of the course, the students will be able to	
1	Design ER /EER diagram and convert to relational model for the realworld application.
2	Apply DDL, DML, DCL and TCL commands
3	Write simple and complex queries
4	UsePL / SQL Constructs.
5	Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity

Suggested List of Experiments	
Sr. No.	**Title of Experiment**
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System
4	Apply DML Commands for the specified system
5	Perform Simple queries, string manipulation operations and aggregate functions.
6	Implement various Join operations.
7	Perform Nested and Complex queries
8	Perform DCL and TCL commands
9	Implement procedure and functions
10	Implementation of Views and Triggers.
11	Demonstrate Database connectivity
12	Implementation and demonstration of Transaction and Concurrency control techniques using locks.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of “Database Management System”
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	

Course Code	Course Name	Credit
CSL403	Operating System Lab	01
	Based on the entire syllabus of CSC403: Database Management System	

Prerequisite: Knowledge on Operating system principles	
Lab Objectives:	
1	To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.
2	To familiarize students with the architecture of Linux OS.
3	To provide necessary skills for developing and debugging programs in Linux environment.
4	To learn programmatically to implement simple operation system mechanisms
Lab Outcomes: At the end of the course, the students will be able to	
1	Demonstrate basic Operating system Commands, Shell scripts, System Calls and API wrt Linux
2	Implement various process scheduling algorithms and evaluate their performance.
3	Implement and analyze concepts of synchronization and deadlocks.
4	Implement various Memory Management techniques and evaluate their performance.
5	Implement and analyze concepts of virtual memory.
6	Demonstrate and analyze concepts of file management and I/O management techniques.

Suggested List of Experiments		
Sr. No.		**Content**
1		**Explore Linux Commands**
	1.1	**Explore usage of basic Linux Commands and system calls for file, directory and process management.** For eg: (mkdir, chdir, cat, ls, chown, chmod, chgrp, ps etc. system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. sort, grep, awk, etc.)
2		**Linux shell script**
	2.1	Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. Display current shell, home directory, operating system type, current path setting, current working directory.
3		**Linux- API**
	3.1	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.
4		**Linux- Process**
	4.1	a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. b. Explore wait and waitpid before termination of process.
5		**Process Management: Scheduling**

	5.1	a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms
6		**Process Management: Synchronization**
	6.1	**a.** Write a C program to implement solution of Producer consumer problem through Semaphore
7		**Process Management: Deadlock**
	7.1	a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm b. Write a program demonstrate the concept of Dining Philospher's Problem
8		**Memory Management**
	8.1	a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.
9		**Memory Management: Virtual Memory**
	9.1	a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.
10		**File Management & I/O Management**
	10.1	a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. **c.** Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN

Term Work:	
1	Term work should consist of 10 experiments covering all modules.
2	Journal must include at least 2 assignments on content of theory and practical of "Database Management System"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus of CSC405: Operating System.

Lab Code	Lab Name	Credits
CSL404	Microprocessor Lab	1

Prerequisite: Basic knowledge digital integrated circuits	
Lab Objectives:	
1	To emphasize on use of Assembly language program.
2	To prepare students for advanced subjects like embedded system and IOT.
Lab Outcomes: At the end of the course, the students will be able to	
1	Use appropriate instructions to program microprocessor to perform various task
2	Develop the program in assembly/ mixed language for Intel 8086 processor
3	Demonstrate the execution and debugging of assembly/ mixed language program

Suggested List of Experiments:	
Sr. No.	**Title of Experiments**
1	Use of programming tools (Debug/TASM/MASM/8086kit) to perform basic arithmetic operations on 8-bit/16-bit data
2	Code conversion (Hex to BCD and BCD to Hex)/ (ASCII to BCD and BCD to ASCII)
3	Assembly programming for 16-bit addition, subtraction, multiplication and division (menu based)
4	Assembly program based on string instructions (overlapping/non-overlapping block transfer/ string search/ string length)
5	Assembly program to display the contents of the flag register.
6	Any Mixed Language programs.
7	Assembly program to find the GCD/ LCM of two numbers
8	Assembly program to sort numbers in ascending/ descending order
9	Any program using INT 10H
10	Assembly program to find minimum/ maximum number from a given array.
11	Assembly Program to display a message in different color with blinking
12	Assembly program using procedure.
13	Assembly program using macro.
14	Program and interfacing using 8255.
15	Program and interfacing of ADC/ DAC/ Stepper motor.

Term Work:	
1	Term work should consist of 10 experiments, out of theses at least one experiment on hardware interfacing.
2	Journal must include at least 2 assignments on content of theory and practical of "Microprocessor"
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus of CSL501and CSC501syllabus.

Lab Code	Lab Name	Credit
CSL405	Skill Base Lab Course: Python Programming	2

Prerequisite: Knowledge of some programming language like C, Java	
Lab Objectives:	
1	Basics of Python programming
2	Decision Making, Data structure and Functions in Python
3	Object Oriented Programming using Python
4	Web framework for developing
Lab Outcomes: At the end of the course, the students will be able to	
1	To understand basic concepts in python.
2	To explore contents of files, directories and text processing with python
3	To develop program for data structure using built in functions in python.
4	To explore django web framework for developing python-based web application.
5	To understand Multithreading concepts using python.

Module		Detailed Content	Hours
1		**Python basics**	**5**
	1.1	Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries Exception, Introduction to OOP, Classes, Objects, Interfaces, Inheritance	
2		**Advanced Python**	**4**
	2.1	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.	
3		**Data Structure in Python**	**3**
	3.1	Link List, Stack, Queues, Dequeues	
4		**Python Integration Primer**	**4**
	4.1	Graphical User interface, Networking in Python, Python database connectivity, Introduction to Django	
5		**Multithreading**	**4**
	5.1	Thread and Process, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue	
6		**NumPy and Pandas**	**6**
	6.1	Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O	
	6.2	Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames	

Textbooks:	
1	Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press
2	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication
3	Anurag Gupta, G. P. Biswas, “Python Programming”, McGraw-Hill
4	E. Balagurusamy, “Introduction to computing and problem-solving using python”, McGraw Hill Education
References:	
1	Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series

2	Laura Cassell, Alan Gauld, “Python Projects”, Wrox Publication

Digital material:

1	"The Python Tutorial",http://docs.python.org/release/3.0.1/tutorial/
2	Beginning Perl,https://www.perl.org/books/beginning-perl/
3	http://spoken-tutorial.org
4	https://starcertification.org/Certifications/Certificate/python

Suggested experiments using Python:	
Sr. No.	**Title of Experiments**
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3	Exploring Files and directories a. Python program to append data to existing file and then display the entire file b. Python program to count number of lines, words and characters in a file. c. Python program to display file available in current directory
4	Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5	Menu driven program for data structure using built in function for link list, stack and queue.
6	Program to demonstrate CRUD (**create, read, update and delete)** operations on database (SQLite/ MySQL) using python.
7	Creation of simple socket for basic information exchange between server and client.
8	Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).
9	Programs on Threading using python.
10	Exploring basics of NumPy Methods.
11	Program to demonstrate use of NumPy: Array objects.
12	Program to demonstrate Data Series and Data Frames using Pandas.
13	Program to send email and read content of URL.

Term Work:	
1	Term work should consist of 12 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 25 Marks (Journal: 10-marks, Attendance: 05-marks, and Mini Project: 10-marks)

Course code	Course Name	Credits
CSM401	Mini Project B	02

Objectives	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
Outcome: Learner will be able to…	
1	Identify problems based on societal /research needs.
2	Apply Knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/ experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9	Demonstrate project management principles during project work.
Guidelines for Mini Project	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4	A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Term Work

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

	Distribution of Term work marks for both semesters shall be as below:	**Marks**
1	Marks awarded by guide/supervisor based on logbook	10
2	Marks awarded by review committee	10
3	Quality of Project report	05

Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines

One-year project:

1	In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group. • First shall be for finalization of problem • Second shall be on finalization of proposed solution of problem.
2	In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

1	In this case in one semester students' group shall complete project in all aspects including, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1	Quality of survey/ need identification
2	Clarity of Problem definition based on need.
3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution
5	Cost effectiveness
6	Societal impact
7	Innovativeness

8	Cost effectiveness and Societal impact
9	Full functioning of working model as per stated requirements
10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individual's as member or leader
13	Clarity in written and oral communication
	In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
	In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Full functioning of working model as per stated requirements
5	Effective use of skill sets
6	Effective use of standard engineering norms
7	Contribution of an individual's as member or leader
8	Clarity in written and oral communication

UNIVERSITY OF MUMBAI
No. UG/39 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/241 of 2010, dated 12th August, 2010 relating to syllabus of the Bachelor of Engineering (B.E.) degree course.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Computer Engineering at its meeting held on 9th April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.51 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.E. & B.E. in Computer Engineering (Sem - V to VIII) has been brought into force with effect from the academic year 2018-19 and 2019-2020, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
22nd June, 2018

(Dr. Dinesh Kamble)
I/c REGISTRAR

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.51/05/05/2018

****

No. UG/ 39 -A of 2018 MUMBAI-400 032 22nd June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies in Computer Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

AC –

Item No.

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Computer Engineering

Second Year with Effect from **AY 2017-18**
Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Computer Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming session, which was attended by more than 85 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Computer Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To equip the Learner with broad education necessary to understand the impact of Computer Science and Engineering in a global and social context.
4. To encourage, motivate and prepare the Learner's for Lifelong- learning.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. Subhash K. Shinde
Chairman, Board of Studies in Computer Engineering,
University of Mumbai, Mumbai.

T. E. Computer Engineering (Semester-V)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CSC501	Microprocessor	4	-	-	4	-	-	4
CSC502	Database Management System	4	-	-	4	-	-	4
CSC503	Computer Network	4	-	-	4	-	-	4
CSC504	Theory of Computer Science	3+1@	-	-	4	-	-	4
CSDLO 501X	Department Level Optional Course -I	4	-	-	4	-	-	4
CSL501	Microprocessor Lab	-	2	-	-	1		1
CSL502	Computer Network Lab	-	2	-	-	1	-	1
CSL503	Database & Info. System Lab	-	2	-	-	1	-	1
CSL504	Web Design Lab	-	2+2*	-	-	2	-	2
CSL505	Business Comm. & Ethics	-	2+2*	-	-	2	-	2
	Total	**20**	**14**	-	**20**	**7**	-	**27**

@ 1 hour to be taken tutorial as class wise.
*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC501	Microprocessor	20	20	20	80	3	-	-	100
CSC502	Database Management System	20	20	20	80	3	-	-	100
CSC503	Computer Network	20	20	20	80	3	-	-	100
CSC504	Theory of Computer Science	20	20	20	80	3	-	-	100
CSDLO 501X	Department Level Optional Course -I	20	20	20	80	3	--	-	100
CSL501	Microprocessor Lab	-	-	-	-	-	25	25	50
CSL502	Computer Network Lab	-	-	-	-	-	25	25	50
CSL503	Database & Info. System Lab	-	-	-	-	-	25	25	50
CSL504	Web Design Lab	-	-	-	-	-	25	25	50
CSL505	Business Comm. & Ethics	-	-	-	-	-	50	-	50
Total		100	100	100	400	-	150	100	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19

T. E. Computer Engineering (Semester-VI)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CSC601	Software Engineering	4	-	-	4	-	-	4
CSC602	System Programming & Complier Construction	4	-	-	4	-	-	4
CSC603	Data Warehousing & Mining	4	-	-	4	-	-	4
CSC604	Cryptography & System Security	4	-	-	4	-	-	4
CSDLO 601X	Department Level Optional Course -II	4	-	-	4	-	-	4
CSL601	Software Engineering Lab	-	2	-	-	1	-	1
CSL602	System software Lab	-	2	-	-	1	-	1
CSL603	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
CSL604	System Security Lab	-	2	-	-	1	-	1
CSP605	Mini-Project	-	4	-	-	2	-	2
	Total	**20**	**12**	-	**20**	**6**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC601	Software Engineering	20	20	20	80	3	-	-	-	100
CSC602	System Programming & Complier Construction	20	20	20	80	3	-	-	-	100
CSC603	Data Warehousing & Mining	20	20	20	80	3	-	-	-	100
CSC604	Cryptography & System Security	20	20	20	80	3	-	-	-	100
CSDLO 601X	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
CSL601	Software Engineering Lab	-	-	-	-	-	25	25	--	50
CSL602	System Software Lab	-	-	-	-	-	25	--	25	50
CSL603	Data Warehousing & Mining Lab	-	-	-	-	-	25	--	25	50
CSL604	System Security Lab	-	-	-	-	-	25	---	25	50
CSP605	Mini-Project	-	-	-	-	-	25	---	25	50
Total		100	100	100	400	-	125	25	100	750

B. E. Computer Engineering (Semester-VII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-		1	-	1
CSL704	Computational Lab-I	-	2			1	-	1
CSP705	Major Project-I	-	6			3	-	3
	Total	**19**	**14**	-	**19**	**7**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
Total		100	100	100	400		150	25	75	750

Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20

B. E. Computer Engineering (Semester-VIII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CSC801	Human Machine Interaction	4	-	-	4	-	-	4
CSC802	Distributed Computing	4	-	-	4	-	-	4
CSDLO 801X	Department Level Optional Course -IV	4	-	-	4	-	-	4
ILO801X	Institute Level Optional Course-II	3	-	-	3	-	-	3
CSL801	Human Machine Interaction Lab	-	2	-	-	1		1
CSL802	Distributed Computing Lab		2			1		1
CSL803	Cloud Computing Lab	-	4	-	-	2		2
CSL804	Computational Lab-II	-	2	-		1		1
CSP805	Major Project-II	-	12			6	-	6
	Total	**15**	**22**	-	**15**	**11**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in				
		Test 1	Test 2	Avg.						
CSC801	Human Machine Interaction	20	20	20	80	3	-	-	-	100
CSC802	Distributed Computing	20	20	20	80	3	-	-	-	100
CSDLO 801X	Department Level Optional Course -IV	20	20	20	80	3	-	-	-	100
ILO801X	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
CSC801	Human Machine Interaction Lab						25	25	-	50
CSL802	Distributed Computing Lab	-	-	-	-	-	25	25		50
CSL803	Cloud Computing Lab	-	-	-	-	-	50	--	25	75
CSL804	Computational Lab-II	-	-	-	-	-	50	--	25	75
CSP805	Major Project-II						50	--	50	100
Total		80	80	80	320	--	200	50	100	750

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	CSDLO5011: Multimedia System CSDLO5012: Advance Operating System CSDLO5013: Advance Algorithm	----------
VI	CSDLO6021: Machine Learning CSDLO6022: Advance Database System CSDLO6023: Enterprise Resource Planning CSDLO6024: Advance Computer Network	----------
VII	CSDLO7031: Advance System Security & Digital Forensics CSDLO7032: Big Data & Analytics CSDLO7033: Robotics	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering
VIII	DLO8011: High Performance Computing DLO8012: Natural Language Processing DLO8013: Adhoc Wireless Network	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management

Course Code	Course Name	Credits
CSC501	Microprocessor	4

Course objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2. To emphasize on instruction set and logic to build assembly language programs.
3. To prepare students for higher processor architectures and Embedded systems

Course outcomes: On successful completion of course learner will be able to:

1. Describe architecture of x86 processors.
2. Interpret the instructions of 8086 and write assembly and Mixed language programs.
3. Explain the concept of interrupts
4. Identify the specifications of peripheral chip
5. Design 8086 based system using memory and peripheral chips
6. Appraise the architecture of advanced processors

Prerequisite: Digital Electronics and Logic Design

Module No.	Unit No.	Topics	Hrs.
1.0		**The Intel Microprocessors 8086/8088 Architecture**	10
	1.1	• 8086/8088 CPU Architecture, Programmer's Model • Functional Pin Diagram • Memory Segmentation • Banking in 8086 • Demultiplexing of Address/Data bus • Study of 8284 Clock Generator • Study of 8288 Bus Controller • Functioning of 8086 in Minimum mode and Maximum mode • Timing diagrams for Read and Write operations in minimum and maximum mode	
2.0		**Instruction Set and Programming**	12
	2.1	• Addressing Modes • Instruction set – Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions • Assembler Directives and Assembly Language Programming, Macros, Procedures • Mixed Language Programming with C Language and Assembly Language. • Programming based on DOS and BIOS Interrupts (INT 21H, INT 10H)	
3.0		**8086 Interrupts**	6
	3.1	• Types of interrupts • Interrupt Service Routine • Interrupt Vector Table • Servicing of Interrupts by 8086 microprocessor • Programmable Interrupt Controller 8259 – Block Diagram, Interfacing the 8259 in single and cascaded mode, Operating modes, programs for 8259 using ICWs and OCWs	

4.0		**Peripherals and their interfacing with 8086**	**12**
	4.1	Memory Interfacing - RAM and ROM Decoding Techniques – Partial and Absolute	
	4.2	8255-PPI – Block diagram, Functional PIN Diagram, CWR, operating modes, interfacing with 8086.	
	4.3	8253 PIT - Block diagram, Functional PIN Diagram, CWR, operating modes, interfacing with 8086.	
	4.4	8257-DMAC – Block diagram, Functional PIN Diagram, Register organization, DMA operations and transfer modes	
5.0		**Intel 80386DX Processor**	**6**
	5.1	• Architecture of 80386 microprocessor • 80386 registers – General purpose Registers, EFLAGS and Control registers • Real mode, Protected mode, virtual 8086 mode • 80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism	
6.0		**Pentium Processor**	**6**
	6.1	Pentium Architecture Superscalar Operation, Integer & Floating Point Pipeline Stages, Branch Prediction Logic, Cache Organisation and MESI Model	
		Total	**52**

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1 Question paper will comprise of 6 questions, each carrying 20 marks.
1. The students need to solve total 4 questions.
2. Question No.1 will be compulsory and based on entire syllabus.
3. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:
1. 8086/8088 family: Design Programming and Interfacing: John Uffenbeck , PHI.
2. Advanced Microprocessors and Peripherals: K M Bhurchandani, A k Ray McGraw Hill
3. The 80386DX Microprocessor: hardware, Software and Interfacing, Walter A Triebel, Prentice Hall
4. Pentium Processor System Architecture: Tom Shanley & Don Anderson, Addison-Wesley.

Reference Books:
1. Intel Microprocessors: Barry B. Brey, 8th Edition, Pearson Education India
2. Microprocessor and Interfacing: Douglas Hall, Tata McGraw Hill.
3. Advanced MS DOS Programming – Ray Duncan BPB
4. Intel 80386 Datasheets
5. IBM PC Assembly language and Programming: Peter Abel, 5th edition, PHI
6. The Pentium Microprocessor, James Antonakons, Pearson Education

Course Code	Course Name	Credits
CSC502	Database Management System	4

Course objectives:

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Apply normalization techniques to normalize the database
4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Course outcomes: On successful completion of course learner will be able to:

1. Understand the fundamentals of a database systems
2. Design and draw ER and EER diagram for the real life problem.
3. Convert conceptual model to relational model and formulate relational algebra queries.
4. Design and querying database using SQL.
5. Analyze and apply concepts of normalization to relational database design.
6. Understand the concept of transaction, concurrency and recovery.

Prerequisite:

Basic knowledge of Data structure.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction Database Concepts:**	4
	1.1	• Introduction, Characteristics of databases • File system v/s Database system • Users of Database system	
	1.2	• Data Independence • DBMS system architecture • Database Administrator	
2.0		**Entity–Relationship Data Model**	8
	2.1	• The Entity-Relationship (ER) Model: Entity types : Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints : Cardinality and Participation, Extended Entity-Relationship (EER) Model : Generalization, Specialization and Aggregation	
3.0		**Relational Model and relational Algebra**	8
	3.1	• Introduction to the Relational Model, relational schema and concept of keys. • Mapping the ER and EER Model to the Relational Model	
	3.2	• Relational Algebra – unary and set operations, Relational Algebra Queries.	
4.0		**Structured Query Language (SQL)**	12
	4.1	• Overview of SQL	

		• Data Definition Commands, Data Manipulation commands, Data Control commands, Transaction Control Commands.	
	4.2	• Set and string operations, aggregate function - group by, having. • Views in SQL, joins , Nested and complex queries, Integrity constraints :- key constraints, Domain Constraints, Referential integrity , check constraints	
	4.3	• Triggers	
5.0		**Relational–Database Design**	**8**
	5.1	• Pitfalls in Relational-Database designs , Concept of normalization • Function Dependencies , First Normal Form, 2nd , 3rd , BCNF, multi valued dependencies , 4NF.	
6.0		**Transactions Management and Concurrency**	**12**
	6.1	• Transaction concept, Transaction states, ACID properties • Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols.	
	6.2	• Recovery System: Failure Classification, Log based recovery, ARIES, Checkpoint, Shadow paging. • Deadlock handling	
		Total	**52**

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1. G. K. Gupta "Database Management Systems", McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill
3. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson education.
4. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.

Reference Books:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
2. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Publication.
3. Sharaman Shah, "Oracle for Professional", SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, " Database Management Systems ",TMH.

Course Code	Course Name	Credits
CSC 503	**Computer Network**	**4**

Course objective:

1. To introduce concepts and fundamentals of data communication and computer networks.
2. To explore the inter-working of various layers of OSI.
3. To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite.
4. To assess the strengths and weaknesses of various routing algorithms.
5. To understand the transport layer and various application layer protocols.

Course Outcomes:

On successful completion of course learner will be able to:

1. Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model with TCP/IP model.
2. Demonstrate the knowledge of networking protocols at data link layer.
3. Design the network using IP addressing and subnetting / supernetting schemes.
4. Analyze various routing algorithms and protocols at network layer.
5. Analyze transport layer protocols and congestion control algorithms.
6. Explore protocols at application layer .

Prerequisite: Digital Communication Fundamentals

Module No.	Unit No.	Topics	Hrs.
1	**Introduction to Networking**		06
	1.1	Introduction to computer network, network application, network software and hardware components (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services	
	1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layer.	
2	**Physical Layer**		06
	2.1	Introduction to Communication System, digital Communication, Electromagnetic Spectrum	
	2.2	**Guided Transmission Media:** Twisted pair, Coaxial, Fiber optics. Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Infrared, Circuit and Packet Switching	

3	**Data Link Layer**		10
	3.1	DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction(Hamming Code, CRC, Checksum) , Elementary Data Link protocols , Stop and Wait, Sliding Window(Go Back N, Selective Repeat), HDLC	
	3.2	**Medium Access Control sublayer** Channel Allocation problem, Multiple access Protocol(Aloha, Carrier Sense Multiple Access (CSMA/CD), Local Area Networks - Ethernet (802.3)	
4	**Network layer**		14
	4.1	4.1 Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems ,IPv4 Protocol, Network Address Translation (NAT)	
	4.2	**Routing algorithms :** Shortest Path (Dijkastra's), Link state routing, Distance Vector Routing	
	4.3	**Protocols** - ARP,RARP, ICMP, IGMP	
	4.4	**Congestion control algorithms:** Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms	
5	**Transport Layer**		10
	5.1	**The Transport Service**: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers	
	5.2	TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	
6	**Application Layer**		06
	6.1	DNS: Name Space, Resource Record and Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP	

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Textbooks:

1. A.S. Tanenbaum, "Computer Networks", Pearson Education, (4e)
2. B.A. Forouzan, "Data Communications and Networking", TMH (5e)
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Addison Wesley, (6e)

References:

1. S.Keshav: An Engineering Approach To Computer Networking, Pearson
2. Natalia Olifer& Victor Olifer,"Computer Networks:Principles, Technologies & Protocols for Network Design", Wiley India, 2011.
3. Larry L.Peterson, Bruce S.Davie, Computer Networks: A Systems Approach, Second Edition (The Morgan Kaufmann Series in Networking).

Course Code	Course Name	Credits
CSC504	Theory of Computer Science	4

Course Objectives:

1. Acquire conceptual understanding of fundamentals of grammars and languages.
2. Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
3. Develop understanding of different types of Turing machines and applications.
4. Understand the concept of Undecidability.

Course Outcomes: On successful completion of course learner will be able to:

1. Identify the central concepts in theory of computation and differentiate between deterministic and nondeterministic automata, also obtain equivalence of NFA and DFA.
2. Infer the equivalence of languages described by finite automata and regular expressions.
3. Devise regular, context free grammars while recognizing the strings and tokens.
4. Design pushdown automata to recognize the language.
5. Develop an understanding of computation through Turing Machine.
6. Acquire fundamental understanding of decidability and undecidability.

Prerequisite: Discrete Mathematics

Module No.	Unit No.	Topics	Theory Hrs.	Tutorial Hrs.
1.0		**Basic Concepts and Finite Automata**	09	03
	1.1	• Alphabets, Strings, Languages, Closure properties. • Finite Automata (FA) and Finite State machine (FSM).		
	1.2	• Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers • NFA to DFA Conversion • Equivalence between NFA with and without ε- transitions • Minimization of DFA • FSM with output: Moore and Mealy machines, Equivalence • Applications and limitations of FA		
2.0		**Regular Expressions and Languages**	06	02
	2.1	• Regular Expression (RE) • Equivalence of RE and FA, Arden's Theorem • RE Applications		
	2.2	• Regular Language (RL) • Closure properties of RLs • Decision properties of RLs • Pumping lemma for RLs		
3.0		**Grammars**	08	03
	3.1	• Grammars and Chomsky hierarchy		
	3.2	• Regular Grammar (RG)		

		• Equivalence of Left and Right linear grammar • Equivalence of RG and FA		
	3.3	**Context Free Grammars (CFG)** • Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity. • Simplification and Applications. • Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF). • CFLs - Pumping lemma, Closure properties		
4.0		**Pushdown Automata(PDA)**	**04**	**01**
	4.1	• Definition, Transitions ,Language of PDA • Language acceptance by final state and empty stack • PDA as generator, decider and acceptor of CFG. • Deterministic PDA , Non-Deterministic PDA • Application of PDA.		
5.0		**Turing Machine (TM)**	**09**	**03**
	5.1	• Definition, Transitions • Design of TM as generator, decider and acceptor. • Variants of TM: Multitrack, Multitape • Universal TM. • Equivalence of Single and Multi Tape TMs. • Applications, Power and Limitations of TMs. • Context Sensitivity and Linear Bound Automata.		
6.0		**Undecidability**	**03**	**01**
	6.1	• Decidability and Undecidability, • Recursive and Recursively Enumerable Languages. • Halting Problem, • Rice's Theorem, • Post Correspondence Problem,		
		Total	**39**	**13**

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, “Introduction to Automata Theory, Languages andComputation”, Pearson Education.
2. Michael Sipser, “Theory of Computation”, Cengage learning.
3. Vivek Kulkarni, “Theory of Computation”, Oxford University Press, India.

Reference Books:

1. J. C. Martin, “Introduction to Languages and the Theory of Computation”, Tata McGraw Hill.
2. Kavi Mahesh, “Theory of Computation: A Problem Solving Approach”, Wiley-India.

Course Code	Course Name	Credits
CSDLO5011	**Multimedia System**	**4**

Course objectives:

1. To introduce students about basic fundamentals and key aspects of Multimedia system.
2. To provide knowledge of compression techniques of different multimedia components
3. To help students to understand multimedia communication standards along with technology environment
4. To provide an opportunity to gain hands-on experience in building multimedia applications.

Course outcomes: Learner will be able to

1. To identify basics of multimedia and multimedia system architecture.
2. To understand different multimedia components.
3. To explain file formats for different multimedia components.
4. To analyze the different compression algorithms.
5. To describe various multimedia communication techniques.
6. To apply different security techniques in multimedia environment.

Prerequisite: Computer Fundaments and Graphics.

Module No.	Unit No.	Topics	Hrs.
1	**Introduction to Multimedia**		8
	1.1	Overview	
	1.2	Objects and Elements of Multimedia	
	1.3	Applications of Multimedia	
	1.4	Multimedia Systems Architecture – IMA, Workstation, Network	
	1.5	Types of Medium (Perception, Representation-..)	
	1.6	Interaction Techniques	
	1.7	I/O devices - Salient features (Electronic Pen , Scanner, Digital Camera, Printers, plotters), Storage Media (Jukebox, DVD), Multimedia Databases	
2	**Text & Digital Image**		10
	Text		
	2.1	Visual Representation, Digital Representation.	
	2.2	File Formats: RTF, TIFF.	
	2.3	Compression Techniques : Huffman Coding, RLE, CCITT group 3 1D	

	Digital Image		
	2.4	Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), examples of images (X-Ray, fractal, synthetic, acoustic).	
	2.5	File formats: BMP, JPG	
	2.6	Compression Techniques: fundamentals (coding, interpixel and psychovisual redundancies),Types – lossless and lossy, Lossless Compression Algorithms– Shannon-Fano, CCITT group 4 2D, Lossy Compression Algorithm – JPEG	
3	**Digital Audio**		8
	3.1	Basic Sound Concepts: computer representation of sound,	
	3.2	File Formats – WAV, MPEG Audio	
	3.3	Compression: PCM, DM, DPCM	
4	**Digital Video**		8
	4.1	Digitization of Video, types of video signals (component, composite and S-video),	
	4.2	File Formats: MPEG Video, H.261	
	4.3	Compression: MPEG	
5	**Multimedia Network Communication and Representation**		10
	5.1	Quality of Service	
	5.2	Multimedia over IP (RTP, RTSP, RTCP,RSVP)	
	5.3	Representation- Authoring systems and user interface	
6	**Multimedia Security**		8
	6.1	Requirements and properties	
	6.2	Mechanisms – Digital Signatures, Steganographic methods	
	6.3	Sample applications – unidirectional distributed systems, information systems and conference systems	
		Total	**52**

Text Books:

1. Multimedia System Design, Prabhat K. Andleigh& Kiran Thakrar, PHI.
2. Multimedia Communication Systems: Techniques, Standards & Networks, K. R. Rao, Zoran S. Bojkovic&Dragorad A. Milovanovic, TMH.
3. Multimedia Systems, K. Buford, PHI.
4. Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

Reference Books:

1. Multimedia Computing Communications & Applications, Ralf Steinmetz & Klara Nahrstedt, Pearson.
2. Digital Image processing, Rafael C. Gonzalez, Richard E. Woods, Pearson.
3. Multimedia Applications, Ralf Steinmetz & Klara Nahrstedt, Springer International Edition

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Suggested List of Experiments:

1. Create a new file format to store a multimedia data.
2. Implement a compression technique and check the efficiency on different inputs.
3. To develop a theme based multimedia presentation
4. To add a digital signature onto a document
5. To perform steganography of text onto an image and check the efficiency with different inputs.

** Perform laboratory work of this course in ‘CSL504: Web Design Lab’ as experiments or mini project.

Course Code	Course Name	Credits
CSDLO5012	**Advanced Operating Systems**	4

Course Objectives:

1. To understand design issues of Advanced Operating systems.
2. To understand the architecture, kernel and file management of Unix operating system.
3. To understand basic concepts and need of Distributed operating systems.
4. To understand concepts and working of different advanced Operating systems like Multiprocessor OS, Real time OS, Mobile OS.

Course Outcomes: On successful completion of the course student should be able to

1. Demonstrate understanding of design issues of Advanced operating systems and compare different types of operating systems.
2. Analyse design aspects and data structures used for file subsystem, memory subsystem and process subsystem of Unix OS.
3. Demonstrate understanding of different architectures used in Multiprocessor OS and analyse the design and data structures used in Multiprocessor operating systems.
4. Differentiate between threads and processes and compare different processor scheduling algorithms used in Multiprocessor OS
5. Classify Real Time OS and analyse various real time scheduling algorithms.
6. Explore architectures and design issues of Mobile OS,Virtual OS, Cloud OS.

Prerequisite: Operating Systems

Module	Unit	Detailed Content	Hrs
1		Introduction	04
		Functions of operating systems, Design approaches: layered, kernel based and virtual machine approach, types of advanced operating systems (NOS, DOS, Multiprocessor OS, Mobile OS, RTOS, Cloud OS)	
2		Unix Kernel and File Management	14
	2.1	System Structure, User Perspective, Architecture of Unix Operating System	
	2.2	Buffer cache: Header, Buffer Pool, Retrieving, Reading and Writing Buffer	
	2.3	File Representation: inodes: Structure of file Directories, Path conversion to inode, superblock, inode assignment, allocation of disk blocks	
3		Unix Process and Memory management	12
	3.1	Detailed design of Process Structure: Kernel Data structures for process, Structure of Uarea and Process table, Process states and Transitions	
	3.2	Context of a Process: Static and Dynamic area of context, Saving the Context Layout of System Memory, Regions, Mapping regions	

		with Process, page table and mapping virtual address to physical address.	
4		Distributed Operating system concepts	06
		Goals, Distributed Computing Models, Hardware Concepts, Software Concepts, Architecture of DOS. Design Issues: Transparency, Flexibility, Scalability, Reliability, Performance, fault tolerance	
5		Multiprocessor Operating System	08
	5.1	Introduction, Basic multiprocessor system architectures, design issues, Threads, Process synchronization: the test and set instruction, the swap instruction, implementation of the process wait	
	5.2	Processor scheduling: Issues, Co-scheduling, Smart scheduling, Affinity Based scheduling	
6		Real Time Operating Systems and Mobile OS	08
	6.1	Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Scheduling in RTOS: Clock driven: cyclic, Event driven: EDF and rate monotonic scheduling.	
	6.2	Mobile OS: Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design issues	

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1. The Design of the UNIX Operating System, PHI, by Maurice J. Bach.
2. Distributed Computing 2nd Edition, Mahajan and Seema Shah, OXford.
3. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G Shivaratri.
4. Mobile Computing by Rajkamal, 1st edition, Oxford.
5. Real Time Operating System, Jane W.S. Liu, Pearson.

Reference Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. "Real-Time Systems: Theory and Practice", Rajib Mall, Pearson Education India, 2006.

Course Code	Course Name	Credit
CSDLO5013	**Advanced Algorithm**	**4**

Course Objectives:

1. To provide mathematical approach for Analysis of Algorithms.
2. To teach advanced data structures.
3. To solve complex problems in real life applications.

Course Outcomes: At the end of the course student will be able to

1. Describe analysis techniques for algorithms.
2. Identify appropriate data structure and design techniques for different problems
3. Identify appropriate algorithm to be applied for the various application like geometric modeling, robotics, networking, etc.
4. Appreciate the role of probability and randomization in the analysis of algorithm
5. Analyze various algorithms.
6. Differentiate polynomial and non deterministic polynomial algorithms.

Prerequisites: Data structures, Discrete mathematics and Analysis of Algorithm

Sr. No.	Module	Detailed Content	Hours
1	**Fundamental of Algorithms**	**Introduction-** **Complexity-**complexity of recursive algorithms, finding complexity by tree method, master method, proving technique (contradiction, mathematical induction). **Amortized analysis-** aggregate analysis, accounting analysis, potential analysis dynamic tables	08
2	**Probabilistic Analysis and Randomized Algorithm**	The hiring problem Indicator random variables Randomized algorithms Probabilistic analysis and further uses of indicator random variable	08
3	**Advanced Data Structure**	**Introduction to trees and heap** **Red-Black Trees:** properties of red-black trees , Operations on Red-black trees **Binomial Heaps:** Binomial trees and binomial heaps, Operation on Binomial heaps **Analysis of all above operations**	12
4	**Maximum Flow**	Flow networks , the ford Fulkerson method ,max bipartite matching , push Relabel Algorithm , The relabel to front algorithm	08

5	**Computational Geometry**	Line Segment properties, Determining whether any pair of segment intersects, finding the convex hull, Finding the closest pair of points.	08
6	**NP-Completeness And Approximation Algorithms**	NP-Completeness: NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems-The vertex-cover problem, The travelling salesman problem	08

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI, India Second Edition.
2. Horowitz, Sahani and Rajsekaran, "Fundamentals of Computer Algorithms", Galgotia.
3. Harsh Bhasin, "Algorithms – Design and Analysis", Oxford, 2015.

Reference Books:

1. Rajeev Motwani, Prabhakar Raghavan, " Randomized Algorithm", Cambridge University
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI
3. Vijay V. Vajirani, "Approximation Algorithms",Springer.

Internal Assessment:

Assessment consists of two tests out of which; one (T1) should be compulsory class test (on at least 02 Modules) and the other (T2) is either a class test or assignments on live problems or course project

Theory Examination:

1. Question paper will comprise of total six questions.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Lab Code	Lab Name	Credits
CSL501	**Microprocessor Lab**	**1**

Lab Objective:

1. To emphasize on use of Assembly language program.
2. To prepare students for advanced subjects like embedded system and IOT.

Lab Outcome:

1. Use appropriate instructions to program microprocessor to perform various task
2. Develop the program in assembly/ mixed language for Intel 8086 processor
3. Demonstrate the execution and debugging of assembly/ mixed language program

Description:

A microprocessor is the most important unit within a computer system. It is responsible for processing the unique set of instructions and processes. It is a controlling unit of a computer, capable of performing Arithmetic Logical Unit (ALU) operations and communicating with the other devices connected to it. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. When computer is turned on, the microprocessor gets the first instruction from the basic input/output system that comes with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or an application program provides instructions to perform.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Use of programming tools (Debug/TASM/MASM/8086kit) to perform basic arithmetic operations on 8bit/16 bit data
2	Code conversion (Hex to BCD, BCD to Hex, ASCII to BCD, BCD to ASCII)
3	Assembly programming for 16-bit addition, subtraction, multiplication and division (menu based)
4	Assembly program based on string instructions (overlapping/ non-overlapping block transfer/ string search/ string length)
5	Assembly program to display the contents of the flag register.
6	Mixed Language program to shift a number for given number of times
7	Assembly program to find the GCD/ LCM of two numbers
8	Assembly program to sort numbers in ascending/ descending order

9	Mixed Language program to increment, decrement the size of the cursor and also to disable it.
10	Assembly program to find minimum/ maximum no. from a given array.
11	Program for device driver (printer/mouse/keyboard)
12	Program based on 32 bit architecture (e.g. Switching from real mode to protected mode using DPMI driver, 32bit multiplication)
13	Assembly program to find factorial of number using procedure
14	Program and interfacing using 8255/ 8253
15	Program and interfacing of ADC/ DAC/ Stepper motor

Term Work:

Term should consist of at least 10 experiments.
Journal must include –

- At least one experiment with use of macros/ procedures
- At least five experiments with use of DOS, BIOS interrupts
- At least two assignments

At least one experiment on hardware interfacing is desirable
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum marks in term work.

Term Work: 25 marks (Total) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Theory + Practical Attendance)

Oral & Practical exam will be based on the CSL501and CSC501 syllabus.

Lab Code	Lab Name	Credits
CSL 502	**Computer Network Lab**	**1**

Lab Objective:
To practically explore OSI layers and understand the usage of simulation tools.

Lab Outcomes:
On successful completion of course learner will be able to

1. Design and setup networking environment in Linux.
2. Use Network tools and simulators such as NS2, Wireshark etc. to explore networking algorithms and protocols.
3. Implement programs using core programming APIs for understanding networking concepts.

Description
The experiments are expected to be performed in Linux environment.

Suggested List of Experiments

Sr. No	Title of Experiments
1.	Setup a network and configure IP addressing, subnetting, masking. (Eg. CISCO Packet Tracer, Student Ed.)
2.	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route)
3.	Build a simple network topology and configure it for static routing protocol using packet tracer.
4.	Perform network discovery using discovery tools (eg. mrtg)
5.	Use Wireshark to understand the operation of TCP/IP layers : ● Ethernet Layer : Frame header, Frame size etc. ● Data Link Layer : MAC address, ARP (IP and MAC address binding) ● Network Layer : IP Packet (header, fragmentation), ICMP (Query and Echo) ● Transport Layer: TCP Ports, TCP handshake segments etc. ● Application Layer: DHCP, FTP, HTTP header formats
6.	CRC/ Hamming code implementation.
7.	Stop and wait protocol/ sliding window (selective repeat / Go back N)
8.	Use simulator (Eg. NS2) to understand functioning of ALOHA, CSMA/CD.
9.	a. Set up multiple IP addresses on a single LAN. b. Using nestat and route commands of Linux, do the following:

	● View current routing table ● Add and delete routes ● Change default gateway c. Perform packet filtering by enabling IP forwarding using IPtables in Linux.
10.	Implementation of DVR/ LSR in NS2/(any other simulator)
11.	Socket programming using TCP or UDP
12.	Simulate congestion control (leaky bucket / token bucket).
13.	Perform File Transfer and Access using FTP
14.	Perform Remote login using Telnet server

Term Work:

Laboratory work should be based on above syllabus of suggested list having minimum 10 experiments, covering all layers.

Experiments ---------- (15) Marks
Assignments ---------- (05) Marks
Attendance (Theory + Practical) ---------- (05) Marks
Total ---------- (25) Marks

Oral & Practical exam will be based on the **above and CSC 503 : Computer Network**.

Lab Code	Lab Name	Credits
CSL503	**Database & Information System Lab**	**1**

Lab Outcome: On successful completion of course learner will be able to:

1. Design and draw ER and EER diagram for the real life problem with software tool.
2. Create and update database and tables with different DDL and DML statements.
3. Apply /Add integrity constraints and able to provide security to data.
4. Implement and execute Complex queries.
5. Apply triggers and procedures for specific module/task
6. Handle concurrent transactions and able to access data through front end (using JDBC ODBC connectivity.)

Description:

- The below suggested experiments needs to be performed by a group of **3/4 students.**
- Select any database management system and conduct all experiments based on the same topic.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create and populate database using Data Definition Language (DDL) and DML Commands for you're the specified System.
4	Apply Integrity Constraints for the specified system.
5	Perform Simple queries, string manipulation operations.
6	Nested queries and Complex queries
7	Perform Join operations
8	Views and Triggers
9	Functions , cursor and procedure.
10	Transaction and Concurrency control
11	Mini project- Creating a Two-tier client-server database applications using JDBC

Assignment: Perform Normalization -1NF, 2NF, 3NF

Term Work:

Laboratory work will be based on DBMS syllabus with minimum 10 experiments to be incorporated.
Experiments should be completed by students on the given time duration
Experiments ---------- (10) Marks
Mini Project---------- (10) Marks
Attendance (Theory + Practical) ---------- (05) Marks
Total ---------- (25) Marks

Practical and Oral :

Practical and oral Exam should be conducted for the Lab, on Database Management System subject for given list of experiments .

Implementation ---------- ----------(15) Marks
Oral ----------(10) Marks
Total ----------(25) Marks

****Oral & Practical exam** will be based on the above and CSC502: 'DBMS' syllabus

Text Books:

1. G. K. Gupta :"Database Management Systems", McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, :"Database System Concepts", 6th Edition, McGraw – Hill
3. Elmasri and Navathe, " Fundamentals of Database Systems", 5thEdition, PEARSON
4. Peter Rob and Carlos Coronel, " Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.

Reference Books :

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g,Black Book, Dreamtech Press
2. PaulrajPonniah, " Introduction to Database Management",Wiley publication
3. Raghu Ramkrishnan and Johannes Gehrke, " Database Management Systems",TMH
4. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

Course Code	Course Name	Credits
CSL504	**Web Design Lab**	**2**

Course objectives:

1. To design and create web pages using HTML5 and CSS3.
2. To Create web pages and provide client side validation.
3. To create dynamic web pages using server side scripting.
4. To use MVC framework for web application development.

Course outcomes: On completion of course learner will be able to:

1. Understand the core concepts and features of Web Technology
2. Design static web pages using HTML5 and CSS3
3. Apply the concept of client side validation and design dynamic web pages using JavaScript and JQuery.
4. Evaluate client and server side technologies and create Interactive web pages using PHP , AJAX with database connectivity using MySQL.
5. Understand the basics of XML, DTD and XSL and develop web pages using XML / XSLT.
6. Analyze end user requirements and Create web application using appropriate web technologies and web development framework

Prerequisite: Data Structures, Basics of Programming Languages

Module No.	Unit No.	Topics	Hrs.
1.0		**INTRODUCTION TO WWW**	**2**
	1.1	Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol	
	1.2	Overview of HTTP, HTTP request – response — Generation of dynamic web pages- W3C Validator, How web works - Setting up the environment (LAMP/XAMP/WAMP server)	
2.0		**CLIENT SIDE PROGRAMMING**	**6**
	2.1	**Markup Language (HTML):** Introduction to HTML and HTML5 - Formatting and Fonts –Commenting Code – Anchors – Backgrounds – Images – Hyperlinks	
	2.2	Lists – Tables – Frames - HTML Forms and controls.	
	2.3	**Cascading Style Sheet (CSS):** The need for CSS, Introduction to CSS 3 – Basic syntax and structure ,CSS Properties-Inline Styles – Embedding Style Sheets	
	2.4	Linking External Style Sheets – Backgrounds –Box Model(Introduction , Border Properties, Padding Properties, Margin Properties), Manipulating text - Margins and Padding - Positioning using CSS., Creating page Layout and Site Designs	
3.0		**INTRODUCTION TO JAVASCRIPT**	**6**
	3.1	Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements, Functions - Objects - Array, Date and Math related Objects	
	3.2	Document Object Model - Event Handling Controlling Windows &	

		Frames and Documents Form handling and validations.	
	3.3	**Advanced JavaScript** - Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript	
	3.4	Object constructor and Prototyping - Sub classes and Super classes – JSON - jQuery and AJAX., Rich Internet Application with AJAX, JQuery Framework	
4.0		**SERVER SIDE PROGRAMMING**	**8**
	4.1	Introduction - Programming basics - Print/echo - Variables and constants – Strings and Arrays	
	4.2	Operators, Control structures and looping structures – Functions – Reading Data in Web Pages	
	4.3	Embedding PHP within HTML - Establishing connectivity with MySQL database, cookies, sessions and Authentication	
	4.4	AJAX with PHP - AJAX with Databases	
5.0		**XML**	**4**
	5.1	Dynamic page generation (adding interactivity, styles, using HTML, DHTML, XHTML, CSS, Java Script), XML –DTD(Document Type Definition) - XML Schema	
	5.2	XML –DTD(Document Type Definition) - XML Schema - Document Object Model - Presenting XML - Using XML Parsers: DOM and SAX,XSL-eXtensible Style sheet Language	
6.0		**WEB DEVELOPMENT FRAMEWORK**	**2**
	6.1	Introduction to Composer - MVC Architecture	
	6.2	Web Application Development using web development framework :-Introduction to Laravel, Development of Web pages using Laravel., Example web applications – Interactive websites, web based information systems , blogs, social networking sites etc.	
		Total	**28**

Text Books:

1. Ralph Moseley , M.T. Savliya ," Developing Web Applications", Willy India, Second Edition, ISBN: 978-81-265-3867-6
2. "Web Technology Black Book", Dremtech Press, First Ediction, 978-7722-997
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY,2014. (http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascript_CSS_HTML5__Robin_Nixon_3e.pdf)
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications. https://ebooks-it.org/0470082801-ebook.htm

Reference Books:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and AtulKahate, "Web Technologies", Second Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", Third Edition, Tata McGraw Hill, 2013.

4. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
5. Steven Holzner, “The Complete Reference - PHP”, Tata McGraw Hill, 2008
6. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012.

Digital Material:

1. www.nptelvideos.in
2. www.w3schools.com
3. http://spoken-tutorial.org

Term work Assessment:

Term work will consist of lab experiments testing all the technologies included in syllabus and a **Mini project** solving an appropriate problem using the above technology.

Module	Detailed Contents	Lab Sessions
1	Installation and Setting of LAMP / WAMP / XAMP	1
2	Create Simple web page using HTML5	1
3	Design and Implement web page using CSS3 and HTML5	1
4	Form Design and Client Side Validation using : a. Javascript and HTML5 b. Javascript and JQuery	2
5	Develop simple web page using PHP	1
6	Develop interactive web pages using PHP with database connectivity MYSQL	2
7	Develop XML web page using DTD, XSL	1
8	Implement a webpage using Ajax and PHP	1
9	Hosting the website with Domain Registration Process.	1
10	Design a Web application using Laravel Framework	3

*** *Setting up /buying the web host management system for hosting of mini project is recommended.**

Term Work: The distribution of marks for term work shall be as follows:

- Lab Assignments : 10 Marks
- Mini Project : 10 Marks
- Attendance : 05 Marks

Practical & Oral Examination:

Practical & Oral examination is to be conducted by pair of internal and external examiners based on the above syllabus.

Course Code	Course Name	Credits
CSL505	**Business Communication & Ethics**	**02**

Course Objectives:

1. To inculcate professional and ethical attitude at the work place
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving.

Course Outcomes: Learner will be able to…

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education , upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills

Module	**Detailed Contents**	**Hrs.**
01	**Report Writing**	**05**
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types: Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports(Memo, Letter, Short and Long Report)	
02	**Technical Writing**	**03**
2.1	Technical Paper Writing(IEEE Format)	
2.2	Proposal Writing	
03	**Introduction to Interpersonal Skills**	**09**
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	**Meetings and Documentation**	**02**
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	**Introduction to Corporate Ethics**	**02**
5.1	Professional and work ethics (responsible use of social media Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	

06	**Employment Skills**	**07**
6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		28

Assessment:

List of Assignments

1. Report Writing(Theory)
2. Technical Proposal
3. Technical Paper Writing(Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills(Group activities and Role plays)
5. Interpersonal Skills(Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation(Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics(Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work

Term work shall consist of all assignments from the list. The distribution of marks for term work shall be as follows:

Book Report	**10 marks**
Assignments:	**10 marks**
Project Report Presentation:	**15 marks**
Group Discussion:	**10 marks**
Attendance:	**05 marks**

References:

1. Fred Luthans," Organizational Behavior", Mc GrawHill,
2. Lesiker and Petit," Report Writing for Business ",McGrawHill
3. R. Subramaniam," Professional Ethics" Oxford University Press
4. Huckin and Olsen, "Technical Writing and Professional Communication ",McGraw
5. Raman and Sharma,FundamentalsofTechnicalCommunication,OxfordUniversityPress
6. Hill Wallace and Masters," Personal Development for Life and Work", Thomson Learning.
7. Heta Murphy," *Effective Business Communication* ",McGraw Hill, edition
8. R.C Sharma and Krishna Mohan," *Business Correspondence and Report Writing",*
9. Raman Sharma, "*Communication Skills",* Oxford University Press
10. B N Ghosh," *Managing Soft Skills for Personality Development* ",Tata McGraw Hill
11. Dufrene, Sinha,"*BCOM*", Cengage Learning, 2ndedition
12. Bell. Smith,"ManagementCommunication"WileyIndiaEdition,3rdedition.
13. Dr. K. Alex, "Soft Skills", S Chand and Company
14. Robbins Stephens P., "Organizational Behavior", Pearson Education
15. https://grad.ucla.edu/asis/agep/advsopstem.pdf

Course Code	Course Name	Credits
CSC601	**Software Engineering**	**4**

Course objectives:

The main objective of the course is to introduce to the students about the product that is to be engineered and the processes that provides a framework for the engineering methodologies and practices.

1. To provide the knowledge of software engineering discipline.
2. To apply analysis, design and testing principles to software project development.
3. To demonstrate and evaluate real time projects with respect to software engineering principles.

Course outcomes:

On successful completion of course, learners will be able to:

1. Understand and demonstrate basic knowledge in software engineering.
2. Identify requirements, analyze and prepare models.
3. Plan, schedule and track the progress of the projects.
4. Design & develop the software projects.
5. Identify risks, manage the change to assure quality in software projects.
6. Apply testing principles on software project and understand the maintenance concepts.

Prerequisite:

1. Concepts of Object Oriented Programming & Methodology
2. Knowledge of developing applications with front end & back end connectivity.

Course syllabus:

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction To Software Engineering and Process Models**	**08**
	1.1	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM)	
	1.2	Generic Process Model, **Prescriptive Process Models:** The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model	
2.0		**Requirements Analysis and Modelling**	**08**
	2.1	Requirement Elicitation, Software requirement specification (SRS), Developing Use Cases (UML)	
	2.2	Requirement Model – Scenario-based model, Class-based model, Behavioural model.	
3.0		**Project Scheduling and Tracking**	**08**
	3.1	Management Spectrum, 3Ps (people, product and process)	
	3.2	Process and Project metrics	

	3.3	**Software Project Estimation:** LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques	
	3.4	**Project scheduling:** Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis	
4.0		**Software Design**	**10**
	4.1	Design Principles, Design Concepts, Effective Modular Design – Cohesion and Coupling	
	4.2	Architectural Design	
	4.3	Component-level design	
	4.4	User Interface Design	
5.0		**Software Risk, Configuration Management & Quality Assurance**	**08**
	5.1	Risk Identification, Risk Assessment, Risk Projection, RMMM	
	5.2	Software Configuration management, SCM repositories, SCM process	
	5.3	Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough	
6.0		**Software Testing and Maintenance**	**10**
	6.1	Strategic Approach to Software Testing, Unit testing, Integration testing Verification, Validation Testing, System Testing	
	6.2	Software Testing Fundamentals, White-Box Testing , Basis Path Testing, Control Structure Testing, Black-Box Testing,	
	6.3	Software maintenance and its types, Software Re-engineering, Reverse Engineering	
		Total	**52**

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 06 questions, each carrying 20 marks.
2. The students need to solve total 04 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Text Books:
1. Roger Pressman, “Software Engineering: A Practitioner’s Approach",McGraw-Hill Publications 2. Ian Sommerville, “Software Engineering”, Pearson Education (9th edition)
3. Ali Behfrooz and Fredeick J.Hudson, "Software Engineering Fundamentals", Oxford University Press

Reference Books:
1. Ugrasen Suman, “Software Engineering – Concepts and Practices”, Cengage Learning
2. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa
3. Jibitesh Mishra and Ashok Mohanty, “Software Engineering”, Pearson
4. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India

Course Code	Course Name	Credits
CSC602	**System Programming And Compiler Construction**	**4**

Course objectives:

1. To understand the role and functioning of various system programs over application program.
2. To understand basic concepts and designing of assembler, Macro processor and role of static and dynamic loaders and linkers.
3. To understand the need to follow the syntax in writing an application program and to learn the how the analysis phase of compiler is designed to understand the programmer's requirements without ambiguity.
4. To synthesize the analysis phase outcomes to produce the object code that is efficient in terms of space and execution time.

Course outcomes: On successful completion of course learner will be able to:

1. Identify the relevance of different system programs.
2. Describe the various data structures and passes of assembler design.
3. Identify the need for different features and designing of macros.
4. Distinguish different loaders and linkers and their contribution in developing efficient user applications.
5. Construct different parsers for given context free grammars.
6. Justify the need synthesis phase to produce object code optimized in terms of high execution speed and less memory usage

Prerequisite: Data Structures, Theoretical computer science, Operating system. Computer Organization and Architecture, Microprocessor

Module No.	Unit No.	Topics	Hrs.
1	**Introduction to System Software**	Concept of System Software, Goals of system softwares, system program and system programming, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.	**2**
2	**Assemblers**	Elements of Assembly Language programming, Assembly scheme, pass structure of assembler, Assembler Design: Two pass assembler Design and single pass Assembler Design for Hypothetical / X86 family processor, data structures used.	**10**
3	**Macros and Macro Processor**	Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested. Design of single pass macro processor, data structures used.	**8**
4	**Loaders and Linkers**	Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.	**8**

5	**Compilers: Analysis Phase**	Introduction to compilers, Phases of compilers: Lexical Analysis- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyser, data structures used . Syntax Analysis- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- Operator precedence parser, SLR Semantic Analysis, Syntax directed definitions.	**12**
6	**Compilers: Synthesis phase**	Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, Three address codes: Triples and Quadruples. Code Optimization: Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent. Code Generation: Issues in the design of code generator, code generation algorithm. Basic block and flow graph.	**12**

Text Books:

1. D. M Dhamdhere: Systems programming, Tata McGraw Hill
2. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman : Compilers Principles, Techniques and Tools , Pearson Education , Second Edition.
3. J. J. Donovan: Systems Programming Tata McGraw Hill Publishing Company

Reference Books:

1. Lex &yacc, 2nd Edition by John R. Levine, Tony Mason & Doug Brown O'Reilly
2. Compiler construction D,M.Dhamdhere second edition MACMILLAM.
3. Compiler construction : principles and practices , Kenneth C.Louden ,CENGAGE Learning
4. System software : An introduction to system programming , Leland L. Beck, Pearson

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC603	Data Warehousing and Mining	4

Course objectives:

1. To identify the scope and essentiality of Data Warehousing and Mining.
2. To analyze data, choose relevant models and algorithms for respective applications.
3. To study spatial and web data mining.
4. To develop research interest towards advances in data mining.

Course outcomes: On successful completion of course learner will be able to:

1. Understand Data Warehouse fundamentals, Data Mining Principles
2. Design data warehouse with dimensional modelling and apply OLAP operations.
3. Identify appropriate data mining algorithms to solve real world problems
4. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
5. Describe complex data types with respect to spatial and web mining.
6. Benefit the user experiences towards research and innovation.

Prerequisite: Basic database concepts, Concepts of algorithm design and analysis.

Module No.	Topics	Hrs.
1.0	**Introduction to Data Warehouse and Dimensional modelling:** Introduction to Strategic Information, Need for Strategic Information, Features of Data Warehouse, Data warehouses versus Data Marts, Top-down versus Bottom-up approach. Data warehouse architecture, metadata, E-R modelling versus Dimensional Modelling, Information Package Diagram, STAR schema, STAR schema keys, Snowflake Schema, Fact Constellation Schema, Factless Fact tables, Update to the dimension tables, Aggregate fact tables.	8
2.0	**ETL Process and OLAP:** Major steps in ETL process, Data extraction: Techniques, Data transformation: Basic tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Analysis, Hypercubes, OLAP operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models : MOLAP, ROLAP.	8
3.0	**Introduction to Data Mining, Data Exploration and Preprocessing:** Data Mining Task Primitives, Architecture, Techniques, KDD process, Issues in Data Mining, Applications of Data Mining, Data Exploration :Types of Attributes, Statistical Description of Data, Data Visualization, Data Preprocessing: Cleaning, Integration, Reduction: Attribute subset selection, Histograms, Clustering and Sampling, Data Transformation & Data Discretization: Normalization, Binning, Concept hierarchy generation, Concept Description: Attribute oriented Induction for Data Characterization.	10

4.0	**Classification, Prediction and Clustering:** Basic Concepts, Decision Tree using Information Gain, Induction: Attribute Selection Measures, Tree pruning, Bayesian Classification: Naive Bayes, Classifier Rule - Based Classification: Using IF-THEN Rules for classification, Prediction: Simple linear regression, Multiple linear regression Model Evaluation & Selection: Accuracy and Error measures, Holdout, Random Sampling, Cross Validation, Bootstrap, Clustering: Distance Measures, Partitioning Methods (*k*-Means, *k*-Medoids), Hierarchical Methods(Agglomerative, Divisive)	**12**
5.0	**Mining Frequent Patterns and Association Rules:** Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Frequent Pattern Mining, Efficient and Scalable Frequent Item set Mining Methods: Apriori Algorithm, Association Rule Generation, Improving the Efficiency of Apriori, FP growth, Mining frequent Itemsets using Vertical Data Format, Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules	**8**
6.0	**Spatial and Web Mining:** Spatial Data, Spatial Vs. Classical Data Mining, Spatial Data Structures, Mining Spatial Association and Co-location Patterns, Spatial Clustering Techniques: CLARANS Extension, Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining, Applications of Web Mining	**6**
	Total	**52**

Text Books:

1. PaulrajPonniah, “Data Warehousing: Fundamentals for IT Professionals”, Wiley India.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd edition.
3. ReemaTheraja “Data warehousing”, Oxford University Press.
4. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.

Reference Books:

1. Ian H. Witten, Eibe Frank and Mark A. Hall " Data Mining ", 3rd Edition Morgan kaufmann publisher.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining", Person Publisher.
3. R. Chattamvelli, "Data Mining Methods" 2nd Edition NarosaPublishing House.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC604	Cryptography and System Security	4

Course Objectives:

1. To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
2. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3. To explore the design issues and working principles of various authentication protocols, PKI standards and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
4. To develop the ability to use existing cryptographic utilities to build programs for secure communication.

Course Outcomes: At the end of the course learner will able to

1. Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
4. Apply different digital signature algorithms to achieve authentication and design secure applications
5. Understand network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Analyze and apply system security concept to recognize malicious code.

Detailed Syllabus:

Module No	Unit No	Detailed Content	Hrs
1	**Introduction & Number Theory**		10
	1.1	Security Goals, Services, Mechanisms and attacks, The OSI security architecture, Network security model, Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography.	
	1.2	Modular Arithmetic and Number Theory:- Euclid's algorithm–Prime numbers-Fermat's and Euler's theorem- Testing for primality -The Chinese remainder theorem, Discrete logarithms.	
2	**Symmetric and Asymmetric key Cryptography and key Management**		12

	2.1	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC5 algorithm.	
	2.2	Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, ElGamal Algorithm.	
	2.3	Key management techniques: using symmetric and asymmetric algorithms and trusted third party. Diffie Hellman Key exchange algorithm.	
3	**Hashes, Message Digests and Digital Certificates**		06
	3.1	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC.	
	3.2	Digital Certificate: X.509, PKI	
4	**Authentication Protocols & Digital signature schemes**		08
	4.1	User Authentication and Entity Authentication, One-way and mutual authentication schemes, Needham Schroeder Authentication protocol, Kerberos Authentication protocol.	
	4.2	Digital Signature Schemes – RSA, ElGamal and Schnorr signature schemes.	
5	**Network Security and Applications**		10
	5.1	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing.	
	5.2	Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial of Service Attacks.	
	5.3	Internet Security Protocols: SSL, IPSEC, Secure Email: PGP, Firewalls, IDS and types, Honey pots	
6	**System Security**		06
	6.1	Software Vulnerabilities: Buffer Overflow, Format string, cross-site scripting, SQL injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	

Text Books:

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
3. Bernard Menezes, "Cryptography & Network Security", Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley.

Reference Books:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

1. Question paper will comprise of total six questions.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Credits
CSDLO6021	**Machine Learning**	**04**

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with regression methods, classification methods, clustering methods.
3. To become familiar with Dimensionality reduction Techniques.

Course Outcomes: Students will be able to-

1. Gain knowledge about basic concepts of Machine Learning
2. Identify machine learning techniques suitable for a given problem
3. Solve the problems using various machine learning techniques
4. Apply Dimensionality reduction techniques.
5. Design application using machine learning techniques

Pre-requisites: Data Structures, Basic Probability and Statistics, Algorithms

Module No.	Unit No.	Topics	Hrs.
1		**Introduction to Machine Learning** Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application.	**6**
2		**Introduction to Neural Network** Introduction – Fundamental concept – Evolution of Neural Networks – Biological Neuron, Artificial Neural Networks, NN architecture, Activation functions, McCulloch-Pitts Model.	**8**
3		**Introduction to Optimization Techniques:** Derivative based optimization- Steepest Descent, Newton method. Derivative free optimization- Random Search, Down Hill Simplex	**6**
4		**Learning with Regression and trees:** Learning with Regression : Linear Regression, Logistic Regression. Learning with Trees**:** Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART).	**10**
5		**Learning with Classification and clustering:**	**14**
	5.1	**Classification:** Rule based classification, classification by Bayesian Belief networks, Hidden Markov Models. **Support Vector Machine**: Maximum Margin Linear Separators, Quadratic Programming solution to finding maximum margin separators, Kernels for learning non-linear functions.	
	5.2	**Clustering:** Expectation Maximization Algorithm, Supervised learning	

		after clustering, Radial Basis functions.	
6		**Dimensionality Reduction:** Dimensionality Reduction Techniques, Principal Component Analysis, Independent Component Analysis, Single value decomposition	**8**
		Total	**52**

Text Books:

1. Peter Harrington "Machine Learning In Action", DreamTech Press
2. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
3. Tom M.Mitchell "Machine Learning" McGraw Hill
4. Stephen Marsland, "Machine Learning An Algorithmic Perspective" CRC Press
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
7. Kevin P. Murphy , Machine Learning " A Probabilistic Perspective"

Reference Books:

1. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers
2. Margaret.H.Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules.

Suggested Experiment work :

1. To implement Linear Regression.
2. To implement Logistic Regression.
3. To implement SVM.
4. To implement PCA.
5. To implement Steepest Descent
6. To implement Random search
7. To implement Naïve Baysian algorithm.
8. To implement Single layer Perceptron Learning algorithm
9. To implement Radialbasis functions.
10. Case study based on any ML technique

**** Laboratory work based on above syllabus is incorporate as mini project in CSM605: Mini-Project.**

Course Code	Course Name	Credits
CSDLO6022	Advanced Database Management System	4

Course objectives:

1. To provide overview of indexing and hashing techniques
2. To impart knowledge of query processing and optimization
3. To provide an overview of distributed database systems.
4. To introduce the concept of document oriented database.
5. To create awareness about potential security threats to a database and mechanisms to handle it.
6. Understand the usage of advanced data models for real life application.

Course outcomes: On successful completion of course learner will be able to:

1. Build indexing mechanisms for efficient retrieval of information from databases.
2. Measure query cost and optimize query execution
3. Design distributed database for better resource management
4. Demonstrate the understanding of the concepts of document oriented databases.
5. Apply appropriate security techniques database systems.
6. Implement advanced data models for real life applications.

Prerequisite: Basic knowledge of Database management System.

Module No.	Unit No.	Topics	Hrs.
1.0		**Indexing and Hashing Techniques**	8
	1.1	**Indexing and Hashing:** ● Operation on Files ● Hashing Techniques; Static and dynamic ● Types of Single-Level Ordered Indexes; Multilevel Indexes; Dynamic Multilevel Indexes Using B-Trees and B+-Trees; Indexes on Multiple Keys,	
2.0		**Query processing and Optimization**	12
		Query Processing : ● Overview ● Measures of Query cost ● Selection operation ● Sorting ● Join Operations, and other Operations Evaluation of Expression **Query Optimization :** ● Translations of SQL Queries into relational algebra ● Heuristic approach & cost based optimization	

3.0		**Distributed Databases**	12
	3.1	• Types of Distributed Database Systems; Distributed Database Architectures; Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design	
	3.2	• Distributed Query Processing (Semi join) • distributed Transaction Management in Distributed Databases • distributed Concurrency Control (locking) , Recovery in Distributed Databases {2PC/3PC) and deadlock management.	
4		**Document oriented database**	
		• Need of object oriented database. • Impedance matching problem between OO languages and Relational database, Case study db4O • Need of Document Oriented database, difference between Document Oriented Database and Traditional database. Types of encoding XML, JSON, BSON, Representation XML, Json Objects. Case study on doc oriented based such a Mariadb	8
5		**Advanced data models**	6
	5.1	• Temporal data models :- Aspects of valid time , Bi-temporal time and bi-temporal time with examples of each. • Spatial model :- Types of spatial data models - Raster, Vector and Image • Mobile databases	
	5.2	• Multimedia databases	
6		**Data Security**	**6**
	6.1	• Introduction to Database Security Issues; authorization , Discretionary Access Control Based on Granting and Revoking Privileges • Mandatory Access Control and Role-Based	

	6.2	Access Control for Multilevel Security ● SQL Injection ● Introduction to Statistical Database Security Introduction to Flow Control	
		Total	**52**

Text Books:

1. Elmasri&Navathe“ fundamentals of Database Systems” IV edition. PEARSON Education.
2. Korth, Silberschatzsudarshan “Database systems, concepts” 5th edition McGraw Hill
3. Raghu Ramkrishnan& Johannes Gehrke “Database Management System” Tata McGraw Hill. III edition.
4. Ruosell J.T. Dyer, Learning MySQL and Mariadb.

Reference Books:

1. Chhanda Ray , “Distributed Database System”, Pearson Education India.
2. Hector Garcia-Molina, Jeffery D. Ullman, Jennifer Widom , “ Database system Implementation”
3. Thomas M.Connolly Carolyn Begg, Database Systems : A practical Approach to Design , Implementation and Management, 4/e.

Suggested mini. Project / Experiment work:

1. Given problem statement 2/3 student to perform-
   a. Design EER model and perform sorting, join operations for the specified problem statement.
   b. Perform the various fragmentation (Horizontal, Vertical, Derived) and check its correctness criteria.
   c. Perform two phase commit protocol (2PC)
2. Mini Project / Case study on document oriented database such a Mariadb
3. Mini Project Case study Development of an application based on any one advance data model (temporal, Spatial Multimedia)

**** Perform Laboratory (Experiments) work in the in CSM605:Mini-Project**

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSDLO6023	**Enterprise Resource Planning(ERP)**	**4**

Course Objectives:

1. To understand the technical aspects and life cycle of ERP systems.
2. To understand the steps and activities in ERP.
3. To identify and describe different types of ERP system.
4. To understand tools and methodology used for designing ERP for an Enterprise.

Course Outcomes: After completion of this course, students will be able ..

1. To understand the basic structure of ERP.
2. To identify implementation strategy used for ERP.
3. To apply design principles for various business modules in ERP.
4. To apply different emerging technologies for implementation of ERP.
5. To analyze security issues in ERP.
6. To acquire ERP concepts for real world applications.

Pre-requisites: Web Engineering, Computer Network, Database Systems

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Enterprise Resource Planning (ERP)** Information System and Its Components, Value Chain Framework, Organizational Functional Units, Evolution of ERP Systems, Role of ERP in Organization, Three-Tier Architecture of ERP system.	**8**
2.0		**ERP and Implementation** ERP implementation and strategy, Implementation Life cycle, Pre-implementation task, requirement definition, implementation Methodology.	**8**
3.0		**ERP Business Modules**	**8**
	3.1	Finance, manufacturing, human resources, quality management, material management, marketing, Sales distribution and service.	
	3.2	Case study on Supply Chain management (SCM), Customer relationship Management (CRM)	
4.0		**Introduction to ERP related Technologies**	**10**
	4.1	Business Process Re-engineering (BPR) ,Data warehousing ,Data Mining, On- line Analytical Processing(OLAP), Product Life Cycle Management (PLM)	
	4.2	Geographical Information Management ,RFID, QR Code ,Bar	

		Coding, E-commerce and their application in Enterprise planning	
5.0		Extended ERP and security issues	**8**
	5.1	Enterprise application Integration (EAI), open source ERP, cloud ERP	
	5.2	Managing ERP Securities: Types of ERP security Issues, System Access security, Data Security and related technology for managing data security	
6.0		Cases of ERP for Enterprises.	**10**
	6.1	Cases of ERP like MySAP for Business suite implementation at ITC, ERP for Nestle GLOBE Project, Oracle ERP Implementation at Maruti Suzuki.	
	6.2	Need of ERP for Small and Medium size enterprises.(Zaveri)	
		Total	**52**

Text Books:

1. Alexis Leon, ERP Demystified: II Edition, Tata McGraw Hill.
2. Rajesh Ray, Enterprise Resource Planning, Text and cases, Tata McGraw Hill.
3. Sandeep Desai, Abhishek Srivastava, ERP to E^2 ERP: A Case study approach, PHI.
4. Jyotindra Zaveri, Enterprise Resource Planning, Himalaya Publishing House, 2012.

Reference Books:

1. V.K. Garg & N.K. Venkatakrishnan, Enterprise Resource Planning: concepts & practices, by ; PHI.
2. Supply Chain Management Theories & Practices: R. P. Mohanty, S. G. Deshmukh, - Dreamtech Press.
3. Enterprise wide resource planning: Theory & practice: by Rahul Altekar, PHI
4. Customer Relationship Management, Concepts and cases, Second Edition.

Mini Project / Laboratory Work:

1. Give case study 2/3 student of any organization. Make a report before-after situation at organization (Domain).
2. Make a list of Resource of the Selected Domain.
3. Categorized the Resource as per the function level process and Identify module of the domain.
4. Explain process of each module of the domain.
5. Perform Business process re-engineering (BPR) on selected Module.
6. Implement new system based on BPR.
7. Perform Impact analysis of the new system as the BPR.
    a. Prepare study on JD Edward Tool.

b. Prepare study on Microsoft Dynamics.

8. Download any open source ERP Tool and prepare Installation Guideline and information about the Tool.
9. Make Data Entry in the Software in all modules & generate report.

**** Perform Laboratory (Experiments) work in the in CSM605:Mini-Project.**

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1 Question paper will comprise of 6 questions, each carrying 20 marks.

- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSDLO6024	**Advanced Computer Network**	**4**

Course Objective:

1. To make learners aware about advances in computer networking technologies.
2. To give overview of advance internet, QoS based and management protocols.
3. To introduce issues related to traffic engineering and capacity planning.

Course Outcomes: On successful completion of course learner will be able to

1. Demonstrate the understanding of advance data communication technologies.
2. Demonstrate the understanding of WAN Technology typically ATM .
3. Demonstrate the understanding of packet switching protocols such as X.25, X.75.
4. Explore the issues of advance internet routing protocols and also QoS based protocols.
5. Analyze issues of traffic requirements and perform capacity planning.
6. Demonstrate the understanding of protocol used for management of network.

Prerequisite: Computer Networks, ISO OSI Layered Protocols, TCP/IP protocol suite.

Module No.	**Unit No.**	**Topics**	**Hrs.**
1	**Data Communications:**		**06**
	1.1	Defining Data Communication needs, Transmission Hierarchy	
	1.2	**Optical Networks**: SONET/SDH standard, Architecture, Format, Hardware, Configuration, advantages	
2	**WAN Technology:**		**10**
	2.1	Introducing ATM Technology, Need and Benefit, Concept, Faces of ATM	
	2.2	Why ATM, BISDN Reference Model, ATM Layer, ATM Adaptation Layer, ATM Signaling	
3	**Protocols and Interfaces:**		**10**
	3.1	**Introduction to TCP/IP:** Issues in IPV4, IPV6 protocol	
	3.2	**Mature Packet Switching Protocols:** ITU Recommendation X.25, User Connectivity, Theory of Operations, Network Layer Functions, X.75 Internetworking Protocol, Advantages and Drawbacks	

4	**Advance Routing Protocols:**		**14**
	4.1	**Internet Routing Protocols :** OSPF, RIP, BGP **Multicast Routing:** Reverse Path Broadcasting, Internet Group Management Protocol, Reverse Path Multicasting, Discrete Vector Multicasting protocol	
	4.2	IP forwarding Architectures **Overlay Model:** Classical IP over ATM and LANE	
	4.3	**Multiprotocol Label Switching MPLS :** Fundamentals of Labels, Label Stack, VC Merging, Label Distribution Protocol, Explicit routing for Traffic Engineering	
	4.4	Integrated services, RSVP, Differentiated Services	
	4.5	**MultiMedia Over Internet:** RTP, Session Control Protocol H.323	
5	**Traffic Engineering :**		**08**
	5.1	**Requirement Definition:** User requirement Traffic Sizing , Traffic Characteristics, Protocols, Time and Delay Considerations	
	5.2	**Traffic Engineering and Capacity planning:**Throughput calculation, Traffic Engineering basics, Traditional traffic Engineering and Queued data and Packet Switched packet modeling, Queuing Disciplines (M/M/1), Design parameters for Peak: delay or latency, availability and reliability.	
6	**Network management**		**04**
	6.1	**Network Management :** SNMP Concept and format, Management Components: SMI, MIB	

Text Books:

1. M. A. Gallo and W. M. Hancock, Computer Communications and Networking Technologies, Cengage Learning, (1e).
2. Leon-Garcia, Communication Networks, Tata McGraw-Hill.
3. Darren L. Spohn, Data Network Design, Tata McGraw-Hill.
4. BehrouzForouzan, TCP/IP Protocol Suite ,McGraw-Hill, (5e).
5. William Stallings, High-Speed Networks and Internets, Pearson Education, (2e).

Reference Books:

1. Andrew Tanenbaum“ Computer Networks”, Prentice Hall, (5e).
2. Cisco Certified Network Analyst study guide, Wiley Publishing House.(7e).
3. Douglas E. Comer, Internetworking with TCP/IP Volume One, (6e).
4. James F. Kurose, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”,Addison Wesley, (5e).

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Lab Code	Lab Name	Credits
CSL601	**Software Engineering Lab**	**1**

Lab Outcome:

On successful completion of laboratory sessions, learners will be able to

1. Identify requirements and apply process model to selected case study.
2. Analyze and design models for the selected case study using UML modeling.
3. Use various software engineering tools.

Description:

The Software Engineering Lab has been developed by keeping in mind the following objectives:

- Select case studies to solve real life problems by applying software engineering principles.
- To impart state-of-the-art knowledge on Software Engineering and UML.

List of Experiments:

Laboratory work will be based on course syllabus with minimum 10 experiments to be incorporated. Assign case study to a group of two/three students and each group to perform the following experiments on their case study.

Sr. No.	Title of Experiments
1	Prepare detailed statement of problem for the selected / allotted mini project and identify suitable process model for the same with justification.
2	Develop Software Requirement Specification (SRS) document in IEEE format for the project.
3	Use project management tool to prepare schedule for the project.
4	Prepare RMMM plan for the project.
5	Identify scenarios & develop UML Use case and Class Diagram for the project.
6	Draw DFD (upto 2 levels) and prepare Data Dictionary for the project.
7	Develop Activity / State Transition diagram for the project.
8	Develop Sequence and Collaboration diagram for the project.
9	Change specification and make different versions using any SCM Tool.
10	Develop test cases for the project using white box testing.

Digital Material:

Practical can be conducted using any open source software tools like Dia, Star UML, etc.

Term Work:

Term work (25 Marks) shall consist of

- Laboratory work ….. 15 marks
- Two assignments … 05 marks
- Attendance (theory and practical) ….. 05 marks

Oral exam will be based on CSC601 and CSL601 syllabus.

Lab Code	Lab Name	Credits
CSL602	**System Software Lab**	**1**

Outcome: At the end of the course learner will be able to

1. Generate machine code by using various databases generated in pass one of two pass assembler.
2. Construct different databases of single pass macro processor.
3. Identify and validate different tokens for given high level language code.
4. Parse the given input string by constructing Top down /Bottom up parser.
5. Implement synthesis phase of compiler with code optimization techniques.
6. Explore various tools like LEX and YACC.

Description: The current System Software is highly complex with huge built in functionality offered to the programmer to develop complex applications with ease. This laboratory course aims to make a student understand-

- The need for modular design
- The need for well-defined data structures and their storage management
- The increase in the complexity of translators as we move from assembly level to high level programming
- The need to produce an efficient machine code that is optimized for both execution speed and memory requirement
- The efficient programming constructs that make them a good coder

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Implementations of two pass Assembler.
2	Implementation of single pass Macro Processor.
4	Implementation of Lexical Analyzer.
5	Implementation of Parser (Any one).
6	Implementation of Intermediate code generation phase of compiler.
7	Implementation of code generation phase of compiler.
8	Study and implement experiments on LEX. YACC, Grey Box Probing.

Reference Books:

1. Modern Compiler. Implementation in Java, Second. Edition. Andrew W. Appel Princeton University. Jens Palsberg Purdue University. CAMBRIDGE.
2. Crafting a compiler with C**,** Charles N. Fischer, Ron K. Cytron, Richard J. LeBlanc .

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ……..(15) Marks.
- Assignment: ..……..……... (05) Marks.
- Attendance ……..…… (05) Marks

  TOTAL: …….. (25) Marks.

Oral & Practical exam will be based on the above and **CSC602** syllabus.

Lab Code	Lab Name	Credits
CSL603	**Data Warehousing and Mining Lab**	**1**

Lab Outcome:

1. Design data warehouse and perform various OLAP operations.
2. Implement classification, prediction, clustering and association rule mining algorithms.
3. Demonstrate classifications, prediction, clustering and association rule mining algorithms on a given set of data sample using data mining tools.
4. Implement spatial and web mining algorithms.

Description:

An operational database undergoes frequent changes on a daily basis on account of the transactions that take place. A data warehouses provides us generalized and consolidated data in multidimensional view. Data mining functions such as classification, prediction, clustering, and association rule mining can be integrated with OLAP operations to enhance the interactive mining of knowledge at multiple level of abstraction. Data mining supports knowledge discovery by finding hidden patterns and associations, constructing analytical models, performing classification and prediction, these mining results can be demonstrated using the data mining tools.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Build Data Warehouse/Data Mart for a given problem statement i) Identifying the source tables and populating sample data ii) Design dimensional data model i.e. Star schema, Snowflake schema and Fact Constellation schema (if applicable)
2	To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot
3	Implementation of Classification algorithm(Decision Tree/ Bayesian)
4	Implementation of Linear Regression.
5	Implementation of Clustering algorithm(K-means/ Agglomerative).
6	Implementation of Association Rule Mining algorithm(Apriori).

7	Perform data Pre-processing task and Demonstrate performing Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA,R tool, XL Miner, etc.)
8	Implementation of page rank algorithm.
9	Implementation of HITS algorithm.
10	Implementation of Spatial Clustering Algorithm- CLARANS Extensions

Term Work:

Laboratory work will be based on above syllabus with minimum 08 experiments to be incorporated.

Experiments ---------- (15) Marks
Assignment---------- (05) Marks
Attendance (Theory + Practical) ---------- (05) Marks
Total ---------- (25) Marks

Oral & Practical exam will be based on the above and CSC603:"Data Warehousing and Mining" syllabus.

Lab Code	Lab Name	Credit
CSL604	**System Security Lab**	**01**

Lab Outcome:

Learner will able to

1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers.
2. To be able to analyze and implement public key algorithms like RSA and El Gamal.
3. To analyze and evaluate performance of hashing algorithms.
4. To explore the different network reconnaissance tools to gather information about networks.
5. To explore and use tools like sniffers, port scanners and other related tools for analysing packets in a network.
6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.
7. To be able to explore various attacks like buffer-overflow, and web-application attacks.

Suggested Experiment List: (Any 10)

Sr. No	Description
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers
2	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal.
3	Implementation of Diffie Hellman Key exchange algorithm
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs
5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
6	Study of packet sniffer tools : wireshark, : 1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters.
7	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc.
8	Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark. Use arping tool to generate gratuitous arps and monitor using wireshark
9	Simulate DOS attack using Hping, hping3 and other tools.
10	Simulate buffer overflow attack using Ollydbg, Splint, Cppcheck etc

11	a. Set up IPSEC under LINUX. b. Set up Snort and study the logs.
12	Setting up personal Firewall using iptables
13	Explore the GPG tool of linux to implement email security
14	SQL injection attack, Cross-Cite Scripting attack simulation

Reference Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, TIm Boyles, Sybex.
3. Network Security Bible, Eric Cole, Wiley India.
4. Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India.

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Experiments ---------- (15) Marks
Assignment---------- (05) Marks
Attendance (Theory + Practical) ---------- (05) Marks
Total ---------- (25) Marks

Oral & practical examination will be based on the above and Cryptography and System Security (CSC604) syllabus.

Lab Code	Lab Name	Credit
CSM605	**Mini-Project**	**2**

Lab Outcome: After successful completion of this Lab student will be able to

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
3. Contribute as an individual or in a team in development of technical projects
4. Develop effective communication skills for presentation of project related activities

Description:

Mini project may be carried out in one or more form of following:
Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, creating awareness in society, etc.

Guidelines:

- A project to be developed based on one or more of the following fields-
  Advance Database Management System, Enterprise Resource Planning, Advance Operating System, Advance Computer Network, etc.
- Mini project may be carried out a group of 2 /3 students. The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

Term Work (TW):

Distribution of marks for term work shall be as follows:

1. Attendance 05 Marks
2. Mini project work 10 Marks
3. Project Report (Spiral Bound) 10 Marks

The final certification and acceptance of TW ensures the satisfactory performance on the above three aspects.

Oral & Practical Examination should be conducted by internal and external examiners appointed by University of Mumbai. Students have to give presentation and demonstration on the Mini-Project.

Course Code	Course Name	Credits
CSC701	Digital Signal & Image Processing	4

Course objectives:

1. To understand the fundamental concepts of digital signal processing and Image processing.
2. To explore DFT for 1-D and 2-D signal and FFT for 1-D signal
3. To apply processing techniques on 1-D and Image signals.
4. To apply digital image processing techniques for edge detection.

Course outcomes: On successful completion of the course learner will be able to:

1. Apply the concept of DT Signal and DT Systems.
2. Classify and analyze discrete time signals and systems
3. Implement Digital Signal Transform techniques DFT and FFT.
4. Use the enhancement techniques for digital Image Processing
5. Differentiate between the advantages and disadvantages of different edge detection techniques
6. Develop small projects of 1-D and 2-D Digital Signal Processing.

Prerequisite: Applied Mathematics

Module No.	Unit No.	Topic details	Hrs.
1.0		**Discrete-Time Signal and Discrete-Time System**	14
	1.1	Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, reversal, scaling, addition, multiplication).	
	1.2	Classification of Discrete-Time Signals, Classification of Discrete-Systems	
	1.3	Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.	
2.0		**Discrete Fourier Transform**	08
	2.1	Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT	
	2.2	Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties.	
	2.3	Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT	
3.0		**Fast Fourier Transform**	06
	3.1	Need of FFT, Radix-2 DIT-FFT algorithm,	

Module No.	Unit No.	Topic details	Hrs.
	3.2	DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.	
	3.3	Spectral Analysis using FFT	
4.0		**Digital Image Fundamentals**	08
	4.1	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization	
	4.2	Representation of Digital Image, Connectivity	
	4.3	Image File Formats: BMP, TIFF and JPEG.	
5.0		**Image Enhancement in Spatial domain**	10
	5.1	Gray Level Transformations, Zero Memory Point Operations,	
	5.2	Histogram Processing, Histogram equalization.	
	5.3	NeighborhoodProcessing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.	
6.0		**Image Segmentation**	06
	6.1	Segmentation based on Discontinuities (point, Line, Edge),	
	6.2	Image Edge detection using Robert, Sobel, Previtt masks, Image Edge detection using Laplacian Mask.	
		Total	52

Text Books:

1. John G. Proakis, Dimitris and G.Manolakis, 'Digital Signal Processing: Principles, Algorithms, and Applications' 4th Edition 2007, Pearson Education.
2. A. Anand Kumar, 'Digital Signal Processing', PHI Learning Pvt. Ltd. 2013.
3. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, 3rd Edition, 2009,
4. S. Sridhar, 'Digital Image Processing', Oxford University Press, Second Edition, 2012.

Reference Books:

1. Sanjit Mitra, 'Digital Signal Processing: A Computer Based Approach', TataMcGraw Hill, 3rd Edition.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, 'Digital Signal Processing' Tata McGraw Hill Publication 1st Edition (2010).
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, 'Digital Image Processing' TataMcGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, 'Fundamentals and Digital Image Processing', Prentice Hall of India Private Ltd, 3rd Edition.

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 50% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC702	**Mobile Communication & Computing**	**4**

Course objectives:

1. To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
2. To explore both theoretical and practical issues of mobile computing.
3. To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

Course outcomes: On successful completion of course learner will be able:

1. To identify basic concepts and principles in mobile communication & computing, cellular architecture.
2. To describe the components and functioning of mobile networking.
3. To classify variety of security techniques in mobile network.
4. To apply the concepts of WLAN for local as well as remote applications.
5. To describe and apply the concepts of mobility management
6. To describe Long Term Evolution (LTE) architecture and its interfaces.

Prerequisite: Computer Networks

Module No.	Unit No.	Topics	Hrs
1.0	1.1	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems,	06
	1.2	Electromagnetic Spectrum, Antenna ,Signal Propagation, Signal Characteristics, , Multiplexing, Spread Spectrum: DSSS & FHSS	
2.0	2.1	GSM Mobile services, System Architecture, Radio interface, Protocols , Localization and Calling, Handover, security (A3,A5 & A8)	**10**
	2.2	GPRS system and protocol architecture	
	2.2	UTRAN , UMTS core network ; Improvements on Core Network,	
3.0	**3.1**	**Mobile Networking** : Medium Access Protocol, Internet Protocol and Transport layer	**12**
	3.2	Medium Access Control: Motivation for specialized MAC, , Introduction to multiple Access techniques (MACA)	

	3.3	Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling, Routing (DSDV,DSR)	
	3.4	Mobile TCP : Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission	
4.0	**4.1**	**Wireless Local Area Networks :** Introduction, Infrastructure and ad-hoc network	**08**
	4.2	**IEEE 802.11:**System architecture , Protocol architecture , Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b	
	4.3	Wi-Fi security : WEP ,WPA, Wireless LAN Threats , Securing Wireless Networks	
	4.4	HiperLAN 1 & HiperLAN 2	
	4.5	Bluetooth: Introduction, User Scenario, Architecture, protocol stack	
5.0	**5.1**	**Mobility Management :** Introduction, IP Mobility, Optimization, IPv6	06
	5.2	Macro Mobility : MIPv6, FMIPv6,	
	5.3	Micro Mobility: CellularIP, HAWAII, HMIPv6,	
6.0	**6.1**	**Long-Term Evolution (LTE) of 3GPP :** LTE System Overview, Evolution from UMTS to LTE	10
	6.2	LTE/SAE Requirements, SAE Architecture	
	6.3	EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced,	
	6.4	System Aspects, LTE Higher Protocol Layers, LTE MAC layer, LTE PHY Layer,	
	6.5	Self Organizing Network (SON-LTE),SON for Heterogeneous Networks (HetNet), Introduction to 5G	
		Total	**52**

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1 Jochen Schilller,"Mobile Communication ", Addision wisely,Pearson Education
2 "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
3 Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi

Reference Books:

1 LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency, Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, Wiley publications
2 Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications," Wiley publications
3 Mobility Protocols and Handover Optimization: Design, Evaluation and Application By Ashutosh Dutta, Henning Schulzrinne, IEEE Press, Wiley Publication
4 Michael Gregg, "Build your own security lab," Wiley India edition
5 Emerging Wireless Technologies and the Future Mobile Internet, Dipankar Raychaudhuri, Mario Gerla, Cambridge.
6 Andreas F.Molisch, "Wireless Communications," Second Edition, Wiley Publications.

Course Code	Course Name	Credits
CSC703	**Artificial Intelligence & Soft Computing**	**4**

Course Objectives (CO):

1 To conceptualize the basic ideas and techniques of AI and SC.

2 To distinguish various search techniques and to make student understand knowledge representation and planning.

3 To become familiar with basics of Neural Networks and Fuzzy Logic.

4 To familiarize with Hybrid systems and to build expert system.

Course Outcomes: Students should be able to -

1 Identify the various characteristics of Artificial Intelligence and Soft Computing techniques.

2 Choose an appropriate problem solving method for an agent to find a sequence of actions to reach the goal state.

3 Analyse the strength and weakness of AI approaches to knowledge representation, reasoning and planning.

4 Construct supervised and unsupervised ANN for real world applications.

5 Design fuzzy controller system.

6 Apply Hybrid approach for expert system design.

Pre-requisites: Basic Mathematics, Algorithms

Module No.	**Unit No.**	**Topics**	**Hrs.**
1.0		**Introduction to Artificial Intelligence(AI) and Soft Computing**	4
	1.1	Introduction and Definition of Artificial Intelligence.	
	1.2	Intelligent Agents : Agents and Environments ,Rationality, Nature of Environment, Structure of Agent, types of Agent	
	1.3	Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.	
2.0		**Problem Solving**	10
	2.1	Problem Solving Agent, Formulating Problems, Example Problems	
	2.2	Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Method: A* Search	
	2.3	Optimization Problems: Hill climbing Search, Simulated annealing, Genetic algorithm	
3.0		**Knowledge, Reasoning and Planning**	10
	3.1	Knowledge based agents	
	3.2	First order logic: syntax and Semantic, Knowledge Engineering in FOL Inference in FOL : Unification, Forward Chaining, Backward Chaining and Resolution	
	3.3	Planning Agent, Types of Planning: Partial Order, Hierarchical Order, Conditional Order	
4.0		**Fuzzy Logic**	12

	4.1	Introduction to Fuzzy Set: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions,	
	4.2	Fuzzy Logic: Fuzzy Logic basics, Fuzzy Rules and Fuzzy Reasoning	
	4.3	Fuzzy inference systems: Fuzzification of input variables, defuzzification and fuzzy controllers.	
5.0		**Artificial Neural Network**	12
	5.1	Introduction – Fundamental concept– Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron	
	5.2	Neural Network Architecture: Perceptron, Single layer Feed Forward ANN, Multilayer Feed Forward ANN, Activation functions, Supervised Learning: Delta learning rule, Back Propagation algorithm.	
	5.3	Un-Supervised Learning algorithm: Self Organizing Maps	
6.		**Expert System**	4
	6.1	Hybrid Approach - Fuzzy Neural Systems	
	6.2	Expert system : Introduction, Characteristics, Architecture, Stages in the development of expert system,	
		Total	52

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
3. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
4. S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Reference Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
3. Zimmermann H.S "Fuzzy Set Theory and its Applications"Kluwer Academic Publishers.
4. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. JacekM.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSDLO7031	**Advanced System Security and Digital Forensics**	**4**

Course Objectives:

1. To understand cyber attacks and defence strategies.
2. To understand underlying principles of access control mechanisms.
3. To explore software vulnerabilities, attacks and protection mechanisms of wireless networks and protocols, mobile devices and web applications.
4. To develop and mitigate security management and policies.
5. To understand and explore techniques used in digital forensics.

Course Outcomes: At the end of the course learner will able to

1. Understand cyber attacks and apply access control policies and control mechanisms.
2. Identify malicious code and targeted malicious code.
3. Detect and counter threats to web applications.
4. Understand the vulnerabilities of Wi-Fi networks and explore different measures to secure wireless protocols, WLAN and VPN networks.
5. Understand the ethical and legal issues associated with cyber crimes and be able to mitigate impact of crimes with suitable policies.
6. Use different forensic tools to acquire and duplicate data from compromised systems and analyse the same.

Prerequisite: Cryptography and System Security

Module No.	Unit No.	Detailed Content	Hrs.
1	**Introduction & Access Control**		08
	1.1	Cyber-attacks, Vulnerabilities, Defence Strategies and Techniques, Authentication Methods and Protocols, Defence in Depth Strategies.	
	1.2	Access Control Policies: DAC, MAC, Multi-level Security Models: Biba Model, Bell La Padula Model, Single Sign on, Federated Identity Management.	
2	**Program & OS Security**		08
	2.1	Malicious and Non-Malicious programming errors, Targeted Malicious codes: Salami Attack, Linearization Attack, Covert Channel, Control against Program threats.	
	2.2	Operating System Security: Memory and Address protection, File Protection Mechanism, User Authentication.	
	2.3	Linux and Windows: Vulnerabilities, File System Security.	
3	**Web Application Security**		12
		OWASP, Web Security Considerations, User Authentication and Session	

		Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security, OAuth 2.0	
4	**Wireless Security**		08
		Wi-Fi Security, WEP, WPA, WPA-2, Mobile Device Security- Security Threats, Device Security, GSM and UMTS Security, IEEE 802.11/802.11i Wireless LAN Security, VPN Security.	
5	**Legal and Ethical issues**		06
	5.1	Cybercrime and its types, Intellectual property, Privacy, Ethical issues.	
	5.2	Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, case studies of ethics.	
6	**Digital Forensics**		10
		Introduction to Digital Forensics, Acquiring Volatile Data from Windows and Unix systems, Forensic Duplication Techniques, Analysis of forensic images using open source tools like Autopsy and SIFT, Investigating logs from Unix and windows systems, Investigating Windows Registry.	

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wile**y**

Reference Books:

1. Computer Security, Dieter Gollman, Third Edition, Wiley
2. Digital Forensics by Nilakshi Jain & Kalbande, Wiley.
3. Incident Response & Computer Forensics by Kevin Mandia, Chris Prosise, Wiley.
4. Cyber Security. Nina Godbole, Sunit Belapure, Wiley.

Digital references:

1. https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

Theory Examination:

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

==========

Laboratory/ Experimental Work

 # The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.

Lab Outcome:

Learner will able to

1. Analyze static code and program vulnerabilities using open source tools.
2. Explore and analyze network vulnerabilities using open source tools.
3. Explore and analyze different security tools to detect web application and browser vulnerabilities.
4. Explore and analyze different tools to secure wireless networks and routers, and mobile devices and perform penetration testing, and analyze its impact.
5. Understand and implement AAA using RADIUS and TACACS.
6. Explore various forensics tools in Kali Linux and use them to acquire, duplicate and analyze data and recover deleted data.

Sr. No	Description
1	Static code analysis using open source tools like RATS, Flawfinder etc.
3	Vulnerability scanning using Nessus, Nikto (Kali Linux)
4	Explore web-application vulnerabilities using open source tools like Wapiti, browser exploitation framework (BeEf), etc.
5	Detect SQL injection vulnerabilities in a website database using SQLMap
6	Performing a penetration testing using Metasploit (Kali Linux)
7	Exploring Router and VLAN security, setting up access lists using Cisco Packet tracer(student edition)
8	Exploring VPN security using Cisco Packet tracer(student edition)
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+
10	Install and use a security app on an Android mobile (e.g. Droidcrypt)
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data: dd, dcfldd, foremost, scalpel, debugfs, wireshark, tcptrace, tcpflow
12	Analysis of forensic images using open source tools like Autopsy, SIFT, FKT Imager
13	Use of steganographic tools like OpenStego, to detect data hiding or unauthorized file copying

14.	Use Password cracking using tools like John the Ripper/Cain and Abel/ Ophcrack to detect weak passwords.

Reference Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex.
3. Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India
4. Network Infrastructure Security, Randy Waver, Dawn Weaver, Cengage Learning.
5. Incident Response & Computer Forensics by Kevin Mandia, Chris Prosise, Wiley.

Digital References:

http://www.opentechinfo.com/learn-use-kali-linux/

Course Code	Course/Subject Name	Credits
CSDLO7032	Big Data Analytics	4

Course Objectives:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce programming skills to build simple solutions using big data technologies such as MapReduce and scripting for NoSQL, and the ability to write parallel algorithms for multiprocessor execution.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
5. To provide an indication of the current research approaches that is likely to provide a basis for tomorrow's solutions.

Course Outcomes: Learner will be able to…

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
1. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, Mapreduce and NoSQL in big data analytics.
2. Collect, manage, store, query and analyze various forms of Big Data.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
5. Solve Complex real world problems in various applications like recommender systems, social media applications, health and medical systems, etc.

Prerequisite:
Some prior knowledge about Java programming, Basics of SQL, Data mining and machine learning methods would be beneficial.

Module	Detailed Contents	Hrs.
01	**Introduction to Big Data and Hadoop** 1.1 Introduction to Big Data, 1.2 Big Data characteristics, types of Big Data, 1.3 Traditional vs. Big Data business approach, 1.4 Case Study of Big Data Solutions. 1.5 Concept of Hadoop 1.6 Core Hadoop Components; Hadoop Ecosystem	06

02	**Hadoop HDFS and MapReduce** 2.1 Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization. 2.2 MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. 2.3 Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce 2.4 Hadoop Limitations	10
03	**NoSQL** 3.1 Introduction to NoSQL, NoSQL Business Drivers, 3.2 NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study 3.3 NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	06
04	**Mining Data Streams:** 4.1 The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. 4.2 Sampling Data techniques in a Stream 4.3 Filtering Streams: Bloom Filter with Analysis. 4.4 Counting Distinct Elements in a Stream, Count-Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements 4.5 Counting Frequent Items in a Stream, Sampling Methods for Streams, Frequent Itemsets in Decaying Windows. 4.6 Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	12
05	**Finding Similar Items and Clustering** 5.1 Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance. 5.2 CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets, Answering Queries	08
	Real-Time Big Data Models 6.1 PageRank Overview, Efficient computation of	

06	PageRank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. 6.2 A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering. 6.3 Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph.	10

Text Books:

1. CreAnand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.

References books:

1. Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley
2. Chuck Lam, "Hadoop in Action", Dreamtech Press
3. Jared Dean, "Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners", Wiley India Private Limited, 2014.
4. 4. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006.
7. Vojislav Kecman, "Learning and Soft Computing", MIT Press, 2010.

Term Work:

Assign a case study for group of 3/4 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large datasetcreated by them.

The distribution of marks for term work shall be as follows:

- Programming Exercises: .... (10) Marks.
- Mini project: ..... (10) Marks.
- Attendance (Theory & Practical) ..... (05) Marks.

TOTAL: ..... (25) Marks.

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

Oral examination:
An oral exam will be held based on the above syllabus.

Suggested Practical List:

1. Hadoop HDFS Practical:
   -HDFS Basics, Hadoop Ecosystem Tools Overview.
   -Installing Hadoop.
   -Copying File to Hadoop.
   -Copy from Hadoop File system and deleting file.
   -Moving and displaying files in HDFS.
   -Programming exercises on Hadoop.
2. Use of Sqoop tool to transfer data between Hadoop and relational database servers.
   a. Sqoop - Installation.
   b. To execute basic commands of Hadoop eco system component Sqoop.
3. To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
4. Experiment on Hadoop Map-Reduce / PySpark:
2. -Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.
5. Create HIVE Database and Descriptive analytics-basic statistics, visualization using Hive/PIG/R.
6. Write a program to implement word count program using MapReduce.
7. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language.
8. Implementing any one Clustering algorithm (*K*-Means/CURE) using Map-Reduce.
9. Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc.
10. Implement PageRank using Map-Reduce.
11. Implement predictive Analytics techniques (regression / time series, etc.) using R/ Scilab/ Tableau/ Rapid miner.
12. **Mini Project:** One real life large data application to be implemented (Use standard Datasets available on the web).

 # The Experiments for this course are required to be performed and to be evaluated

in CSL704: Computational Lab-1.

Course Code	Course Name	Credits
CSDLO7033	**Robotics**	**4**

Course objectives:

1 To know basics of a typical robot and its characteristics.
2 To analyse mathematically kinematic modelling of a typical robot manipulator.
3 To identify actuators, sensors and control of a robot for different applications.
4 To apply task planning and vision algorithms.

Course outcomes: On successful completion of course learner will be able to:

1. Describe typical robot and its characteristics.
2. Analyse kinematics parameters of robotic manipulator.
3. Identify actuators, sensors and control of a robot for different applications.
4. Design task plan and motion for a robot.
5. Apply Robotics to solve day to day problems using vision algorithms.
6. Use robot programming languages and acquire skills to program robots.

Prerequisite: Mathematical concepts of Geometry, Matrices Algebra, knowledge of Basic Electronics.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction and Fundamentals of Robotics**	**08**
	1.1	Types of automation, Introduction, definition of a Robot, Classification of Robots, Robotics, History of Robotics, Advantages and Disadvantages of Robots, Robot Applications	
	1.2	Tasks involved in Robotics, Robot Components, Robot characteristics and classification, Degrees of Freedom, Robot joints, Robot Coordinates, Robot Reference frames, Programming Modes, Robot Workspace, Work Envelop.	
2.0		**Direct and Inverse Kinematics**	**08**
	2.1	**Direct (Forward) Kinematics:** Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA.	
	2.2	**Inverse Kinematics:** Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA.	
		Sensors, Actuators and Drive Systems	**08**

3.0	**3.1**	**Sensors:** Characteristics, Utilization, Types - Position, Velocity, Acceleration, Force and Pressure, Torque, Visible Light and Infrared, Touch and Tactile, Proximity, Range Finders sensors.	
	3.2	**Actuators and Drive System:** Characteristics, Hydraulic Actuators, Pneumatic Devices, Electric Motors	
4.0		**Robot Task and Motion Planning**	**10**
	4.1	Reactive Paradigms: Overview, Attributes of reactive paradigm	
	4.2	Task level programming, Uncertainty, Configuration Space, Gross motion planning, Fine-motion planning, Simulation of Planner motion, Source and goal scene, Task planner Simulation.	
	4.3	Robot Motion Planning: Concept of motion planning, BUG 1, BUG 2 and Tangent Bug Algorithms	
5.0		**Robot Vision**	**10**
	5.1	Image Representation, Template Matching, Polyhedral Objects	
	5.2	Shape Analysis, Iterative Processing	
	5.3	Perspective Transformations, Structured Illumination , Camera Calibration	
6.0		**Expert Systems, Robot Language and Fuzzy Logic**	**12**
	6.1	Introduction to Expert Systems, Expert system Characteristics, Robot as a Expert System, Robot Languages: Classification of Robot Languages, Computer Control and Robot Software, VAL System, and Language.	
	6.2	Introduction, Fuzzy set, Fuzzification, Fuzzy Inference Rule Base, Defuzzification, Applications of Fuzzy Logic in Robotics.	
		Total	**52**

Text Books:

1. Introduction Robotics - Analysis, Control, Applications by Saeed B. Niku, Second Edition, Wiley India.
2. Fundamentals of Robotics – Analysis and Control by Robert J. Schilling, Pearson
3. Introduction to AI robotics by Robin Murphy, PHI.

4. Robotics Technology and Flexible Automation by S. R. Deb, TMH.
5. Artificial Intelligence by Rich, Knight and Nair, TMH.
6. Introduction to Fuzzy Sets by M Ganesh PHI

Reference Books:

1. Robotics – Control, Sensing, Vision, and Intelligence by K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Tata McGraw Hill
2. Principles of Robot Motion – Theory, Algorithms and Implementation by Howie Choset, Lynch, PHI
3. Introduction to Fuzzy Logic using Matlab,By: S.N.Sivanandam,S.N.Deepa,P Sumathi , Springer Publications

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work :

The distribution of marks for term work shall be as follows:

• Programming Exercises: .... (10) Marks.
• Mini project: ..... (10) Marks.
• Attendance (Theory & Practical) ..... (05) Marks.
TOTAL: ..... (25) Marks.

Suggested List of Experiments:

1 Representation of Various Robots and there all Specification (Study Experiment)

2 Co-ordinate Transform of a Robot

3 Fundamental Rotation

4 Composite Rotation

5 BFS and DFS

6 Homogeneous Rotation

7 Run Length Encoding

8 Shrink and swell Operator

9 BUG1 Algorithm

10 Bug2 Algorithm

11 Tangent Bug Algorithm

12 Edge detection algorithm

13 Case Study of CNC Machine

14 Designing a Robot Manipulator for Pre defined Task

Students can perform experiments based on Theory Syllabus or any 12 experiments from above list of experiments or experiments framed by teachers.

 # The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.

Course Code	Course Name	Credits
ILO 7011	**Product Life Cycle Management**	**03**

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development,	05

	Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO 7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Sr. No	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:**Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Sr. No.	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Sr. No	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology	07

	5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO 7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05

04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Credits
ILO 7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Sr. No.	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO 7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Sr. No.	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures:	09

	5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Sr. No	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity,	10

	factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	**Development Engineering**	**03**

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to…

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Sr. No.	Module Contents	Hrs
01	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	**08**
02	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	**04**
03	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	**06**
04	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
05	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.	**10**

	Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
06	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately
40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407

Lab Code	Lab Name	Credits
CSL701	**Digital Signal and Image Processing Lab**	**1**

Lab Outcome: The learner will be able to

1. Sample and reconstruct the signal.
2. Implement and apply operations like Convolution, Correlation, DFT and FFT on DT signals
3. Implement spatial domain Image enhancement techniques.
4. Implement Edge detection techniques using first order derivative filters.

Description:

Implementation of programs can be in C or C++ or any computational software. A List of ten experiments is given below, are needed to be performed covering all syllabus modules. Additional experiments within the scope of the syllabus can be added.

Suggested List of Experiments:

1. Sampling and Reconstruction
2. To perform Discrete Correlation
3. To perform Discrete Convolution
4. To perform Discrete Fourier Transform
5. To perform Fast Fourier Transform
6. Implementation of Image negative, Gray level Slicing and Thresholding
7. Implementation of Contrast Stretching ,Dynamic range compression & Bit plane Slicing
8. Implementation of Histogram Processing
9. Implementation of Image smoothing/ Image sharpening
10. Implementation of Edge detection using Sobel and Previtt masks

Term Work:

- Laboratory work will be based on above syllabus of CSC701 - 'Digital Signal and Image Processing' with minimum 10 experiments to be incorporated.
- The distribution of marks for term work shall be as follows:

Lab Performance	15 Marks
Assignments	05 Marks
Attendance (Theory & practical)	05 Marks

Lab Code	Lab Name	Credits
CSL702	Mobile Application Development Lab	1

Lab Outcome:

1. To develop and demonstrate mobile applications using various tools
2. Students will articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it.
3. Students will able to carry out simulation of frequency reuse , hidden terminal problem
4. To develop security algorithms for mobile communication network
5. To demonstrate simulation and compare the performance of Wireless LAN
6. To implement and demonstrate mobile node discovery and route maintains.

Description: The softwares like Android Studio, J2ME, NS2, NS3 and any other software which is suitable are recommended for performing the practicals.

Suggested List of Experiments:

Sr. No.	Title of Experiments
01	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell. Design a game based application on the above concept.
02	To understand the cellular frequency reuse concept to find the cell clusters within certain geographic area. Design a game based application on the above concept.
03	Implementation a Bluetooth network with application as transfer of a file from one device to another.
04	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
05	To implement Mobile node discovery
06	Implementation of GSM security algorithms (A3/A5/A8)
07	Illustration of Hidden Terminal Problem (NS-2) Consider two Wifi base stations (STA) and an access point (AP) located along the x-axis. All the nodes are fixed. The AP is situated at the middle of the two STA, the distance of separation being 150 m. [variable]. Node #0 and node #1 are the hidden terminals. Both are transmitting some data to the AP (almost at same rate) at the same time. The loss across the wireless link between each STA and the AP is fixed at 50 dB irrespective of the distance of separation. To study how RTS/CTS helps in wireless networks, 1. No RTS/CTS is being sent. 2. Nodes do exchange RTS/CTS packets. **Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.**

08	To setup & configuration of Wireless Access Point (AP) using NS3. Analyze the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.
09	Develop an application that writes data to the SD card.
10	Develop an application that uses GUI components.
11	Write an application that draws basic graphical primitives on the screen.
12	Develop an application that makes use of database.
13	Develop a native application that uses GPS location information.
14	Implement an application that creates an alert upon receiving a message.
15	Implementation of income tax/loan EMI calculator and deploy the same on real devices.

Digital Material (if Any):

1. http://www.isi.edu/nsnam/ns/ : NS-2 software download
2. https://nsnam.isi.edu/nsnam/index.php/NS_manual
3. https://www.nsnam.org/ : Ns-3 Software Download
4. http://vlssit.iitkgp.ernet.in/ant/ant/

Text Books:

1. Jochen Schilller,"Mobile Communication ", Addision wisely,Pearson Education
2. "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
3. Ekram Hossain and Teerawat Issariyakul, "Introduction to Network Simulator NS-2," Springer , Second Edition.
4. Michael Burton, "Android Appliocation Development for Dummies, " A wiley brand
5. Marko Gargenta & Masumi Nakamura, " Learning Android," O'reilly publications
6. James Keogh, "The complete reference J2ME, " Mcgraw-Hill.

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): …… (15) Marks.

Assignments: ……..... (05) Marks.

Attendance (Theory + Practical)…… (05) Marks

TOTAL: …… (25) Marks.

Oral & Practical exam will be based on the above and CSC702: Mobile Communication & Computing syllabus.

Lab Code	Lab Name	Credits
CSL703	**Artificial Intelligence & Soft Computing Lab**	**1**

Lab Outcomes: Learner will be able to

1 To realize the basic techniques to build intelligent systems

2 To create knowledge base and apply appropriate search techniques used in problem solving.

3 Apply the supervised/unsupervised learning algorithm.

4 Designfuzzy controller system.

Description: The current applications from almost all domains, like games, robots, expert system, optimization or even the search engines are becoming smarter. We have moved to the era of knowledge processing from data and information processing. Therefore learning these technologies practically is very essential for a student to gain the proficiency. They will also learn and be able to appreciate the use of fusion of basic techniques.

LAB	**Topic / Activity**	**Explanation of Activity**
Lab 1	• Identify the problem • PEAS Description • Problem formulation	Select a problem statement relevant to AI
Lab 2	Introduce AI programming Language	Introduce PROLOG programming.
Lab 3	• Start Implementation • Knowledge Representation and Create Knowledge Base	Use AI programming languages Or C/JAVA
Lab 4	Implement search algorithms to reach goal state	Identify and analyse Algorithm to solve the problem
Lab 5	To implement Mc-Culloch Pitts Model for a problem	Apply to solve AND / OR/ XOR, etc.
Lab 6	To implement Fuzzy Controller system	Design an automobile or washing machine controller, etc. and implement
Lab 7	To implement Basic Supervised / Unsupervised Neural Network learning rules for a problem.	Design a NN using a learning method to generate knowledge for classification.
Lab 8	Case study on Hybrid Systems	Study the designing of Neuro Fuzzy systems
Lab 9	Case study of an Application	Printed Character Recognition, Face Recognition, etc.

Term Work:

1. Labs 1-4 are to design and implement an intelligent system using AI techniques.
2. Labs 5-7 are to design and implement an Intelligent System using SC techniques.
3. Perform any one from Lab 8 and lab 9.

The distribution of marks for term work shall be as follows:

Lab Performance (Experiments /case studies):	15
Assignment	05
Attendance (Theory & Practical)	05

Oral examination will be based on the above and **CSC703**: '**AI and SC**' Syllabus.

Lab Code	Lab Name	Credits
CSL703	**Computational Lab-I**	**1**

Lab Outcome: After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Description:

Design and implementation of any case study/ applications /experiments / mini project based on departmental level optional courses using modern tools.

Term work:

The distribution of marks for **term work** shall be as follows:

Lab/ Experimental Work	:	15
Report/ Documentation	:	05
Attendance (Theory & Practical)	:	05

Practical & Oral examination is to be conducted based on respective departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.

Course Code	Title	Credit
CSP705	**Major Project- I**	**3**

Objective: The Project work enables students to develop further skills and knowledge gained during the programme by applying them to the analysis of a specific problem or issue, via a substantial piece of work carried out over an extended period. For students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:

1. **Project Topic:**
   - To proceed with the project work it is very important to select a right topic. Project can be undertaken on any subject addressing IT programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
   - Project work must be carried out by the group of at least two students and maximum three and must be original.
   - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
   - The project work can be undertaken in a research institute or organization/company/any business establishment.
   - Student must consult internal guide along with external guide (if any) in selection of topic.
   - Head of department and senior staff in the department will take decision regarding selection of projects.
   - Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
   - In case of industry projects, visit by internal guide will be preferred.

2. **Project Report Format:**

   At the end of semester a project report should preferably contain at least following details:-

   - Abstract
   - Introduction
   - Literature Survey
     - Survey Existing system
     - Limitation Existing system or research gap
     - Problem Statement and Objective
     - Scope
   - Proposed System
     - Analysis/Framework/ Algorithm
     - Details of Hardware & Software
     - Design details
     - Methodology (your approach to solve the problem)

- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**
   Distribution of marks for term work shall be as follows:
   a. Weekly Attendance on Project Day
   b. Project work contribute
   c. Project Report (Spiral Bound)
   d. Term End Presentation (Internal)

   The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. **Oral & Practical :**
   Oral &Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-I.

Course Code	Course Name	Credits
CSC801	**Human Machine Interaction**	**4**

.**Course Objectives:** At the end of the course, students will be able to –

1. Learn the foundation of human machine interaction.
2. Understand the importance of human psychology in designing good interfaces.
3. Be aware of mobile interaction design and its usage in day – to – day activities.
4. Understand various design technologies to meet user requirements.
5. Encourage to indulge into research in Machine Interaction Design.

Course Outcomes: At the end of the course, the students will be able to -

1. Identify User Interface (UI) design principles.
2. Analysis of effective user friendly interfaces.
3. Apply Interactive Design process in real world applications.
4. Evaluate UI design and justify.
5. Create application for social and technical task.

Pre-requisites: Web Technologies; Software Engineering; Experience in designing interfaces for applications and web sites. Basic knowledge of designing tools and languages like HTML, Java, etc

Module No.	Topics	Hrs.
1.0	**FOUNDATIONS OF HMI:** The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving . The computer: Devices, Memory, processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms.	8
2.0	**DESIGN & SOFTWARE PROCESS**: Mistakes performed while designing a computer system, Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds .Interactive Design basics, process, scenarios, navigation, Iteration and prototyping. HMI in software process: software life cycle, usability engineering, Prototyping in practice, design rationale. Design rules: principles, standards, guidelines, rules. Recognize the goals, Goal directed design process. Evaluation Techniques: Universal Design.	10
3.0	**GRAPHICAL USER INTERFACE:** The graphical User Interface: Popularity of graphics, the concept of direct manipulation, graphical systems, Characteristics. Web user Interface: Interface popularity, characteristics. The merging of graphical Business systems and the Web. Principles of user interface design.	8

4.0	**SCREEN DESIGNING**: Design goals , Screen planning and purpose, organizing screen elements, ordering of screen data and content , screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.	10
5.0	**INTERFACE DESIGN FOR MOBILE DEVICES**: Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications, Games, Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8
6.0	**INTERACTION STYLES AND COMMUNICATION**: Windows:Characteristics, Components, Presentation styles, Types of Windows, Management, operations. Text messages: Words, Sentences, messages and text words, Text for web pages. Icons, Multimedia and colors	**8**
	Total	**52**

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rdEdition, Pearson Education, 2004.
2. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.
3. Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
4. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.
5. Donald A. Normann, " Design of everyday things",Basic Books; Reprint edition 2002.
6. Brian Fling, "Mobile Design and Development", First Edition , O'Reilly Media Inc., 2009.

Reference Books:

1. Rogers Sharp Preece,"Interaction Design:Beyond Human Computer Interaction",,Wiley.
2. Guy A. Boy "The Handbook of Human Machine Interaction", Ashgate publishing Ltd.
3. Kalbande,Kanade,Iyer,"Galitz's Human Machine Interaction", Wiley Publications.

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC802	**Distributed Computing**	**04**

Course objectives:

1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms

Course outcomes: On successful completion of course learner will be able to:

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies;
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

Prerequisite: Java Programming, Operating Systems, Computer Networks

Module No.	Unit No.	Topics	Hrs.
1.0	**Introduction to Distributed Systems**		**06**
	1.1	Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept.	
	1.2	Middleware: Models of Middleware, Services offered by middleware, Client Server model.	
2.0	**Communication**		**10**
	2.1	Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)	
	2.2	Message Oriented Communication, Stream Oriented Communication, Group Communication	
3.0	**Synchronization**		**10**
	3.1	Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.	
	3.2	Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala's Algorithm, Maekawa's Algorithm	
	3.3	Token Based Algorithms: Suzuki-Kasami's Broardcast Algorithms, Singhal's Heurastic Algorithm, Raymond's Tree based Algorithm, Comparative Performance Analysis.	
4.0	**Resource and Process Management**		**06**
	4.1	Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach	
	4.2	Introduction to process management, process migration, Threads,	

		Virtualization, Clients, Servers, Code Migration	
5.0	**Consistency, Replication and Fault Tolerance**		**08**
	5.1	Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management	
	5.2	Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery	
6.0	**Distributed File Systems and Name Services**		**12**
	6.1	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Andrew File System (AFS)	
	6.2	Introduction to Name services and Domain Name System, Directory Services, Case Study: The Global Name Service, The X.500 Directory Service	
	6.3	Designing Distributed Systems: Google Case Study	
		Total	**52**

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

a. Question paper will comprise of 6 questions, each carrying 20 marks.
b. The students need to solve total 4 questions.
c. Question No.1 will be compulsory and based on entire syllabus.
d. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, , "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

Reference Books:

1. A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
2. M. L. Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2004.

Course Code	Course Name	Credit
DLO8011	**High Performance Computing**	04

Course Objectives:

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigms.

Course Outcomes: Learner will be able to-

1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.

Prerequisite: Computer Organization

Sr.No.	Module	Detailed Content	Hours
1	Introduction	**Introduction to Parallel Computing:** Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function) **Classification Models**: Architectural Schemes (Flynn's, Shore's, Feng's, Handler's) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory) **Parallel Architectures:** Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture	6
2	Pipeline Processing	Introduction, Pipeline Performance, Arithmetic Pipelines, Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling	8
3	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	10
4	Parallel Algorithm Design	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	12

5	Performance Measures	Performance Measures : Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks	6
6	HPC Programming	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations **MPI:** the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Introduction to OpenMP	10

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing", Pearson Education, Second Edition, 2007.
2. M. R. Bhujade, "Parallel Computing", 2nd edition, New Age International Publishers, 2009.
3. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill, Second Edition, 2010.
4. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

Reference Books:

1. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing: Technology, Architecture, Programming", McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, "High- Performance Computing: Paradigm and Infrastructure" Wiley, 2006.

Internal Assessment: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of total six questions.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Laboratory Work:

Description: The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

Suggested Experiment List:

Sr. No.	Detailed Content
1	Execution of Simple Hello world program on MPI platform
2	a. Program to send data and receive data to/from processors using MPI b. Program illustrating Broadcast of data using MPI
3	Implement a parallel program to demonstrate the cube of N number within a set range.
4	Write a parallel program for area of a circle/triangle
5	Implement a program to demonstrate balancing of workload on MPI platform
6	Using directives of MPI/OpenMP implement parallel programming for calculator application (add, sub, multiplication and division)
7	**Mini Project** Evaluate performance enhancement of HPC for any of the following: One-Dimensional Matrix-Vector Multiplication/ Single-Source Shortest-Path/ Sample Sort/Two-Dimensional Matrix-Vector Multiplication

Course Code	Course Name	Credits
DLO8012	**Natural Language Processing**	**4**

Course objectives:

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. To design and implement applications based on natural language processing
4. To implement various language Models.
5. To design systems that uses NLP techniques

Course outcomes: On successful completion of course learner should:

1. Have a broad understanding of the field of natural language processing.
2. Have a sense of the capabilities and limitations of current natural language technologies,
3. Be able to model linguistic phenomena with formal grammars.
4. Be able to Design, implement and test algorithms for NLP problems
5. Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP
6. Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction...etc.

Prerequisite: Data structure & Algorithms, Theory of computer science, Probability Theory.

Module No.	Unit No.	Topics	Hrs.
1	**Introduction**	History of NLP, Generic NLP system, levels of NLP , Knowledge in language processing , Ambiguity in Natural language , stages in NLP, challenges of NLP ,Applications of NLP	4
2	**Word Level Analysis**	Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST , Lexicon free FST Porter stemmer. N –Grams- N-gram language model, N-gram for spelling correction.	10
3	**Syntax analysis**	Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).	10
4	**Semantic Analysis**	Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD) ,Dictionary based approach	10

5	**Pragmatics**	Discourse –reference resolution, reference phenomenon , syntactic & semantic constraints on co reference	8
6	**Applications (preferably for Indian regional languages)**	Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition.	10

Text Books:

1. Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and Hinrich Schutze, " Foundations of Statistical Natural Language Processing ", MIT Press, 1999.

Reference Books:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. Daniel M Bikel and Imed Zitouni " Multilingual natural language processing applications" Pearson, 2013
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) " The Handbook of Computational Linguistics and Natural Language Processing " ISBN: 978-1-118-
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
5. Brian Neil Levine, An Introduction to R Programming
6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial : An introduction into R application and programming

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Laboratory Work/Case study/Experiments:

Description: The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

The objective of Natural Language Processing lab is to introduce the students with the basics of NLP which will empower them for developing advanced NLP tools and solving practical problems in this field.

Reference for Experiments: **http://cse24-iiith.virtual-labs.ac.in/#**

Reference for NPTEL: http://www.cse.iitb.ac.in/~cs626-449

Sample Experiments: possible tools / language: R tool/ Python programming Language

Note: Although it is not mandatory, the experiments can be conducted with reference to any Indian regional language.

1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2. Morphological Analysis
3. N-gram model
4. POS tagging
5. Chunking
6. Named Entity Recognition
7. Case Study/ Mini Project based on Application mentioned in Module 6.

Course Code	Course Name	Credits
DLO8013	Adhoc Wireless Networks	4

Course objectives:

1. To Identify the major issues associated with ad-hoc networks
2. To identify the requirements for protocols for wireless ad-hoc networks as compared to the protocols existing for wired network.
3. To explore current ad-hoc technologies by researching key areas such as algorithms, protocols, hardware, and applications.
4. To Provide hands-on experience through real-world programming projects
5. To provide advanced in–depth networking materials to graduate students in networking research.

Course outcomes: On successful completion of course learner will be able to:

1. Identify the characteristics and features of Adhoc Networks.
2. Understand the concepts & be able to design MAC protocols for Ad Hoc networks
3. Implement protocols / Carry out simulation of routing protocols of Adhoc Networks
4. Interpret the flow control in transport layer of Ad Hoc Networks
5. Analyze security principles for routing of Ad Hoc Networks
6. Utilize the concepts of Adhoc Networks in VANETs

Prerequisite: Computer Network, Wireless Networking

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**04**
	1.1	Introduction to wireless Networks. Characteristics of Wireless channel,	
	1.2	Issues in Ad hoc wireless networks, Adhoc Mobility Models:- Indoor and outdoor models,	
	1.3	Introduction to Adhoc networks – definition, characteristics features, applications.	
2.0		**MAC protocols for Wireless Ad-Hoc Networks**	**12**
	2.1	Introduction	
	2.2	Issues in designing MAC for Wireless Ad-Hoc Networks	
	2.3	Design Goals and classification of MAC for Wireless Ad-Hoc Networks	
	2.4	Contention based MAC protocols for Wireless Ad-Hoc Networks, with reservation mechanisms, scheduling Mechanisms	
	2.5	MAC protocols using directional antennas, Other MAC Protocols	
	2.6	IEEE standards MAC Protocols: 802.15.1(WPAN based on Bluetooth), 802.15.4 (WSN/Zigbee), 802.15.6 (WBAN).	
3.0		**Routing Protocols for Wireless Ad-Hoc Networks**	**10**
	3.1	Introduction, Issues in designing a routing protocol for Wireless Ad-Hoc Networks	
	3.2	Classification of routing protocols, Table driven routing protocols like DSDV, WRP,	

		On- demand routing protocols like ABR, DSR, TORA, AODV, etc.	
	3.3	Hybrid Routing Protocols : ZRP, Routing Protocols with efficient flooding mechanism, Hierarchical Routing Protocols, Power aware routing protocols	
4.0		**Transport Layer**	**10**
	4.1	Transport layer protocols for Ad hoc wireless Networks: Introduction,	
	4.2	Issues in designing a transport layer protocol for Ad hoc wireless Networks,	
	4.3	Design goals of a transport layer protocol for Ad hoc wireless Networks,	
	4.4	Classification of transport layer solutions: Split Approach , End-to-End approach :TCP-F,TCP-ELFN, Ad-Hoc TCP, TCP Buffering capability and Sequencing information	
	4.5	End-to-End Quality of Service	
5.0		**Security**	**08**
	5.1	Security attacks in wireless Ad hoc wireless Networks, Network security requirements,	
	5.2	Issues & challenges in security provisioning,	
	5.3	Link Layer security attacks: 802.11 MAC , WPA and variations	
	5.4	Network Security Attacks: Routing Protocol Attacks: attacks using falsifying route errors and broadcasting falsifying routes, spoofing attacks, Rushing attacks, Secure routing in Ad hoc wireless Networks	
6.0		**Vehicular Ad-Hoc Network (VANET)**	**08**
	6.1	Introduction: Challenges and Requirements, , Layered architecture for VANETs, DSRC /WAVE standard (IEEE 802.11p)	
	6.2	IEEE 802.11p protocol Stack (PHY & MAC) , A Survey on Proposed MAC Approaches for VANETs like TDMA, SDMA and CDMA based approaches, DSRC MAC & LLC	
	6.3	Georouting: CBF, Flooding with broadcast suppression	
	6.4	Delay Tolerant Network, Introduction to Opportunistic Networking in Delay Tolerant Vehicular Ad Hoc Networks	
		Total	**52**

Assessment:

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Text Books:

1. Siva Ram Murthy and B.S. Manoj , "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education, 2007 **(T1)**
2. C. K. Toh, "Adhoc Mobile Wireless Networks", Pearson Education, 2002 **(T2)**
3. Charles E. Perkins, "Adhoc Networking", Addison – Wesley, 2000 **(T3)**
4. Dipankar Raychaudhuri, Mario Gerla, "Emerging Wireless Technologies and the Future Mobile Internet, D, Cambridge. **(T4)**

Reference Books:

1. Subir Kumar Sarkar, "Ad-Hoc Mobile Wireless Networks: principles, protocols and applications" CRC Press **(R1)**
2. Prasant Mohapatra and Sriramamurthy, "Ad Hoc Networks: Technologies and Protocols", Springer International Edition, 2009, **(R2)**
3. Stefano Basangi, Marco Conti, Silvia Giordano, Ivan Stojmenovic, "Mobile Ad-Hoc Networking, " John-Wiley and Sons Publications, 2004,**(R3)**
4. Hannes Hartenstein, Kenneth Laberteaux, "VANET Applications and Interworking Technologies," Wiley Publications (R4)
5. Christoph Sommer , Falko Dressler, "Vehicular Networking," Cambridge University Press, 2014 **(R5)**

Laboratory Work

Lab Outcome:

1. Explore the knowledge of NS2 and NS3 by installing it and make it ready
2. Shall synthesize a simulation and evaluate the performance of WLAN 802.11 and Bluetooth
3. Students will able to analyze and implement MAC & Network layer protocols using open source and synthesis as well as evaluate its performance
4. Implement Transport layer protocols / Carry out simulation of routing protocols of Adhoc Networks
5. Describe and interpret the use security routines and evaluate its performance
6. Explore and understand the capability of SUMO and MOVE as well as Nessi by installing it and analyze it by applying on various scenarios

Description: It is recommended that Network simulation Softwares like NS-2, NS-3, SUMO (Simulation software for Urban MObility) with MOVE. Software like Nessi is also recommended for the event based security attacks simulation and measure.

The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Installation of NS2 & NS3 in Fedora 19 (32 bit) OS Linux.
2	Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS2
3	Implementation a Bluetooth network in NS3 with application as transfer of a file from one device to another
4	To implement and compare MAC layer protocols, MACAW, MACA-BI and MACA with piggybacked Reservation using NS-3

5	Develop sample wireless network in which a. implement AODV and AOMDV protocol b. Calculate the time to receive reply from the receiver using NS2. c. Generate graphs which show the transmission time for packet. Implement wireless network. Capture data frame and identify fields using NS2.
6	Communicate between two different networks (NS-3) which has following specifications: a. One network has Class A network with "TORA protocol" b. Second has Class B network "AODV protocol"
7	To calculate and compare average throughput for various TCP variants like TCP-F (Feedback) and Ad-Hoc TCP using NS-3
8	Explore and use security tools like WEP & WPA and evaluate its performance on mobile terminals
9	Simulation of Urban Mobility (SUMO) along with MOVE is software that helps in simulating the VANETs. Install it on Fedora 19 (32 bit) OS Linux
10	Create a simulation for road traffic with 6 junctions. There are various vehicles going on and your own car also. Select a shortest route for your car. Demonstrate with simulation software SUMO and MOVE.
11	A car acts as a malicious node and can be analyzed for the packet loss before and after malicious activity. Using SUMO and MOVE.
12	Create an Ad-hoc Network using nessi Simulation software and include events incorporate dropped packets, infected flows, compromised machines, unavailable services etc, and check its performance

Digital Material (if Any):

1. http://www.isi.edu/nsnam/ns/ : NS-2 software download (D1)
2. https://nsnam.isi.edu/nsnam/index.php/NS_manual (D2)
3. https://www.nsnam.org/ : Ns-3 Software Download (D3)
4. http://www.nsnam.com/2013/11/vanet-simulator-in-fedora-19-32-bit.html (D4)
5. http://www.sumo.dlr.de/userdoc/Tutorials/Quick_Start.html (D5)
6. http://veins.car2x.org/ (D6)
7. http://www.nessi2.de/ (D7)

Text Books:

1. Ekram Hossain and Teerawat Issariyakul, "Introduction to Network Simulator NS-2," Springer , Second Edition. (T1)
2. Jack L. Burbank, "Introduction to Network Simulator 3," Wiley Publications(T2)
3. Siva Ram Murthy and B.S. Manoj , "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education, 2007 (T3)
4. Michael Gregg, "Build your own security lab," Wiley India edition (T4)

Course Code	Course Name	Credits
ILO 8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	8

	5.3 Project Contracting Project procurement management, contracting and outsourcing,	
06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

REFERENCES:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management,Gido Clements, Cengage Learning
4. Project Management,Gopalan, Wiley India
5. Project Management,Dennis Lock, 9th Edition, Gower Publishing England

Course Code	Course Name	Credits
ILO 8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine	05

	Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO8023	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	5
02	**Organizational Behaviour (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6

04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale • Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning • Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	6
06	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO8025	**Professional Ethics and Corporate Social Responsibility (CSR)**	**03**

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ILO8026	**Research Methodology**	**03**

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**

05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

Course Code	Course Name	Credits
ILO 8028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ILO8029	**Environmental Management**	**03**

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Lab Code	Lab Name	Credits
CSL801	Human Machine Interactions Lab	1

Lab Outcome:

1: To design user centric interfaces.
2: To design innovative and user friendly interfaces.
3: To apply HMI in their day-to-day activities.
4: To criticize existing interface designs, and improve them.
5: To Design application for social Task.
6: To Design application for Technical Tasks

Description:

Human Machine Interaction provides the study of user interface and benefit of good design. The design process gives an idea about how people interact with computer and the problems that they fall, so understanding the human characteristics is important as this lays the base for a good interface. It enables the students to apply his/her design skills to develop an appropriate Mobile App or Website. Students also learn the different types of icon, color and its representation with social and ethical concerns. Students can also learn the different software tools used to assemble and build user interface along with the different types of interaction devices and finally try to measure the usability of the application by learning HMI principles.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Problem representation for Designing User Interface
2	Design a Mobile app/ Website that can teach mathematics to children of 4-5 years age in schools in Rural /Urban Sector
3	Design a Mobile App/Website that can help people to sell their handmade products in metro cities
4	ATM machine/KIOSK screen design for rural people.
5	Design a Mobile App/Website to get an experience for passengers whose flight /train is delayed.
6	Design an UI application for Institute event management.
7	Design of User interface for the system using various interaction styles.
8	Statistical Graphics and its use in visualization
9	Design appropriate icons pertaining to a given domain .(Eg. Greeting cards)

10	Design a personal website for an Artisan
11	Design a interface for Home appliances
12	Design an interactive data access using Graphics (QR, BAR Code, Image etc) and generating a print form
13	Redesign of a user interface (Suggest and implement changes in Existing User Interface
14	Design a navigator for a student new in your Institute.
15	Design a navigator for a person new in tourist city/ village
16	Design UI for Motor paralysis for disabled people.
17	KIOSK design for hospital/school/educational campus/National Institute.
18	To calculate screen complexity of existing Graphical User Interface and redesign the interface to minimize the screen complexity.

Guidelines:

1. Students are expected to use advanced tools and Technologies towards execution of lab work.
2. Students can work individually or only 2-3 Students can form a team if they wish to work in Group.
3. Case Study and assignments may be linked with CSC801 Syllabus.

Term Work:

Laboratory work will be based on above syllabus with minimum 10(Ten) experiments in line with the above Lab outcomes to be incorporated with 13(Thirteen) lab session of 2 (two) hours each. The problem statement can be decided by the instructor in line with the above list of experiments

The distribution of 25 marks for term work shall be as follows:

Lab Performance	15
Mini Project	05
Attendance (Theory & Practical)	05

Oral exam will be based on the above and CSC801:'HMI Theory' Syllabus.

Lab Code	Lab Name	Credits
CSL802	**Distributed Computing Lab**	**01**

Lab Outcome:

1. Develop, test and debug RPC/RMI based client-server programs.
2. Implement the main underlying components of distributed systems (such as IPC, name resolution, file systems etc.)
3. Implement various techniques of synchronization.
4. Design and implement application programs on distributed systems.

Suggested List of Experiments:

Sr. No.	Title of Experiments
1	Client/server using RPC/RMI.
2	Implementation of multi tread application
3	Inter-process communication
4	Group Communication
5	Load Balancing Algorithm.
6	Name Resolution protocol.
7	Election Algorithm.
8	Clock Synchronization algorithms.
9	Mutual Exclusion Algorithm.
10	Deadlock management in Distributed systems
11	Distributed File System
12	CORBA

Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): …… (15) Marks.
Assignments: ……..... (05) Marks.
Attendance (Theory + Practical)…… (05) Marks
TOTAL: …… (25) Marks.

Oral exam will be based on the above and CSC802 syllabus.

Lab Code	Course Name	Credits
CSL803	**Cloud Computing Lab**	**2**

Lab Objectives: The course will help the learners to get familiar with

1. Key concepts of virtualization.
2. Various deployment models such as private, public, hybrid and community.
3. Various service models such as IaaS and PaaS.
4. Security and Privacy issues in cloud.

Lab Outcomes: On completion of the course learners will be able to

1. Adapt different types of virtualization and increase resource utilization.
2. Build a private cloud using open source technologies.
3. Analyze security issues on cloud.
4. Develop real world web applications and deploy on commercial cloud.
5. Demonstrate various service models.

Module	Detailed Contents	Hours
01	**Title:** Study of NIST model of cloud computing. **Objective:** Understand deployment models, service models, advantages of cloud computing.	2
02	**Title:** Virtualization. **Objective**: Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability. **Technology:** XEN/ Vmwares EXSi	2
03	**Title:** Infrastructure as a Service. **Objective:** Implement IaaS using your resources. **Technology:** Open Stack / Eucalyptus	2
04	**Title:** Identity Management in Cloud **Concept:** Simulate identity management in your private cloud. **Technology:** Open Stack	2
05	**Title:** Storage as a Service **Objective:** Explore Storage as a Service for remote file access using web interface. **Technology:** ownCloud	2
06	**Title:** Cloud Security **Objective:** Understand security of web server and data directory. **Technology:** ownCloud	2
07	**Title:** Platform as a Service **Objective:** Deploy web applications on commercial cloud. **Technology:** Google appEngine/ Windows Azure	2
08	**Title:** Amazon Web Service **Objective:** To create and access VM instances and demonstrate various	2

	components such as EC2, S3, Simple DB, DynamoDB. **Technology:** AWS	
09	**Title:** Software as a Service **Objective:** Understand on demand application delivery and Virtual desktop infrastructure. **Technology:** Ulteo	2
10	**Title: Case Study on Fog Computing** **Objective**: To have a basic understanding of implementation/applications of fog computing.	2
11	**Title:** Mini Project **Objective:** Using the concepts studied throughout the semester students shall be able to 1. Create their private cloud for the institute using the available resources. 2. Apply security concepts to secure a private cloud. 3. Implement efficient load balancing. 4. Compare various virtualization technologies with given resource. 5. Create cloud applications such as messenger, photo editing website, your own social media etc. **Note:** Evaluators must check if students have used appropriate cloud computing tools for their projects.	6

Digital Material

www.openstack.org

Text Books:

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge,2010
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley - India, 2010 ,
3. Getting Started with OwnCloud by Aditya Patawar , Packt Publishing Ltd, 2013

Term Work:

- Term work should consist of at least 6 experiments and a mini project.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
- Laboratory work (experiments): …….. (15) Marks.
- Mini project..... …… (15) Marks.
- Mini Project Presentation & Report..... (10) Marks
  Assignments..... (05) Marks
- Attendance ……..(05) Marks
- **TOTAL: ……(50) Marks.**

Practical and Oral examination will be based on Laboratory work, mini project and above syllabus.

Lab Code	Course Name	Credits
CSL804	**Computational Lab II**	**1**

Lab Outcome: After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Description:

Design and implementation of any case study/ applications /experiments / mini project based on departmental level optional courses using modern tools.

Term work:

The distribution of marks for **term work** shall be as follows:

Lab Experimental Work & mini project	:	25
Report/ Documentation/Presentation	:	20
Attendance (Theory & Practical)	:	05

Practical & Oral examination is to be conducted based on departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.

Course Code	Title	Credit
CSP805	**Major Project- II**	**6**

Objective: The primary objective is to meet the milestone s formed in the overall project plan decided in Project - I. The idea presented in Project -I should be implemented in Project -II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

Guidelines:

Project Report Format:

At the end of semester a student need to prepare a project report should be prepared as per the guidelines issued by the University of Mumbai. Along with project report a CD containing: project documentation, Implementation code, required utilities, Software's and user Manuals need to be attached.

Term Work:

Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project.

Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day
b) Project work contributions as per objective
c) Project Report (Hard Bound)
d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical :

Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-II.

UG- Instrumentation Engineering

Sr. No.	Subject Code	Subject Name	Count
1	ISC302, ISL301	Transducers-I, Transducers I -Lab	2
2	ISC303, ISL302	Analog Electronics, Analog Electronics- Lab	2
3	ISC304, ISL303	Digital Electronics, Digital Electronics -Lab	2
4	ISC305	Electrical Networks and Measurements	1
5	ISL304	Object Oriented Programming Lab	1
6	ISM301	Mini Project – 1 A	1
7	ISC402	Transducers-II	1
8	ISC403, ISL402	Signal Conditioning and Circuit Design, Signal Conditioning and Circuit Design- Lab	2
9	ISC404, ISL403	Feedback Control System, Feedback Control System-Lab	2
10	ISC405, ISL401	Control System Components, Process Control Components-Lab	2
11	ISL404	Virtual Instrumentation - Lab	1
12	ISM401	Mini Project – 1 B	1
13	ISC502,ISL502	Applications of Microcontroller, Applications of Microcontroller- Lab Practice	2
14	ISC503, ISL503	Control System Design, Control System Design Lab Practice	2
15	ISC504, ISL504	Control System Components, Control System Components Lab Practice	2

16	ISDLO501X, ISL505	Department Level Optional Course I, Department Level Optional Course I – Lab Practice	2
17	ISL506	Mini-project – I	1
18	ISC601, ISL601	Process Instrumentation System,Process Instrumentation System – Lab Practice	2
19	ISC602, ISL602	Industrial Data Communication, Industrial Data Communication – Lab Practice	2
20	ISC603, ISL603	Electrical machines and Drives, Electrical machines and Drives – Lab Practice	2
21	ISC604, ISL604	Digital Signal Processing, Digital Signal Processing – Lab Practice	2
22	ISC605, ISL605	Advanced Control System, Advanced Control System – Lab Practice	2
23	ISL 606	Mini-project - II	1
24	ISC701, ISL701	Industrial Process Control, Industrial Process Control – Lab Practice	2
25	ISC702, ISL702	Biomedical Instrumentation, Biomedical Instrumentation– Lab Practice	2
26	ISC703, ISL703	Industrial Automation, Industrial Automation – Lab Practice	2
27	ISDLO703X, ISL704	Department Level Optional Course III, Department Level Optional Course III – Lab Practice	2
28	ISL705	Project I	1
29	ISC801, ISL801	Instrumentation Project Documentation and Execution, Instrumentation Project Documentation and Execution Lab	2
30	ISC802, ISL802	Instrument and System design, Instrument and System design Lab	2

31	ISDLO804X, ISL803	Department Level Optional Course IV, Department Level Optional Course IV – Lab Practice	2
32	ISL804	Project II	1
		Total	54

AC- 23/7/2020

Item No. 143

UNIVERSITY OF MUMBAI

Bachelor of Engineering
In
Instrumentation Engineering

Second Year with Effect from AY 2020-21
Third Year with Effect from AY 2021-22
Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC23/7/2020
Item No. 143

UNIVERSITY OF MUMBAI

Syllabus for Approval

1	Title of the Course	S.Y of B.E in Instrumentation Engineering
2	Eligibility for Admission	**After Passing First Year Engineering as per the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	**New** / ~~Revised~~ **REV- 2019 'C' Scheme**
9	To be implemented from Academic Year	**With effect from Academic Year: 2020-2021**

Date:

Dr. S.K.Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Majumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

PREAMBLE

Technical education in our country is progressing rapidly in manifolds. To maintain the quality of education a systematic approach is necessary, which can be obtained by building a strong technical base with the quality. Accreditation provides quality assurance in higher education and recognition to the institution or program, meeting certain specified standards. The main-focus of an accreditation process is to measure the program outcomes, essentially the range of skills and knowledge that a student will have at the time of graduation from the program. Faculty of Science & Technology of the University of Mumbai has taken a lead in incorporating a philosophy of outcome-based education in the process of curriculum development. The earlier syllabus was more focused on providing information and knowledge across various domains, which led to loading of students heavily, in terms of direct contact hours.

I, as a Chairman, Board of Studies in Instrumentation Engineering of University of Mumbai, happy to state here that, the revised curriculum focused on not only providing knowledge content but also on skill-based activities like attitudes, self-learning, and project-based activities. More than 30 senior faculty members from the different affiliated institutes of University of Mumbai were actively participated in this process. They are either Heads of Departments or their senior representatives from the Department of Instrumentation Engineering. The salient features of revised syllabus of Instrumentation Engineering, REV 2019 'C' Scheme are:

1. The overall credits and approach of the curriculum proposed in the present revision are in line with AICTE model curriculum.
2. Course objectives and course outcomes are framed as per NBA guidelines (Bloom's Taxonomy) and are clearly defined for each course.
3. Detailed guidelines are presented to understand the depth and the approach to course to be taught, which will enhance learner's learning process.
4. The credit and grading system enables a learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching.
5. Minimizes the burden of contact hours, total credits of the entire program will be approximately 172. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skillsets.
6. It also focuses on continuous evaluation which will enhance the quality of education.
7. Credit assignment for courses is based on 15 weeks teaching-learning process, however, the content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond the syllabus, etc.
8. The revised curriculum emphasizes on skill-based laboratories and project-based learning by introducing mini projects in the second and third year of programs, which will facilitate self-learning of students.

Dr. Alice Cheeran - Chairperson (BoS in Instrumentation Engineering)
Dr. M. D. Patil - Member
Dr. M. J. Lengare - Member
Dr. Sharad P. Jadhav - Member
Dr. Dipak Gawali – Member

Program Structure for Second Year Instrumentation Engineering

(With Effect from 2020-2021)

Scheme for Semester- III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC301	Engineering Mathematics-III	3	--	1	3	--	1	4
ISC302	Transducers-I	4		--	4		--	4
ISC303	Analog Electronics	3	--	--	3	--	--	3
ISC304	Digital Electronics	3	--	--	3	--	--	3
ISC305	Electrical Networks and Measurements	4	--	--	4	--	--	4
ISL301	Transducers-I - Lab	--	2	--	--	1	--	1
ISL302	Analog Electronics - Lab	--	2	--	--	1	--	1
ISL303	Digital Electronics - Lab	--	2	--	--	1	--	1
ISL304	Object Oriented Programming Lab	--	3#	--	--	1.5	--	1.5
ISM301	Mini Project – 1 A	--	3$	--	--	1.5	--	1.5
Total		**17**	**12**	**1**	**17**	**06**	**1**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	PR & OR	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ISC302	Transducers-I	20	20	20	80	3	--	--	100
ISC303	Analog Electronics	20	20	20	80	3	--	--	100
ISC304	Digital Electronics	20	20	20	80	3	--	--	100
ISC305	Electrical Networks and Measurements	20	20	20	80	3	--	--	100
ISL301	Transducers-I - Lab	--	--	--	--	--	25	25	50
ISL302	Analog Electronics - Lab	--	--	--	--	--	25	25	50
ISL303	Digital Electronics - Lab	--	--	--	--	--	25	25	50
ISL304	Object Oriented Programming Lab	--	--	--	--	--	25	25	50
ISM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
	Total	**--**	**--**	**100**	**400**	**--**	**150**	**125**	**775**

$ indicates work load of Learner (Not Faculty), for Mini Project

Out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches

Scheme for Semester -IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC401	Engineering Mathematics -IV	3	--	1	3	--	1	4
ISC402	Transducers-II	4	--	--	4	--	--	4
ISC403	Signal Conditioning and Circuit Design	3	--	--	3	--	--	3
ISC404	Feedback Control System	3	--	--	3	--	--	3
ISC405	Control System Components	4	--	--	4	--	--	4
ISL401	Process Control Components - Lab	--	2	--	--	1	--	1
ISL402	Signal Conditioning and Circuit Design - Lab	--	2	--	--	1	--	1
ISL403	Feedback Control System - Lab	--	2	--	--	1	--	1
ISL404	Virtual Instrumentation -Lab	--	3#	--	--	1.5	--	1.5
ISM401	Mini Project – 1 B	--	3$	--	--	1.5	--	1.5
Total		**17**	**12**	**1**	**17**	**6**	**1**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	PR & OR	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ISC401	Engineering Mathematics -IV	20	20	20	80	3	25	--	125
ISC402	Transducers-II	20	20	20	80	3	--	--	100
ISC403	Signal Conditioning and Circuit Design	20	20	20	80	3	--	--	100
ISC404	Feedback Control System	20	20	20	80	3	--	--	100
ISC405	Control System Components	20	20	20	80	3	--	--	100
ISL401	Process Control Components - Lab	--	--	--	--	--	25	25	50
ISL402	Signal Conditioning and Circuit Design - Lab	--	--	--	--	--	25	25	50
ISL403	Feedback Control System - Lab	--	--	--	--	--	25	25	50
ISL404	Virtual Instrumentation- Lab	--	--	--	--	--	25	25	50
ISM401	Mini Project – 1 B	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**125**	**775**

$ indicates work load of Learner (Not Faculty), for Mini Project

out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC301	Engineering Mathematics-III	3	--	1	3	--	1	4

Subject code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Subject Code	Subject Name	Credits
ISC301	Engineering Mathematics-III	4
Course Objectives	**The course is aimed** 1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications. 2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills 3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane. 4. To understand the basics of Linear Algebra and its applications 5. To use concepts of vector calculus to analyze and model engineering problems.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Apply the concept of Laplace transform to solve the real integrals in engineering problems. 2. Apply the concept of inverse Laplace transform of various functions in engineering problems. 3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems. 4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables. 5. Illustrate the use of matrix algebra to solve the engineering problems. 6. Apply the concepts of vector calculus in real life problems.	

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors.

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	**CO-1** **7**
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	CO-2 6
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	CO-3 7
04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z) Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	CO-4 7

05	**Module: Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	CO-5 6
06	**Module: Vector Differentiation and Integra**l 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	CO-6 6

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4 - 6 students should be assigned a self-learning topic. Students should prepare a presentation/ problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:-

1. Advanced engineering mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC302	Transducers-I	4	--	--	4	--	--	4

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC302	Transducers-I	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC302	Transducers-I	4
Course Objectives	**The course is aimed** 1. To introduce the students for the purpose of explaining the measurement systems, errors of measurement. 2. To understand the definition and classification of sensors and transducers based of their principle of operation and their applications in the various industries. 3. To familiarize the student with the identification, classification, construction, working principle and application of various transducers used for displacement, level, temperature, speed and vibration measurement.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Explain the measurement systems, sources errors of measurement. 2. List and compare various standards used for selection of transducers/sensors. 3. Describe the working principles of various displacement sensors and transducers. 4. Interpret and apply different temperature transducers/sensors for industrial applications. 5. Formulate and Design the solutions for given applications using appropriate level sensors and transducer. 6. Apply the techniques of speed and vibration measurement in different industries.	

Prerequisite: Units and standards of measurement, concept of transducers (resistive, piezoelectric, pressure, optical and pyro sensors, etc.), Knowledge of basic measurement.

Details of Syllabus:

Module	Contents	Hrs.	CO Mapping
1.	**Instrumentation System** Units and standards of measurement, Introduction, block diagram, functional elements of measurement system, static and dynamic characteristics of transducer, Measurement and calibration systems- Requirement. sources of errors and their statistical analysis, standards and calibration.	**04**	**CO1**
2.	**Sensor and Transducer:** Definition, working principle, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital), selection criteria, transducer specifications, test condition and operating conditions.	**04**	**CO2**
3.	**Displacement transducers:** **Resistive type transducers:** potentiometer (linear and logarithmic), piezo-resistive effect. **Inductive type transducers:** LVDT, RVDT (transfer function, linearity, sensitivity, source, frequency dependence, phase null, and signal conditioning). **Capacitive type transducers:** Linear and rotary (with change in distance between plates, change in dielectric constant and change in overlapping area) **Digital transducer:** translational and rotary encoders (absolute position and incremental position encoders). **Proximity sensors:** inductive, capacitive, optical, ultrasonic, hall-effect and magnetic. **Pneumatic transducer:** flapper- nozzle transducer**.** Comparative study for Displacement Transducers with applications, and materials for capacitive, resistive, inductive and ultrasonic transducers**.**	**14**	**CO3**
4.	**Temperature transducers:** Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of mechanical temperature Sensors (thermometer, thermostat). **Resistance temperature detector (RTD):** Principle, types, Configurations, construction and working of RTD, Material for RTD, Signal Measurement techniques for RTD, Comparative Response curves for RTD, 2 wire, 3wire and 4 wire RTD Element, Lead wire Compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD and sums. **Thermistors**: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications and sums. **Thermocouples:** Principle, thermoelectric effect, See beck effect, Peltier effect, laws of thermocouple, types of thermocouple with Characteristic	**14**	**CO4**

	curve, thermocouple table, Sensitivity, constructional Features of Thermocouples., Thermo couple specifications, electrical noise and noise reduction techniques, cold junction Compensation method, thermopile, thermocouple emf measurement method, Thermo well Material of construction and its specifications and sums. **Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its Applications. Comparative study for Temperature Transducers.		
5.	**Level Transducers:** working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type (Time domain reflectometry/ Phase difference sensors), solid level detectors, fiber optic level detectors, Level switches. Comparative study for Level Transducers.	**08**	**CO5**
6.	**Speed and Vibration Measurement:** stroboscopes, toothed rotor, eddy current, electromagnetic transducers (moving coil, moving magnet), AC and DC tachometers: Hall Effect proximity pickup, photoelectric, photo-reflective, pulse counting method. Seismic, LVDT, piezoelectric.	**08**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be a compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. B.C Nakra, K.K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003 - Electronic instruments - 632 page.
2. Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003) - 344 pages.
3. A. K. Sawhney, Puneet Sawhney,A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996 -
4. Rangan, Mani, Sharma.Instrumentation systems and Devices, 2nd Ed.,Tata McGraw Hill.
5. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.

Reference Books:

1. Doeblin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.
2. Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3. Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
4. Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005
5. S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
6. B.E. Jones, Instrument Technology.
7. Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.
8. Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC303	Analog Electronics	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC303	Analog Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC303	Analog Electronics	3
Course Objectives	**The course is aimed** 1. To familiarize the student with basic electronic devices and circuits. 2. To analyze the DC biasing circuits, low and high frequency AC analysis of various electronic devices. 3. To introduce the students with basic construction and operation of differential and multistage amplifier. 4. To design different types voltage regulators and discuss the power amplifiers. 5. To employ various devices for industrial and consumer electronics.	
Course Outcomes	**On successful completion of course learner/student will be able to:** **1.** Demonstrate the application of diodes and formulate the DC analysis of BJT. **2.** Formulate and attribute BJT biasing techniques and its frequency response. **3.** Apply the basic construction and characteristics of FET to analyze the DC and AC circuits. **4.** Utilize the basic construction and characteristics of MOSFET to formulate the DC and AC circuits. **5.** Describe the Differential and multistage amplifier and its stages in detail. **6.** Discuss the power amplifiers and design power supply using different IC	

Pre-requisite: Introduction of PN junction

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Bipolar Junction Transistor:** Introduction to Diodes and its applications as Clipper and Clamper, Bipolar Junction Transistor, Device structure and physical operation, characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuits, Stability Analysis.	**08**	**CO1**
2.	**BJT AC Analysis:** Amplification in AC domain, BJT transistor modelling, The r_e Transistor model, Hybrid equivalent model for CE configuration, Derivation of parameters trans-conductance, input resistances, voltage gain and current gain. Single stage BJT amplifiers CE configuration (with and without feedback), Small Signal equivalent circuit, frequency response of a CE amplifier, low frequency response, high frequency response.	**08**	**CO2**
3.	**Field effect Transistors:** Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET. FET as an amplifier and its analysis (CS) and its frequency response.	**06**	**CO3**
4.	**MOS Field effect Transistors:** Introduction to MOSFET as basic element in VLSI, Device structure and physical operation, current – voltage characteristics, the MOSFET as an amplifier and a switch, DC Analysis of MOSFET Circuits, Biasing MOSFET Amplifier Circuits, frequency response of a CS amplifier, low frequency response.	**06**	**CO4**
5.	**Differential and Multistage Amplifiers:** Preview, the Differential Amplifier, Basic BJT Differential Pair (SIBO, SIUO, DIBO, DIUO), Capacitive coupled and Direct coupled multistage amplifier. Differential Amplifier with Active Load, Gain Stage and Simple Output Stage, Diff-Amp Frequency Response.	**04**	**CO5**
6.	**Power Amplifier:** Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Push Pull Amplifier, **Power supply design** using 78xx series, 79xx series and adjustable voltage IC regulators like 723 and 317. Switched Mode Power Supply (SMPS) – Block diagram with advantages and disadvantages over conventional power supply.	**07**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, *"Electronic Devices and Circuit Theory",* PHI publishers, 2004
2. Thomas L. Floyd," Electronic Devices", Pearson 2015.
3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar , "*Microelectronic Circuits,: Theory and Applications",* OUP, 2013
4. D. A. Neamen, "Micro *Electronic Circuit Analysis and Design*", McGraw-Hill, New Delhi, 2010.

Reference Books:

1. J. Millman and C. C. Halkias*, "Integrated Electronics: Analog and Digital Circuits and Systems",* Tata McGraw-Hill Publishing Company, 1988.
2. D. A. Bell, "*Electronic Devices and Circuits*", OUP, India, 2010.
3. T. F. Boghart, J. S. Beasley and G. Rico, "*Electronic Devices and Circuits*", Pearson Education, 2004.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC304	Digital Electronics	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC304	Digital Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC304	Digital Electronics	3
Course Objectives	**The course is aimed** 1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits. 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Represent numerical values in various number systems and perform number conversions between different number systems. 2. Analyze and design, digital combinational circuits using logic gates with IEEE/ANSI standard symbols. 3. Formulate and design sequential logic circuits. 4. Formulate and design asynchronous sequential logic circuits. 5. Explain nomenclature and technology in memory devices. 6. Apply the concept of logic families and their application to design the digital system.	

Pre-requisite: Knowledge of number systems and Boolean logic.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Binary number system:** Binary Arithmetic, Binary codes: Weighted, BCD, 8421, Gray code, Excess 3 code, ASCII, Error detecting code. **Reduction methods:** Boolean laws, De-Morgan's Theorem, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions.	**06**	**CO1**
2.	**Design of combinational logic circuits:** Adders, Subtractors, Code conversion, Parity checker, Magnitude comparators, BCD adder, Multiplexer, Demultiplexer, Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer. Hazards in logic circuits and its elimination.	**10**	**CO2**
3.	**Sequential logic circuits :** Flip flops- SR, D and Master slave JK, T, Realization of one flip flop using other flip flops, Asynchronous & Synchronous counters, Modulo n counter, shift registers.	**06**	**CO3**
4.	**Asynchronous sequential circuits:** Circuit Design – primitive state / flow table, Minimization of primitive state table, state assignment, Excitation table, Excitation map, cycles.	**05**	**CO4**
5.	**Logic families:** Basics of digital integrated circuits, basic operational characteristics and parameters. TTL, Schottky clamped TTL, tri-state gate ECL, IIL, MOS devices CMOS comparison of logic families. PMOS, NMOS and E2 CMOS, BiCMOS**.**	**06**	**CO5**
6.	**Memory and programmable logic devices:** PROM / EPROM / EEPROM / EAPROM Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to Complex Programmable Logic Device (CPLD), Field Programmable Gate Arrays (FPGA).	**06**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books

1. M. Morris Mano, *"Digital Design",* Prentice Hall of India, 2003.
2. John .M Yarbrough, *"Digital Logic Applications and Design",* Thomson-Vikas publishing house, 2002.
3. Barry B. Brey, *"The Intel Microprocessors*", Pearson/Prentice Hall, 2006.
4. B. Ram, *"Fundamentals of Microprocessors and Microcontrollers",* Dhanpat Rai Publications, 2004.

References Books:

1. Charles H. Roth., *"Fundamentals of Logic Design",* Thomson Publication Company, 2003.
2. Donald P. Leach and Albert Paul Malvino*, "Digital Principles and Applications",* Tata McGraw Hill Publishing Company Limited, 2003.
3. R. P. Jain, *"Modern Digital Electronics",* Tata McGraw–Hill publishing company limited, 2003.
4. Thomas L. Floyd, *"Digital Fundamentals",* Pearson Education, 2003.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC305	Electrical Networks and Measurements	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC305	Electrical Networks and Measurements	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC305	Electrical Networks and Measurements	4
Course Objectives	**The course is aimed** 1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. 2. To introduce the concept of circuit elements and analyze DC and AC circuits using various theorems. 3. To analyze the transient response of series and parallel A.C. circuits. 4. To analyze two port model of circuit and evaluate its parameters. 5. To synthesize the circuits using different techniques. 6. To demonstrate basic analog and digital Instruments. 7. To identify the various techniques for measurement of R-L-C.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Analyze AC and DC circuits using different theorems. 2. Evaluate transient and steady-state the parameters of passive electrical networks. 3. Analyze network using poles and zeros and determine their parameters like Z, Y, and ABCD. 4. Synthesize the networks using canonical forms. 5. Demonstrate construction and working principle and applications of analog and digital instruments. 6. Formulate electrical bridges and evaluate electrical parameter like R, L, C.	

Prerequisite: Analysis of DC networks for independent sources, mesh, node analysis, network theorems, and fundamentals of RLC networks.

Detailed Syllabus

Module	Contents	Hrs.	CO mapping
1.	**Network Theorems** Analysis of networks with dependent sources: mesh analysis, nodal analysis, super mesh and super node concept, source transformation technique, superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. Solution of networks with AC sources, Analysis of coupled circuits (self-inductance, mutual inductance, and dot convention).	**12**	**CO1**
2.	**Transient Analysis** Initial Conditions in Elements, Solution of a First order and Second order differential equations, Transients in R-L, R-C and RLC Circuits.	**08**	**CO2**
3.	**Network Functions and Two-Port parameters** Network functions for one port and two port networks, driving point and transfer functions, ladder network, poles and zeros of network functions, time domain behaviour from pole-zero plot. Two-Port parameters, Open circuit, Short circuit, transmission and hybrid parameters, relationship between parameter sets, reciprocity and symmetry conditions, parallel connection of two port networks.	**08**	**CO3**
4.	**Fundamentals of Network Synthesis.** Causality and stability, Hurwitz polynomials, positive real functions, synthesis of one port networks with two kinds of elements. Properties and synthesis of L-C, R-C, R-L driving point impedances, synthesis of R-L-C function.	**10**	**CO4**
5.	**Analog & Digital Meters** D'Arsonaval galvanometers, PMMC and PMMI instruments. Shunts and multipliers, Construction and working principle of: ammeters, voltmeters, ohmmeters, power factor meter, energy meter, Q meters, Analog multimeters. Electronic Voltmeters, Digital Voltmeter and digital multimeter. CRO, Measurement of phase and frequency.	**07**	**CO5**
6.	**Measurement of R, L, C** Measurement of medium, low and high resistance, Megger AC bridges, measurement of self and mutual inductances (Maxwell and Hay Bridges). Measurement of capacitance (Schering Bridge). Derivations and numerical related to all bridges.	**07**	**CO6**

Internal Assessment Test:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Kuo Franklin F., *"Network analysis and synthesis",* Wiley International, 1962.
2. Van Valkenburg M.E., *"Network analysis",* Eastern Economy Edition, 1983.
3. A. K. Sawhney, Puneet Sawhney, *"A course in Electrical and Electronic Measurement and Instrumentation",* Dhanpat Rai and Co. Rai, 1996.

Reference Books:

1. Hayt William, Kemmerly Jr.Jack E*., "Engineering circuit Analysis",* Tata McGraw Hill, 2002.
2. Edminister Joseph A., Nahvi Mohmood, *"Electric Circuits",* Tata McGraw Hill, 1999.
3. Shyammohan Sudhakar, *"Circuits and Networks Analysis and Synthesis",* Tata McGraw Hill, 2000.
4. Ravish Singh, " Electrical Networks Analysis and Synthesis", Mc-Graw Hill

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL301	Transducers-I - Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL301	Transducers-I - Lab	--	--	--	--	25	25	-	50

Subject Code	Subject Name	Credits
ISL301	Transducers-I –Lab	1
Course Objectives	**The course is aimed** 1. To make students understand the Identification, construction, working principle of various transducers used for Displacement measurement, Temperature measurement, Level measurement and miscellaneous measurement. 2. To experimentally verify the principle and characteristics of various transducers.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Demonstrate various measurement techniques and measuring instruments. 2. Demonstrate Flapper Nozzle system. 3. Plot and validate the performance characteristics of displacement transducers 4. Validate the characteristics of various temperature transducers. 5. Describe the construction and operation of various level transducers. 6. Demonstrate the performance characteristics of miscellaneous	

Syllabus: Same as that of Subject ISC302 Transducers-I

List of Experiments:

Sr. No	Contents	CO Mapping
1.	Demonstrate the basic measurements techniques and Measuring Instruments.	CO1
2.	Plot response curve for Flapper Nozzle system and validate the results with stand values.	CO2
3.	Plot and validate the LVDT characteristics.	CO3

4.	Test and evaluate distance using ultrasound transducer.	CO3
5.	Measure and verify the given displacement using Potentiometer.	CO3
6.	Plot and validate the characteristics of RTD	CO4
7.	Draw and validate the characteristics of various Thermocouples.	CO4
8.	Draw and validate the characteristics of Thermistors.	CO4
9.	Test and compare temperature measurement with and without Thermo-well.	CO4
10.	Perform and validate Liquid Level Measurement using DP Cell	CO5
11.	Plot and validate performance characteristics of capacitive level sensor.	CO5
12.	Perform and distinguish Liquid Level Measurement using Tubular Level Gauge and ultra-sonic sensor.	CO5
13.	Plot the static characteristics of different proximity sensors.	CO6
14.	Demonstrate the Humidity measurement.	CO6

Any other experiments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:

Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on ISC 302 Transducer-I

Term Work:

1) Minimum of **Ten** experiments covering all cos can be conducted during the semester for term work and practical examination.
2) Assignments based on syllabus which will help students to understand the Topic can be given during the semester as a support to Evaluate Term work.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL302	Analog Electronics-Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL302	Analog Electronics- Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL302	Analog Electronics-Lab	1
Course Objectives	**The course is aimed** 1. To familiarize the student with basic electronic devices and circuits. 2. To modal and analyze applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To experiment with differential and multistage amplifier. 4. To design different types of power supply.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. DC analysis of BJT. 2. Analyze BJT biasing techniques and frequency response. 3. Plot and evaluate parameters using FET characteristics. 4. Draw and evaluate parameters of MOSFET characteristics. 5. Implement and simulate Differential amplifier configuration 6. Design of power supply.	

Syllabus: Same as that of Subject ISC303 Analog Electronics.

List of Experiments:

Sr. No	Contents	CO mapping
1.	Design the Diode circuit as Clipper and Clamper.	CO1
2.	Verify the input -output characteristics of BJT in CE configuration.	CO1
3.	Implementation of a biasing circuit for BJT and estimate the parameters.	CO1
4.	Plot and validate the frequency response of BJT amplifier.	CO2
5.	Analyse the JFET circuit and validate its transfer characteristics.	CO3
6.	Plot and validate the frequency response of FET amplifier.	CO3
7.	Analyse the MOSFET circuit and validate its transfer characteristics.	CO4
8.	Plot the frequency response of MOSFET amplifier	CO4
9.	Simulate the multistage amplifier and analyse its frequency response with the help of simulation software.	CO5
10.	Simulate the differential amplifier and analyse its frequency response with the help of simulation software.	CO5
11.	Simulate the class A power amplifier and analyse with the help of simulation software.	CO6
12.	Design of fixed voltage regulator using adjustable regulator IC.	CO6

Any other experiment based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:
Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on **ISC303 Analog Electronics.**.

Term Work:

Term work shall consist of minimum 08 Experiments covering all COs and any 02 practical should be verified with simulation software**.**

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL303	Digital Electronics- Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL303	Digital Electronics- Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL303	Digital Electronics- Lab	1
Course Objectives	**The course is aimed** 1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits, 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Demonstrate numerical values in various number systems and perform number conversions between different number systems. 2. Exemplify operation of logic gates using IEEE/ANSI standard symbols. Analyze and design, digital combinational circuits. 3. Design and validate sequential logic circuits. 4. Design and verify asynchronous sequential logic circuits. 5. Demonstrate nomenclature and technology in memory devices. 6. Analyze logic families and their application to design the digital system.	

Syllabus: Same as that of Subject ISC304 Digital Electronics.

List of Experiments:

Sr. No	Detailed Contents	CO Mapping
1	Implement conversion of Gray/Binary code.	**CO1**
2	Truth table verification and implementation of all gates using Universal gates.	**CO2**
3	Implementation of half/ full adder/ Subtractor.	**CO2**
4	Implementation of magnitude comparator.	**CO3**
5	Realise full adder using 2:1 Multiplexer.	**CO3**
6	Realise full Subtractor using 2:1 Multiplexer.	**CO3**
7	Implementation of various flip-flops.	**CO4**
8	Design and implement RS flip flop into other flip flops.	**CO4**
9	Design and implement JK flip flop into other flip flops.	**CO4**
10	Design and implement modulo-n counter.	**CO5**
11	Design and implement ring counter.	**CO5**
12	Design and implement universal shift register.	**CO5**
13	Implement BCD to seven segments display.	**CO6**
14	Design finite state machine for a digital lock	**CO6**

Any other experiment based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:
Practical Examination will be based on performing one Experiment in the Laboratory from the list of Experiments given in the syllabus & the Oral Examination will be based on **ISC304 Digital Electronics.**.

Term Work:

Term work shall consist of minimum 08 Experiments covering all COs and any 02 practical should be verified with simulation software**.**

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL304	Object Oriented Programming - Lab	-	3#	-	-	1.5	-	1.5

Subject Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
ISL304	Object Oriented Programming- Lab	-	-	-	-	25	25	-	50

out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches.

Subject Code	Subject Name	Credits
ISL304	Object Oriented Programming- Lab	1.5
Course Objectives	**The course is aimed** 1. To learn the object-oriented programming concepts 2. To study various java programming constructs like multithreading, exception handling, packages etc. 3. To explain components of GUI based programming	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Apply fundamental programming constructs. 2. Illustrate the concept of packages, classes and objects. 3. Elaborate the concept of strings arrays and vectors. 4. Implement the concept of inheritance and interfaces. 5. Implement the notion of exception handling and multithreading. 6. Develop GUI based application	

Prerequisite: Structured Programming Approach

Details of Syllabus:

Module	Contents	Hrs.	CO Mapping
1	**Introduction to Object Oriented Programming** **OO Concepts:** Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. **Features of Java, JVM** **Basic Constructs/Notions:** Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	**02**	**CO1**
2	**Classes, Object and Packages** Class, Object, Method. Constructor, Static members and methods Passing and returning Objects Method Overloading, Packages in Java, creating user defined packages, access specifiers.	**03**	**CO2**
3	**Array, String and Vector** Arrays, Strings, String Buffer, Wrapper classes, Vector	**02**	**CO3**
4	**Inheritance and Interface** Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword, Implementing interfaces, extending interfaces	**02**	**CO4**
5	**Exception Handling and Multithreading** Error vs Exception, try, catch, finally, throw, throws, creating own exception, Thread lifecycle, Thread class methods, creating threads, Synchronization	**02**	**CO5**
6	**GUI programming in JAVA** **Event Handling:** Event classes and event listener **Introduction to AWT:** Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Checkbox and Radio Buttons.	**02**	**CO6**

Text books:

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

Reference Books:

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. Dietal and Dietal, 'Java: How to Program', 8/e, PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.

List of Experiments/ Assignments:

Sr. No.	Detailed Contents	CO mapping
1.	Program on various ways to accept data through keyboard and unsigned right shift operator.	**CO1**
2.	Program on branching, looping, labelled break and labelled continue.	**CO1**
3.	Program to create class with members and methods, accept and display details for single object.	**CO2**
4.	Program on constructor and constructor overloading	**CO2**
5.	Program on method overloading	**CO2**
6.	Program on passing object as argument and returning object	**CO2**
7.	Program on creating user defined package	**CO2**
8.	Program on 1D array	**CO3**
9.	Program on 2D array	**CO3**
10.	Program on String	**CO3**
11.	Program on String Buffer	**CO3**
12.	Program on Vector	**CO3**
13.	Program on single and multilevel inheritance (Use super keyword)	**CO4**
14.	Program on abstract class	**CO4**
15.	Program on interface demonstrating concept of multiple inheritance	**CO4**
16.	Program on dynamic method dispatch using base class and interface reference.	**CO4**
17.	Program to demonstrate try, catch, throw, throws and finally.	**CO5**
18.	Program to demonstrate user defined exception	**CO5**
19.	Program on multithreading	**CO5**
20.	Program on concept of synchronization	**CO5**
21.	Program to create GUI application without event handling using AWT controls	**CO6**
22.	Program to create GUI application without event handling using AWT controls	**CO6**
23.	Program to create GUI application without event handling using AWT controls	**CO6**
24.	Program to create GUI application with event handling using AWT controls	**CO6**
25.	Mini Project based on content of the syllabus. (Group of 2-3 students)	**CO1-CO6**

Any other experiment based on syllabus which will help students to understand concept.

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 20 programs from the list of suggested programs, two assignments covering whole syllabus and one Mini-project of your choice.

The distribution of marks for term work shall be as follows:

Laboratory work (Performing Experiments): 10 Marks

Laboratory work (programs/ journal) : 05 Marks

Mini Project : 05 Marks

Marks Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISM301	Mini Project – 1 A	--	3[$]	--	--	1.5	--	1.5

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISM301	Mini Project – 1 A	--	--	--	--	25	--	25	50

Subject Code	Subject Name	Credits
ISM301	Mini Project – 1 A	1.5
Course Objectives	**The course is aimed** 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyse the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to life long learning. 9. Demonstrate project management principles during project work.	

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalisation of problem and proposed solution
- Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

****

SEM IV

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC401	Engineering Mathematics-IV	3	--	1	3	--	1	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC401	Engineering Mathematics-IV	20	20	20	80	25	--	--	125

Subject Code	Subject Name	Credits
ISC401	Applied Mathematics-IV	4
Course Objectives	**The course is aimed** 1. To study the line and contour integrals and expansion of complex valued function in a power series. 2. To understand the basic techniques of statistics for data analysis, Machine learning and AI. 3. To study the probability distributions and expectations. 4. To acquaint with the concepts of vector spaces used in the field of machine learning and engineering problems. 5. To familiarize with the concepts of Quadratic forms and Singular value decomposition. 6. To learn the concepts of Calculus of Variations.	
Course Outcomes	**On successful completion of course learner/student will be able to**: 1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals. 2. Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI. 3. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities. 4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems. 5. Use the concept of Quadratic forms and Singular value decomposition in various Engineering applications. 6. Find the extremals of the functional using the concept of Calculus of variation.	

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution.

Module	Detailed Contents	Hrs.
01	**Module: Complex Integration** 1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 1.2 Taylor's and Laurent's series (without proof). 1.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof). **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations, Z- Transform.	CO-1 7
02	**Module: Statistical Techniques** 2.1 Karl Pearson's Coefficient of correlation (r) . 2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) 2.3 Lines of regression. 2.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	CO-2 6
03	**Module: Probability Distributions** 2.1 Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function. 3.2 Expectation, mean and variance. 3.3 Probability distribution: Poisson & normal distribution. **Self-learning Topics:** Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.	CO-3 7
04	**Module: Linear Algebra: Vector Spaces:-** 4.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (with proof), Unit vector. 4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors. 4.3 Vector spaces over real field, subspaces. **Self-Learning Topics**:- Linear combinations, linear Dependence and Independence, QR decomposition.	CO-4 6

05	**Module: Linear Algebra: Quadratic Forms** 5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. 5.2 Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite. 5.3 Reduction of Quadratic form to a canonical form using congruent transformations. 5.4 Singular Value Decomposition. **Self-learning Topics:** Orthogonal Transformations**,** Applications of Quadratic forms and SVD in Engineering.	CO-5 7
06	**Module: Calculus of Variations:** 6.1 Euler- Lagrange equation (Without Proof), When F does not contain y, When F does not contain x, When F contains x, y, y'. 6.2 Isoperimetric problems- Lagrange Method. 6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method. **Self-Learning Topics:-** Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action, Several dependent variables.	CO-6 6

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
4. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
5 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
7. Beginning Linear Algebra Seymour Lipschutz Schaum's outline series, Mc-Graw Hill Publication
8..Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC402	Transducers-II	4	--	--	4	--	--	4

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC402	Transducers-II	20	20	20	80	--	--	--	100

Subject Code	Subject Name	Credits
ISC402	Transducers-II	4
Course Objectives	**The course is aimed** 1. To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement 2. To study electro-chemical sensors and transducers used for density and viscosity measurement	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Explain working principle of strain gauges. 2. Demonstrate working principle of pressure transducers 3. Illustrate basic fundamentals of flow transducers. 4. List and identify flow transducers for flow measurement. 5. Describe the terminologies of electrochemical sensors and their applications in industry. 6. Select sensors for force measurement, density, humidity, pH measurement.	

Prerequisite: Units and standards of measurement, concept of transducers (resistive, piezoelectric, pressure, etc.), Knowledge of basic measurement.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Strain Measurement** Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges and its sums.	**04**	**CO1**
2.	**Pressure Measurement** Pressure scales, units and relations, classification **Primary pressure sensors** - elastic elements like bourdon tube, diaphragm, bellows, properties and selection of elastic materials, Calibration using dead weight tester. **Electrical/Secondary Pressure Transducers**: Capacitive, piezo-electric and its material, variable reluctance, LVDT, strain gauge. **High Pressure Measurement**: Bulk modulus cell, Bridgeman type. **Differential pressure measurement**: Materials, construction and working of DP Cell. **Pressure measurement using manometer**: U-tube types, well type, inclined type, micro manometer and its sums. **Vacuum Measurement** Units and relations, McLeod gauge, Pirani gauge, thermocouple gauge	**14**	**CO2**
3.	**Fundamentals of flow measurement** Properties of fluid, types of fluid, dimensionless numbers, types of fluid flow, continuity equation, Bernoulli's equation, hydrostatic law, Pascal's law, flow through pipes – major and minor losses, flow measurement through open channel-weirs and notches. Materials used for flow sensors, performance of materials, corrosion resistors, erosion, effect of vapour pressure	**08**	**CO3**
4.	**Flow Measurement** **Head Type**: Orifice, Venturi, Nozzle, Pitot tube, Annubar, characteristics of head type flow meters and its sums. **Variable Area Type**: Rotameter **Velocity and Inertia based flowmeters**: Turbine, Electromagnetic, Ultrasonic, Positive displacement, Anemometers, **Mass flow measurement**: Coriolis and Vortex flow meter **Solid flow measurements.**	**14**	**CO4**
5.	**Electro-chemical Sensors:** Terminology, equations, units. pH measurement-electrodes, measuring circuits, maintenance, temperature compensation, calibration. Conductivity measurement-probes and measuring circuits	**06**	**CO5**
6.	**Force Measurement:** Strain gauge, LVDT, piezoelectric. Torque: Torsion bar, strain gauge. Density Measurement – Displacement and float type densitometers Hydrometers, Radiation and Ultrasonic densitometers Viscosity Measurement – Capillary tube viscometer, Efflux type viscometer, Variable area viscometer	**06**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
6. The weightage for numerical should be of maximum 25%.

Text Books:

1. Nakra B.C., Chaudhary K.K., Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
2. Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2nd edition (2003) - 344 pages.
3. Sawhney A.K., Electrical and Electronic Measurement and Instrumentation, Dhanpatrai And Co.
4. Rangan, Mani, Sarma, "Instrumentation Systems and Devices", 2nd ed., Tata Mc Graw Hill.

Reference Books:

1. Doeblin E.D., "Measurement system", Tata Mc Graw Hill., 4th ed, 2003
2. Liptak B.G., "Instrument engineer's handbook – Process measurement and analysis".
3. Douglas M. Considine, "Process Instruments and controls", Handbook, Mc Graw Hill.
4. Curtis Johnson, "Process Control Instrumentation Technology", 8th ed, 2005
5. Andrew Williams, "Applied Instrumentation in process industry", Vol-I, Gulf publishing company.
6. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi publications.
7. David W. Spitzer, "Industrial Flow Measurement", ISA Publication.
8. Sawhney A.K., "Mechanical Measurement", Dhanpatrai And Co.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC403	Signal Conditioning Circuit Design	3	--	--	3	--	--	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC403	Signal Conditioning Circuit Design	20	20	20	80	--	--	--	100

Subject Code	Subject Name	Credits
ISC403	Signal Conditioning Circuit Design	3
Course Objectives	**The course is aimed** 1. To introduce the students the basic properties of OpAmp, analysis and design of electronic circuits using OpAmp. 2. To give the knowledge about the various components analog signal conditioning. 3. To impart knowledge of design considerations of analog signal conditioning of components. 4. To give the students knowledge about various components digital signal conditioning. 5. To make the students capable to apply knowledge to design various transducer signal conditioning circuits.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Describe op-amp parameters and types and derivation of operational amplifiers. 2. Design the various operation amplifier circuits for linear. 3. Formulate and design non-linear applications of op-amp. 4. Design of analog signal conditioning circuits. 5. Design of Digital signal conditioning circuits. 6. Apply signal conditioning concepts to design various transducers signal conditioning circuits.	

Prerequisite: Knowledge of various sensors and basic electronics.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Fundamentals of Operational Amplifier** Block diagram of Operational amplifier, Ideal Op Amp, characteristics of op-amp, op-amp parameters, Operational amplifier open loop and closed loop configurations, Inverting and non-inverting amplifier.	**04**	**CO1**
2.	**Linear Applications of Operational Amplifier** Amplifiers: Adder, subtractor, difference amplifier, Integrator, and practical integrator, , Differentiator and practical differentiator, Current to Voltage converter, voltage to current converter (grounded and floating load), Instrumentation amplifier with three Op-amps, and application of Op-Amp in Transducer Measurement System.	**08**	**CO2**
3.	**Nonlinear Applications of Operational Amplifier** Comparator and its characteristics, Zero Crossing Detector (ZCD), Schmitt trigger, window detector, Sample and Hold Circuit, Peak to Peak Detector, Precision half wave and full wave rectifiers, Sine wave oscillators using op-amp.: Barkhausen criteria, Wein bridge oscillator, RC phase shift oscillator. Waveform Generators: Square wave generator and triangular wave generator, Design and applications of Multivibrators: Astable, Monostable using IC 555, PLL.	**08**	**CO3**
4.	**Analog Signal Conditioning** Standard analog signals, Signal Level and bias changes, Linearization, conversion, filtering and impedance matching, concept of loading. Voltage divider, Wheatstone bridge circuits, Active filter. Guidelines for analog signal conditioning design and design based problems.	**04**	**CO4**
5.	**Digital Signal Conditioning** Converters – ADCs and their different types, DACs and their different types, V to F and F to V converters. Characteristics of digital data – digitized value, sampled data system and linearization.	**07**	**CO5**
6.	**Transducer Signal Conditioning** Signal Conditioning of Temperature, Pressure, optical, strain gauges, Displacement and piezoelectric transducers signal conditioning. Data logger circuit, Data acquisition system (Block Diagram Level)	**08**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Ramakant Gaikwad, *"Op-amp & Linear ICs",* PHI Pearson Education, 2003.
2. C. D. Johnson, *"Process Control Instrumentation Technology"*, 2016.
3. D. E. Pippenger and E. J. Tobanen, *"Linear and Interface Circuits Applications",* McGraw Hill, 1988.
4. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson.

Reference Books:

1. Roy Choudhary, *"Linear Integrated Circuits",* Wiley Eastern, 1991.
2. Coughlin & Driscoll, *"Op-amp and Linear ICs"* 6th Edition, PHI 2002.
3. Sergio Franco, *"Design with op-amp analog ICs"* McGraw Hill, 1988.
4. Robert G. Seippel, *"Transducer Interfacing – Signal Conditioning for Process Control",* Prentice Hill, 2000.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC404	Feedback Control System	3	--	--	3	--	--	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC404	Feedback Control System	20	20	20	80	--	--	--	100

Subject Code	Subject Name	Credits
ISC404	Feedback Control System	3
Course Objectives	**The course is aimed** 1. The students should be able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective. 2. The students should learn how to represent system by transfer function and block diagram reduction method and Mason's gain formula. 3. The students should able to learn time response analysis and demonstrate their knowledge to frequency response. 4. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Identify open-loop and closed-loop control systems 2. Formulate mathematical model for the physical systems 3. Simplify representation of complex systems using reduction techniques. 4. Identify performance characteristics of first and second-order systems. 5. Apply root-locus technique for stability analysis. 6. Analyze performance characteristics of systems using frequency response methods.	

Prerequisite: Knowledge of mathematics and network theory.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1	**Introduction** Definition of control system and related terms, open loop and closed loop system, examples. Development of automatic control systems, classification of control system, examples	04	CO1
2	**Mathematical Models of Physical Systems** Definition of physical systems, principle of superposition and homogeneity, linear/non-linear, time variant/time invariant systems. Types of dynamic model, linear elements of electrical and mechanical systems.	06	CO2
3	**Transfer Function and Feedback Characteristics** Definition of transfer function, sinusoidal transfer function, transfer functions of physical systems, block diagram algebra, reduction rules, signal flow graphs-definition, construction, properties, and Mason's gain formula, effect of feedback, effect of disturbances signals.	09	CO3
4	**Time Response Analysis** Standard test signals, pulse and impulse function, step function, ramp function, parabolic function, sinusoidal function, dynamic response, time response of first order system, time response of second order system, specifications, steady - state error, system types and error constants, design specifications of second order system- desired close loop pole location and the dominant condition.	08	CO4
5	**Stability Analysis and Root Locus** Concept of stability, definitions, bounded input-bounded output stability, relative stability, necessary and sufficient conditions for stability, Routh stability criterion, relative stability analysis, root locus technique, applications, concept, construction of root loci, root loci of different systems, electrical RLC circuits, etc.	06	CO5
6	**Frequency Response and Stability Analysis** Correlation between time and frequency response, polar plots, Bode plots, Nyquist stability criterion, frequency response specifications, stability analysis using-bode, polar, definitions and significance of gain margin and phase margin.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Textbooks

1. Nagrath I. G., Gopal M., *Control System Engineering*, New Age International (P) Ltd. Publishers 2000
2. Kuo Benjamin C., "Automatic Control Systems", 6th ed., Prentice Hall of India, New Delhi, 1993.

Reference Books

1. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998.
2. Nise Norman S., "Control Systems Engineering", 3rd ed., John Wiley and Sons, Inc.-2000.
3. Lewis Paul H., Chang Yang, "Basic Control Systems Engineering", Prentice Hall International, Inc. 1997.
4. Raymond T. Stefani, Bahram Shahian,- Clement J. Savant and Gene H. Hostetter, "Design of Feedback Control Systems", 4th ed., Oxford University Press, New Delhi, 2001.
5. Dhanesh N. Manik, "Control System", Cengage Lerning India, 1st edition, 2012

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC405	Control System Components	4	--	--	4	--	--	4

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC405	Control System Components	20	20	20	80	--	--	--	100

Subject Code	Subject Name	credits
ISC405	Control System Components	4
Course objective	**The course is aimed** 1. To impart knowledge of different control system components like Hydraulic, Pneumatic, Electrical & Electronics and their comparison. 2. To make the students to learn different types of Transmitters. 3. To make the students to understand concept of control valve, different types, their working & selection criteria. 4. To make the students to learn various Auxiliary process control components and its applications. 5. To give the students an overview of Industrial Control components & their Need in Instrumentation.	
Course Outcome	**On successful completion of course learner/student will be able to:** 1. Explain and select various pneumatic system components and circuits. 2. Select and compare various control systems like Hydraulic, pneumatic and electric. 3. Apply knowledge to classify, select and use various transmitters. 4. Classify and select various control valves and their accessories. 5. Describe and select industrial components and study their usage. 6. Demonstrate auxiliary process components.	

Prerequisite: Knowledge of sensors, Measurement system, basic control system and Electrical Engineering.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1	**Pneumatic system components** Pneumatic System Components: ISA symbols, Instrument Air and Plant Air. Air compressor system and its accessories. Directional control valves and special types of pneumatic valve such as Pilot-operated valves, Non-return valves, Flow control valves, Sequence valves, and Time delay valve, Linear actuators- Single-acting, Double-acting, and special type of double-acting cylinder, Rotary actuators- Air motors. Process Control Pneumatics: Volume boosters, Air relays, Pneumatic logic gates, Pneumatic Circuits-Standard Symbols used for developing pneumatic circuits, Sequence diagram.	**10**	**CO1**
2	**Hydraulic System Components:** Hydraulic pumps(centrifugal, gear , lobe), Pressure regulation method, Loading valves, Hydraulic valves, Electro Hydraulic actuators, speed control circuits for Hydraulic actuators, Selection and comparison of pneumatic, hydraulic and electric systems.	**04**	**CO2**
3	**Transmitters** Need, specifications and classification of transmitters, Need for Standardization of signals, concept of live zero and dead zero, 2-wire; 3-wire and 4-wire transmitters and its calibration, Electronic versus pneumatic transmitters, Electronic type transmitters - temperature; Pressure (gauge); differential pressure; level(capacitive type); flow transmitter (magnetic); SMART /Intelligent transmitter; Block schematic and Comparison with conventional transmitter; applications of transmitters, **Multivariable transmitter.**	**12**	**CO3**
4	**Process Control Valves & converters** Need and specifications of Control Valve; Control valve terminology; Control valve constructional details; Air to Open(AO), Air to Close (AC); MOC (Material of construction); classification of control valve; applications, advantages, disadvantage of - Globe, Ball, Needle, Butterfly, Diaphragm, Pinch, Gate, Solenoid; Flow characteristics (Inherent and Installed); Valve positioners: necessity, types-motion balance and force-balance, Effect on Performance of control valve; Control Valve Actuators - Electrical, Pneumatic, Hydraulic, Electro-mechanical, and piston actuators; selection guidelines for control valve. Converters: Need for Converters and types, working of Pneumatic to Electrical and Electrical to Pneumatic converters. Feeders and dampers. Working of safety valve, relief valve and their application.	**14**	**CO4**

5	**Industrial Control Components** **Panel Switches**: Construction, symbolic representation, working, application of Toggle switches, Push buttons, Selector switches, DIP switches, Rotary switches, Thumbwheel switches, Drum switch, Limit switches, emergency push button, Tactile switch, Switch specifications. CAM SWITCHES MAGNETIC contactors, PILOT Light. **Industrial switches:** Temperature, Flow, Level and, Pressure Switch, Vibration switch. **Control Relays:** Construction, working, specifications, and applications of Electro-mechanical relay, Solid state relays. Interposing relays and Overload relays. **Contactors/starters:** Construction, working, specifications and applications of starters and contactors. Comparison between relays and starters /contactors.	**08**	**CO5**
6	**Auxiliary Process Control Components** Alarm annunciators and its sequences; Temperature regulator, Flow regulator, stepper motor (working principle)	**04**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books Recommended:

1. Andrew Parr, Hydraulic &pneumatics; A Technicians & Engineers Guide, Second Edition
2. Control Valve Handbook – Forth Edition, Fisher.
3. Pneumatics workbook Basic Level - FESTO
4. C.L.Albert and D.A. Coggan, “Fundamentals of Industrial Control”, ISA, 1992.
5. Bela G. Liptak, “Instrument Engineer’s Hand Book – Process Control”, Chilton Company, 3rd Edition, 1995.
6. Andrew Williams, “Applied instrumentation in the process industries”, 2nd Edition, Vol. 1 & 3, Gulf publishing company.
7. Guy Borden, Paul G Friedman , style Editor Control Valves- ISA
8. Process Instruments & Control Handbook, Douglas. M.Considine, McGraw-Hill

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL401	Process Control Components – Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL401	Process Control Components – Lab	--	--	--	--	25	25		50

Course Objectives	**The course is aimed** 1. To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement 2. To study electro-chemical sensors and transducers used for density and viscosity measurement 3. To impart knowledge of different control system components like Hydraulic, Pneumatic and Electrical and their comparison. 4. To make the students to learn different process components and auxiliary process control components.
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Explain working principle of strain gauges, pressure transducers 2. Learn Basic fundamentals of flow transducers identify types of flow and use different transducers for flow measurement. 3. Explain the terminologies of electrochemical, density, humidity, pH measurement sensors, and their applications in industry. 4. Study, select and implement various pneumatic, hydraulic and electro-pneumatic system components and circuits. **5.** Apply knowledge to classify, select and use various Transmitters, control valves and their accessories 6. Describe the Need of Auxiliary process control components and study their industrial usage.

Syllabus: Same as that of Subject ISC402 Transducers-II and ISC405 Control System Components.

List of the Experiments:

Sr. No.	Detailed Contents	CO mapping
1.	Strain gauge characteristics and weight measurement	**CO1**
2.	Study use of semiconductor strain gauges for pressure measurement	**CO1**
3.	Study measurement of pressure using bellows, diaphragm, bourdon tube, manometer.	**CO1**
4.	Test and calibration of pressure gauges using dead weight tester.	**CO1**
5.	Measurement of flow using orifice/venturi tube/nozzle/pitot tube.	**CO2**
6.	Measurement of flow using rotameter/ electromagnetic flow meter.	**CO2**
7.	Study and characterization of pH meter/ conductivity meter.	**CO3**
8.	Measurement of Density/Viscosity	**CO3**
9.	Study of various pneumatic / hydraulic control system components.	**CO4**
10.	Study of various electro-pneumatic control system components.	**CO4**
11.	Study operation and calibration of flow/ level/ temperature transmitter	**CO5**
12	Study of different types of control valve actuator.	**CO5**
13	Calibration of I to P and / P to I converter.	**CO5**
14.	Study characteristics of control valve	**CO5**
15.	Study different types and operation of control valve and valve positioner.	**CO6**
16.	Study of pressure/temperature/level/flow switches and control relays.	**CO6**

Note:

1. Minimum of **Ten** experiments can be conducted during the semester for term work and practical examination.
3) Factory visit is advised to understand the working of the control system components.
4) Assignments based on syllabus which will help students to understand the Topic can be given during the semester as a support to Evaluate Term work.

Practical/Oral Examination:

Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on Entire subject.

Term Work:
Term work shall consist of minimum **Ten** Experiments **covering all COs.**

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL402	Signal Conditioning Circuit Design - Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL402	Signal Conditioning Circuit Design - Lab	--	--	--	--	25	25		50

Subject Code	Subject Name	Credits
ISL402	Signal Conditioning Circuit Design- Lab	1
Course Objectives	**The course is aimed** 1. To introduce the students the basic properties of OpAmp, analysis and design of electronic circuits using OpAmp. 2. To give the knowledge about the various components analog signal conditioning. 3. To impart knowledge of design considerations of analog signal conditioning of components. 4. To give the students knowledge about various components digital signal conditioning. 5. To make the students capable to apply knowledge to design various transducer signal conditioning circuits.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Evaluate op-amp parameters and design of basic op-amp amplifier circuits. 2. Design and Implement various linear applications using op-amp. 3. Design and Implement various non-linear applications using op-amp. 4. Apply principles of analog signal conditioning for op-amp based circuit design. 5. Apply concepts of digital signal conditioning for op-amp based circuit design. 6. Design and develop signal conditioning circuits for different transducers.	

Syllabus: Same as that of Subject ISC403 Signal Conditioning Circuit Design.

List of Experiments:

Sr. No	Detailed Contents	CO Mapping
1.	Demonstrate use of Op-Amp as inverting and non-inverting amplifier	CO1
2.	Determination of opamp parameters- CMRR, Slew Rate, Offset Voltages & currents	CO1
3.	Adder and Subtractor using Op-amp	CO2
4.	Design Instrumentation Amplifier using 3 Op-amps.	CO2
5.	Design and demonstrate I to V and V to I converter circuit	CO2
6.	Design and implement Astable and Monostable Multivibrator using IC 555	CO2
7.	Implementation of Precision rectifiers using Op-amp.	CO3
8.	Design and demonstrate integrator and differentiator using Op-amp.	CO3
9.	Design of Wein bridge oscillator using Op-amp	CO3
10.	Design of RC phase shift oscillator using Op-amp	CO3
11.	Design and demonstrate second order LPF and HPF.	CO4
12.	Design and demonstrate general signal conditioning circuit to convert sensor output to 0-5 V	CO4
13.	Design and demonstrate general signal conditioning circuit to convert sensor output to 4-20 mA	CO4
14.	Design and demonstrate Analog to Digital converter circuit or Digital to Analog converter circuit	CO5
15.	Design and demonstrate signal conditioning circuit for weight measuring system using strain gauge	CO6
16.	Study and Simulation of Data Acquisition System	CO6
17.	Design signal conditioning circuit for RTD	CO6

Practical/Oral Examination:

Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on subject **ISC403 Signal Conditioning Circuit Design**.

Term Work:

Term work shall consist of minimum 08 experiments (any 5 Experiments from 1 to 10 plus any 3 experiments from remaining list of experiments) covering all COs and out of that 02 experiment should be simulation software.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments)	: 10 Marks
Laboratory work (journal)	: 10 Marks
Attendance (class Room plus Lab Practice)	: 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL403	Feedback Control System- Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL403	Feedback Control System -Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL403	Feedback Control System- Lab	1
Course Objectives	**The course is aimed** 1. The students should be able to examine steady-state and frequency response of the Type 0, 1, and 2 systems. 2. The students should be able to examine steady-state and frequency response of first and second order electrical systems. 3. The students should able to examine time response analysis of first and second order systems. 4. Students can be able to inspect stability analysis of system using Root locus, Bode plot, polar plot.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Plot frequency response of first-order electrical system. 2. Plot time response of second-order electrical system and calculate the steady-state error. 3. Demonstrate the way to obtain the transfer function and validate transient and steady-state response using test signals such as step, ramp, and parabolic. 4. Validate the effect of damping factor on response of second order system. 5. Inspect the time response specifications of systems by using root-locus. 6. Inspect the frequency response specifications of systems by using bode-plot, Polar plot, Nyquist-plot techniques, and comment on the stability of system	

Syllabus: Same as that of Subject ISC404 Feedback Control System.

List of the Laboratory Experiments:

Module	Contents	CO mapping
1.	To plot the effect of time constant on first – order systems response.	CO1
2.	To plot the frequency response of first-order system	CO1
3.	To plot the time response of second – order systems	CO2
4.	To examine steady state errors for Type 0, 1, 2 systems	CO3
5.	To study the block diagram reduction technique by using simulation software	CO3
6.	To interpret the effect of damping factor on the performance of second order system.	CO4
7.	To inspect the relative stability of systems by Root-Locus using Simulation Software	CO5
8.	To inspect the stability of systems by Bode plot using Simulation Software	CO6
9.	To determine the frequency response specifications from Polar plot of system	CO6
10.	To inspect the stability of systems by Nyquist plot using Simulation Software	CO6

Any other experiment based on syllabus which will help students to understand topic/concept.

Note: Sr. 1 to 4 experiments should be performed using practical kit /breadboard and Sr. 5 to 10 by using simulation software like MATH CAD/MATLAB/SCILAB/OCTAVE or equivalent.

Practical and Oral Examination:

Practical Examination will be based on performing one Experiment in the laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on subject **ISC404-** Feedback Control System.

Term Work:

Term work shall consist of minimum **Eight** experiments to cover all COs of this Lab Practice Course.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL404	Virtual Instrumentation - Lab	--	3#	--	--	1.5	--	1.5

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL404	Virtual Instrumentation - Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL404	Virtual Instrumentation Lab	1.5
Course Objectives	**The course is aimed** To study graphical programming language for creating simulation and custom applications that interact with real-world data or signals in fields of science and engineering.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Design logical operations, using Graphical programming language 2. Develop customized virtual instruments and represent them in required format with user friendly graphical programming software for LOOPS like FOR LOOP, WHILE LOOP etc. 3. Plot the generated data and also able to export the data outside the programming environment 4. Select the data acquisition card or simulated software module and make user interface in the field of engineering. 5. Describe the concepts of different analysis tool. 6. Design and develop real world applications using graphical programming software.	

out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches.

Prerequisite: Knowledge of Mathematics and conversion, LOOPs, switch CASE of any other software like C program, simple concept of proportional process control action.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1	**INTRODUCTION** Virtual Instrumentation: Historical perspective, block diagram and Architecture of a virtual instrument, Conventional Instruments versus Virtual Instruments, data-flow techniques, graphical programming in data flow.	2	CO1
2	**VI PROGRAMMING TECHNIQUES** Data types, VIs and sub-VIs, Structures (For, While etc.) arrays, clusters, shift registers, case and sequence structures, formula nodes. Debugging techniques	2	CO2
3	**PLOTING AND EXPORT DATA** Strings, File I/O, Plotting data: graphs and charts, report generation.	2	CO3
4	**DATA ACQUISITION** Introduction to data acquisition on PC, Digital I/O, counters and timers, Software and Hardware installation, Calibration, Resolution, Data acquisition interface requirements, VISA programming.	3	CO4
5	**MEASUREMENT ANALYSIS TOOLS** Use of analysis tools for measurement of max, min, peak to peak voltage. Time period of signal, correlation methods. Design of oscilloscope, digital multimeter.	2	CO5
6	**APPLICATIONS** System development for a process. Development of Graphical User Interface (GUI). Implementation of various controllers (ON / OFF control, PID control) for a process. Simulation of a simple second order system.	2	CO6

List of Experiments:

Module	Contents	CO mapping
1.	To develop a VI to calculate speed, convert degree Celsius to Fahrenheit	CO1
2.	To develop a Sub VI to implement Half adder and Full ADDER	CO2
3.	To develop VI using FOR and WHILE loop to add 10 numbers, calculate Factorial of a given number	CO2
4.	To create VI to find roots of quadratic equation, user defined unit conversions etc using case structure.	CO2
5.	To create VI student database using String control and Array and cluster functions.	CO2
6.	Applications of Graphical Programming Software in digital electronics—binary to decimal conversion etc.	CO1, CO2
7.	To develop a VI for storing all the points of simulated signal using File I/Os	CO3
8.	Build a VI to plot circle in XY graph, generate and plot random numbers on chart, different colors in an intensity graph etc with graph, chart properties and options.	CO3

9.	Measurement of AC/ DC voltage and current using DAQ cards.	**CO4**
10.	Develop the VI, to On/Off the LED's using DAQ devices (Arduino, Raspberry Pi etc.)	**CO4**
11.	Applications of Graphical Programming Software in process tank level / temperature control, alarm annunciator, batch process control etc.	**CO5**
12.	To create VI to simulate bottle filling plant using Sequence structure.	**CO5**
13.	Applications of Graphical Programming Software in control —simulate first and second order system response, effect of damping factor etc.	**CO6**
14.	To create VI to simulate traffic light control, stirred tank heater etc. using Sequence structure	**CO6**

Practical/Oral Examination:

Practical Examination will be based on performing one Experiment in the laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on subject ISL404 **Virtual Instrumentation Lab.**

Note:

1. Any other experiments based on syllabus which will help students to understand topic/concept can also be included.
2. For this course use Graphical Programming Software like LabVIEW or Open Source Software

Term Work:

Term work shall consist of minimum 10 programs from the list of suggested programs.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Reference Books:

1. Jovitha Jerome, "Virtual Instrumentation", PHI, 2018.
2. Robert Bishop, "Learning with LabVIEW TM 7 express", Pearson Education, 2005.
3. Gupta S, "Virtual Instrumentation Using LabVIEW", Tata McGraw Hill Publishing Company Limited.
4. Labview for everyone, - Lisa K. Wells & Jettrey Travis Prentice Hall, New Jersey, 1997.
5. LabVIEW users manual.

Website: www.ni.com

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISM401	Mini Project – 1 B	--	3[$]	--	--	1.5	--	1.5

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISM401	Mini Project – 1 B	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISM401	Mini Project – 1 B	1.5
Course Objectives	**The course is aimed** 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentalsto attempt solutions to the problems. 4. To inculcate the process of self-learning and research.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyse the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to life long learning. 9. Demonstrate project management principles during project work.	

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

AC
Item No.

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Instrumentation Engineering

Third Year with Effect from **AY 2018-19**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

From Co-coordinator's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai, has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's), course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of Studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enable a much-required shift in focus from teacher-centric to learner-centric education. Since the workload estimated is based on the investment of time in learning, not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. **Choice Based Credit and Grading System** were implemented for First Year of Engineering (Undergraduate) from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year of Engineering (Undergraduate) in the academic year 2017-2018 and so on.

Dr. Suresh K. Ukarande
Coordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and to achieve recognition of the institution or program meeting certain specified standards. The main-focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as a Chairman, Board of Studies in Instrumentation Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Instrumentation Engineering, more than ten senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs and POs of undergraduate program in Instrumentation Engineering are listed below;

Program Educational Objectives (PEOs)

- Graduates will have successful career in industry or pursue higher studies to meet future challenges of technological development.
- Graduates will develop analytical and logical skills that enable them to analyze and design Instrumentation and Control Systems.
- Graduates will achieve professional skills to expose themselves by giving an opportunity as an individual as well as team.
- Graduates will undertake research activities in emerging multidisciplinary fields.

Program Outcomes (POs)

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Dr. S. R. Deore,
Chairman,
Board of Studies in Electrical Engineering,
Member - Academic Council
University of Mumbai

Program Structure for

TE Instrumentation Engineering
University of Mumbai
(With Effect from 2018-19)

Scheme for Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC501	Signals and Systems	4	-	-	4	-	-	4
ISC502	Applications of Microcontroller	4	-	-	4	-	-	4
ISC503	Control System Design	4	-	-	4	-	-	4
ISC504	Control System Components	4	-	-	4	-	-	4
ISDLO501X	Department Level Optional Course I	3	-	-	3	-	-	3
ISL501	Business Communication and Ethics	-	4#	-	-	2	-	2
ISL502	Applications of Microcontroller – Lab Practice	-	2	-	-	1	-	1
ISL503	Control System Design Lab Practice	-	2	-	-	1	-	1
ISL504	Control System Components – Lab Practice	-	2	-	-	1	-	1
ISL505	Department Level Optional Course I – Lab Practice	-	2	-	-	1	-	1
ISL506	Mini-project – I	-	2	-	-	1	-	1
Total		**19**	**14**	**-**	**19**	**07**	**-**	**26**

Out of four hours, 2 hours theory shall be taught to entire class and 2 hours practical in batches

Examination Scheme for Semester V

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC501	Signals and Systems	80	20	-	-	-	100
ISC502	Applications of Microcontroller	80	20	-	-	-	100
ISC503	Control System Design	80	20	-	-	-	100
ISC504	Control System Components	80	20	-	-	-	100
ISDLO501X	Department Level Optional Course I	80	20	-	-	-	100
ISL501	Business Communication and Ethics	-	-	50	-	-	50
ISL502	Applications of Microcontroller – Lab Practice	-	-	25	-	25	50
ISL503	Control System Design Lab Practice	-	-	25	25	-	50
ISL504	Control System Components – Lab Practice	-	-	25	-	25	50
ISL505	Department Level Optional Course I – Lab Practice	-	-	25	25	-	50
ISL506	Mini-project – I	-	-	25	25	-	50
Total		**400**	**100**	**175**	**75**	**50**	**800**

Note: As per above Examination Scheme, the Minimum marks are as follows –

Max. Marks	Min. marks
80	32
50	20
25	10
20	8

Program Structure for
TE Instrumentation Engineering
University of Mumbai
(With Effect from 2018-19)

Scheme for Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC601	Process Instrumentation System	4	-	-	4	-	-	4
ISC602	Industrial Data Communication	3	-	-	3	-	-	3
ISC603	Electrical machines and Drives	4	-	-	4	-	-	4
ISC604	Digital Signal Processing	4	-	-	4	-	-	4
ISC605	Advanced Control System	3	-	-	3	-	-	3
ISDL0602X	Department Level Optional Course II	3	-	-	3	-	-	3
ISL601	Process Instrumentation System – Lab Practice	-	2	-	-	1	-	1
ISL602	Industrial Data Communication – Lab Practice	-	2	-	-	1	-	1
ISL603	Electrical machines and Drives – Lab Practice	-	2	-	-	1	-	1
ISL604	Digital Signal Processing – Lab Practice	-	2	-	-	1	-	1
ISL605	Advanced Control System – Lab Practice	-	2	-	-	1	-	1
ISL 606	Mini-project - II	-	2	-	-	1	-	1
Total		**21**	**12**	**-**	**21**	**06**	**-**	**27**

Examination Scheme for Semester VI

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC601	Process Instrumentation System	80	20	-	-		100
ISC602	Industrial Data Communication	80	20	-	-		100
ISC603	Electrical machines and Drives	80	20	-	-		100
ISC604	Digital Signal Processing	80	20	-	-		100
ISC605	Advanced Control System	80	20	-	-		100
ISDL0602X	Department Level Optional Course II	80	20	-	-		100
ISL601	Process Instrumentation System – Lab Practice	-	-	25	25		50
ISL602	Industrial Data Communication – Lab Practice	-	-	25	-	-	25
ISL603	Electrical machines and Drives – Lab Practice	-	-	25	25	-	50
ISL604	Digital Signal Processing – Lab Practice	-	-	25	-	25	50
ISL605	Advanced Control System – Lab Practice	-	-	25	-	25	50
ISL 606	Mini-project - II	-	-	25#	-	-	25
	Total	**480**	**120**	**150**	**50**	**50**	**850**

Note: As per above Examination Scheme, the Minimum marks are as follows –

Max. Marks	Min. marks
80	32
50	20
25	10
20	8

Mini-project based on internal oral and project report.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC501	**Signals and Systems**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC501	**Signals and Systems**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC501	**Signals and Systems**	4
Course Objective	1. To learn fundamental characteristics of signals and systems. 2. To classify the signals and systems according to their property. 3. To acquire knowledge for the use of mathematical transforms and their applications. 4. Develop basic problem solving skills and become familiar with application area of signals and systems.	
Course Outcome	Students will be able to – 1. Describe the basic concept of signals and systems and their classification and operations on signals and plot the result. 2. Examine analysis of LTI systems using convolution and correlation. 3. Execute Fourier series analysis of periodic signals. 4. Demonstrate Fourier Transform and its applications. 5. Explain application of Laplace transform for analysis of CT signals and systems. 6. Demonstrate an ability to apply Z Transform for the analysis of DT signals and systems.	

Details of Syllabus:

Prerequisite: Knowledge of Fundamentals of Engineering Mathematics, Basic understanding of Differential and Integral calculus, Knowledge of Fourier Analysis and Laplace Transform

Module	Contents	Hrs	CO mapping
1	**Introduction**:-Signals and Systems definition, Types of signals, continuous time and Discrete time signal operations, Amplitude scaling, Time shifting, Time reversal, Time scaling, Multiple transformation, Mathematical operations additions, subtraction, multiplication of signals, Classification of signals according to their property, Periodic/Aperiodic, Even/Odd, Energy/Power/Causal/Non causal, Deterministic/Random signals, Classification of systems according to their property, Linear/Nonlinear, Static /Dynamic, Time Invariant/Time	12	**CO1**

	variant, Causal/non causal, Stable/Unstable, Invertible/Non Invertible systems.		
2	**Linear Time Invariant System**: -Characterizing CT LTI and DT LTI systems in terms of Impulse responses and Differential equations, Property of LTI systems, Convolution Integral and Convolution sum representation of LTI systems, Auto and Cross correlation of signals	6	**CO2**
3	**Fourier Series**: -Fourier series of CT and DT signals and their property, Dirichlet's condition, Exponential and Trigonometric Fourier series of periodic signals, Parseval's formula, Gibbs phenomenon, Amplitude and phase spectra of periodic signals.	5	**CO3**
4	**Fourier Transform Analysis of Signals**: -Fourier transform of CT and DT signals, Property of Fourier Transform, Magnitude and Phase calculation, Application of Fourier Transform.	6	**CO4**
5	**Application of Laplace Transform in Signal processing**: -Bilateral and Unilateral Laplace Transform of signals, Region of Convergence, Properties of Laplace Transform, Inverse Laplace Transform, Solution to differential equation, System transfer function and Response calculations, Poles and Zeros representation.	7	**CO5**
6	**Introduction to Z Transform**: -Z Transform definition, Region of convergence and it's property, Bilateral and Unilateral Z Transform, Z Transform property, Relation between Laplace Transform, Fourier Transform and Z Transform, Inverse Z Transform by Inspection, Partial fraction and power series method, System function and Response calculations, Poles and Zeros representation, Concept of Causality and Stability, Frequency Response calculation by using Z Transform.	12	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Oppenheim, Willsky, S.Hamid Nawab, "Signals and Systems" PHI,2nd edition, 2002.
2. M.J. Roberts, "Signals and Systems" McGraw-Hill, 1st edition,2003.
3. B.P Lathi, "Principles of linear systems and signals" Oxford,2nd edition,2009.
4. Narayana Iyer, "Signals and Systems" CENGAGE Learning,1st edition, 2011.

Reference Books:

1. V. Krishnaveni, A. Rajeswari, “Signals and Systems”, 1st editionWiley India,2012.
2. J.B. Gurung, “Signals and Systems”, PHI,1st edition,2009.
3. A Anandkumar, “Signals and Systems”, PHI,3rd edition, 2013.
4. Rameshbabu, “Signals and Systems”, SCITECH, 4thedition,2011.
5. Hwei P. Hsu, “Schaum's Outline of Signals and Systems”, McGraw-Hill,2014.
6. Simon Haykin, “Signals and Systems”, Wiley, 2ndedition,2003.
7. Rodger E. Ziemer, “Signals and Systems”, Pearson, 4th edition, 1998.

Subject Code	Subject Name	Teaching Scheme	Credits Assigned					
ISC502	**Applications of Microcontroller**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISC502	**Applications of Microcontroller**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC502	**Applications of Microcontroller**	**4**
Course objectives	1. To give overview of embedded systems and make aware of design challenges and technology. 2. To impart knowledge of fundamentals of MCS-51 microcontroller family and working of the system. 3. To make the students understand various programming tools and development of software using assembly and higher level language. 4. To give knowledge of integrated hardware of MCS-51 5. To give knowledge of interfacing of MCS-51 with different peripheral devices such as LCD, keyboard, Memory, ADC, DAC etc. 6. To make the students capable to develop application using learned concepts of hardware, software and interfacing.	
Course Outcomes	The students will be able to: 1. Identify the technology in the area of embedded systems. 2. Explain the comparative study of various microcontrollers and microprocessors 3. Outline the knowledge of operation of integrated hardware components. 4. Explain programming tools and design software programs in assembly or ‘C’ language. 5. Solve and construct interfacing of peripheral components with MCS 51. 6. Investigate, recommend and design the sophisticated application based on MCS-51 such as Traffic light control, Digital weighing machine etc.	

Details of Syllabus:

Prerequisite: Knowledge of Digital Electronics, Programming skills.

Module	Content	Hrs	CO Mapping
1	**Introduction to Embedded systems** Definition, embedded system overview, Examples of embedded system, Development challenges, embedded processors, IC technology and Design Technology and tradeoffs. RISC and CISC processors **Introduction to Microprocessors and Microcontrollers** Microprocessor Definition, Microcontroller Definition Operation of ALU, Evolution of Microprocessors, Block Diagram of microprocessor based system and development cycle.	08	CO1
2	**MCS-51 microcontroller** Architecture of MCS 51 family of microcontroller, and its Variants and comparison. Comparison of microprocessor & microcontroller. CPU timing and machine cycle. Memory organization, SFRS.	04	CO2
3	**MCS 51 programming and tools** Simulator, in-circuit debugger, in-circuit emulator, programmers, integrated development environment (IDE), cross compilers. Merits & demerits of above tools. Assembly language programming process. Programming tools. Instruction set, addressing modes. Programming practice using assembly & C compiler	10	CO3
4	**Integrated peripherals of MCS 51** Integrated peripherals such as Timers/Counters, parallel I/O ports. Interrupt Structure. Power saving & power down mode. Operation of serial port. Programming for implementation of asynchronous serial communication	08	CO4
5	**MCS 51 Interfacing** Interfacing with Memories RAM/EPROM. Interfacing to LCD, 7 segment display, Keyboard, ADC, DAC, relay, opto- isolator, DC motor, Stepper Motor	12	CO5
6	**Case Studies** Data acquisition systems, Digital weighing machine, Washing machines, Traffic light controller , Frequency counter, Speed Control of DC motors and similar system design	06	CO6

Internal Assessment:
Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Mazidi M.A., The 8051 Microcontroller & Embedded systems, Pearson Education Second edition. 2006
2. Kenneth Ayala, The 8051 Microcontroller, Thomson Delmar Learning, Third Edition.2005
3. Steve Heath, Embedded Systems Design, Newnes publication, Second edition, ISBN 0 7506 5546

Reference Books:

1. David Simon, Embedded Software Primer, Pearson Education, ISBN 81-7808-045-
2. Tony Givargis , Embedded System Design: A Unified Hardware/Software Introduction, Wiley Student Edition. ISBN No.812650837X
3. P.S. Manoharan , P.S. Kannan, Microcontroller based system design, SciTech Publications (India) Pvt. Ltd. ISBN No. 8183715982
4. 8051 / MC151 / MCS251 Datasheets
5. Microcontrollers - Architecture, Programming, Interfacing and System Design, Pearson Education India; Second edition (2011), ISBN-10: 8131759903.

Websites:

1. www.atmel.com
2. www.microchip.corn
3. www.nXp.com

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC503	Control System Design	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC503	**Control System Design**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC503	**Control System Design**	4
Course Objective	1. To develop the skills to represent the system in state space form. 2. To impart knowledge required to design state feedback controller and state estimator. 3. To develop the skills to design the compensator in time and frequency domain and to design the PID compensator.	
Course Outcome	Students should be able to - 1. Obtain state-space model of electrical circuits, translational/rotational mechanical systems and electromechanical systems etc with emphasis on linear time-invariant systems 2. Obtain solution of state equations by using Laplace transform methods, Cayley Hamilton method etc. 3. Examine system for its stability, controllability and observability and design controller and observer with given transient specifications. 4. Design Lead, Lag and Lead –lag compensator using time domain method. 5. Design Lead, Lag and Lead –lag compensator using frequency domain method. 6. Study the PID controller tuning by Ziegler Nicholas and Cohen-coon methods	

Details of Syllabus:

Prerequisite: Knowledge of Matrix algebra, Root-locus, Bode-plot and Nyquist stability criterion.

Module	Contents	Hrs	CO mapping
1	**State Space Representation of Continuous Time Systems:** Terminology of state space representation, advantages of state space representation over classical representation, physical variable form, phase variable forms: controllable canonical form (companion I), observable canonical form (companion II), diagonal/Jordon canonical form (parallel realization), cascade realization, conversion of state model to transfer function. Similarity transformation for diagonalization of a plant matrix, Vander Monde matrix.	08	CO1

2	**Solution of State Equation:** State Transition Matrix and its properties, computation of state transition matrix using Laplace transformation method, Cayley Hamilton theorem, matrix exponential series and via diagonalization.	06	CO2
3	**Analysis and Design of Control System in State Space:** Controllability, stabilizability, observability and detectability properties. Necessary and sufficiency conditions for complete state controllability and observability.State feedback structure, Pole placement design using state feedback. State observers – Full state observer.	10	CO3
4	**Introduction to Compensator:** Derivative and integral error compensation, Analysis of the basic approaches to compensation, cascade compensation, feedback compensation **Compensator Design using Root-locus:** Improving steady-state error and transient response by feedback compensation, cascade compensation, integral, derivative compensation, Lag, Lead, Lag-Lead compensation	10	CO4
5	**Compensator Design using Frequency response:** Systems with time delay, transient response through gain adjustment, Lag, Lead, Lag-Lead compensation.	08	CO5
6	**PID Controller Design:** PID controller tuning: Ziegler-Nichols method, Cohen-coon method, Designing PID controller using Root-Locus.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall of India, 4th edition, 2002

2. M. Gopal, Control Systems Principles and Design, TMH, New Delhi, 2nd edition,2002

Reference Books:

1. Norman S. Nise, Control Systems Engineering, John Wiley and Sons, Inc. 2000.
2. Francis Raven, Automatic Control Engineering, 5th edition McGraw-Hill International Edition,
3. G.C.Goodwin, S.F.Graebe, M.E. Salgado, Control System Design, Pearson education
4. B. C. Kuo "Automatic control systems", Prentice Hall of India.
5. M. Gopal, Control Systems Principles and Design,TMH, New Delhi, 2n edition, 2002.
6. Stefani, Shahian, Savant, Hostetter, Design of Feedback Control Systems, Oxford University Press, 4thEdition, 2007.
7. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, Addition-Wesley,1999.
8. I.J.Nagrath and M. Gopal, Control System Engineering, 3rdEdition, New Age International (P) Ltd., Publishers - 2000.
9. B.C. Kuo, Farid Gdna Golnaraghi, Automatic Control Systems, PHI, 7th edition, 2003.
10. M. N. Bandopadhay, Control Engineering - Theory &Practice, PHI, 2003

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ISC504	Control System Components	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC504	Control System Components	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC504	Control System Components	4
Course objective	1. To impart knowledge of different control system components like Hydraulic, Pneumatic, Electrical & Electronics and their comparison. 2. To make the students to learn different types of Transmitters. 3. To make the students to understand concept of control valve, different types, their working & selection criteria. 4. To make the students to learn various Auxiliary process control components and its applications. 5. To give the students an overview of Industrial Control components & their Need in Instrumentation.	
Course Outcome	The students will be able to 1. Study, select & implement various pneumatic system components & circuits. 2. Select & Compare various control systems like Hydraulic, pneumatic & electric. 3. Apply knowledge to classify, select & use various Transmitters. 4. Select, classify & use various control valves & their accessories. 5. Describe the Need of Auxiliary process control components & study their industrial usage. 6. Apply knowledge of Industrial Control Components & their application.	

Prerequisite: Knowledge of sensors, Measurement system, basic control system and Electrical Engineering.

Control System Components			
Module	**Content**	**Hrs.**	**CO Mapping**
1	**Pneumatics** Introduction to Process and Control system. Pneumatic System Components: ISA symbols, Instrument Air and Plant Air, Air supply system and its components, Air compressors, Pressure regulation devices, air dryers, Directional control valves and special types of pneumatic valve such as Pilot-operated valves, Non-return valves, Flow control valves, Sequence valves, and Time delay valve, Linear actuators- Single-acting, Double-acting, and special type of double-acting cylinder, Rotary actuators- Air motors. Process Control Pneumatics: Volume boosters, Air relays, Pneumatic transmitter, Pneumatic logic gates, Pneumatic Circuits-Standard Symbols used for developing pneumatic circuits, Sequence diagram.	10	CO1
2	**Hydraulics** Hydraulic System Components:Hydraulic pumps(centrifugal, gear , lobe), Pressure regulation method, Loading valves, Hydraulic valves, Hydraulic actuators (cylinder and motor), Speed control circuits for Hydraulic actuators, Selection and comparison of pneumatic, hydraulic and electric systems.	4	CO2
3	**Transmitters** Need, specifications and classification of transmitters, Need for Standardization of signals, concept of live zero and dead zero, 2-wire; 3-wire and 4-wire transmitters and its calibration, Electronic versus pneumatic transmitters, Electronic type transmitters - temperature; Pressure (gauge); differential pressure; level(capacitive type); flow transmitter (magnetic); SMART /Intelligent transmitter; Block schematic and Comparison with conventional transmitter; applications of transmitters, Need for Converters and its calibration - Pneumatic to Electrical and Electrical to Pneumatic converters.	8	CO3
4	**Process Control Valves** Need and specifications of Control Valve; Control valve terminology; Control valve constructional details; Air to Open(AO), Air to Close (AC); MOC (Material of construction); classification of control valve; applications, advantages, disadvantage of - Globe, Ball, Needle, Butterfly, Diaphragm, Pinch, Gate, Solenoid; Flow characteristics (Inherent and Installed); Valve positioners: necessity, types-motion balance and force-balance, Effect on Performance of control valve; Control Valve Actuators -Electrical, Pneumatic, Hydraulic, Electro-mechanical, and piston actuators; selection guidelines for control valve	12	CO4

5	**Auxiliary Process Control Components** Alarm annunciators and its sequences; Fire and gas detectors (types –flame, gas, fire and gas siren), Feeders, Dampers, Temperature regulator, Flow regulator, Temperature , Flow, Level and, Pressure Switch, Relief valves, safety valves and rupture disk, Thermostats and Humidistat, Steeper motor (working principle)	6	CO5
6	**Industrial Control Components** Switches: Construction, symbolic representation, working, application of Toggle switches, Push buttons, Selector switches, DIP switches, Rotary switches, Thumbwheel switches, Drum switch, Limit switches, emergency push button, Switch specifications. Control Relays: Construction, working, specifications, and applications of Electro-mechanical relay, Reed relay, hermetically sealed relay, Solid state relays. Interposing relays and Overload relays. Contactors/starters: Construction, working, specifications and applications of starters and contactors. Comparison between relays and starters /contactors.	8	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books Recommended:

1. Andrew Parr, “Hydraulic & pneumatics”; A Technicians & Engineers Guide, Second Edition
2. Bela G. Liptak, “Instrument Engineer’s Hand Book – Process Control”, Chilton Company, 3rd Edition, 1995.
3. Douglas. M.Considine, “Process Instruments & Control Handbook”, McGraw-Hill
4. C.L.Albert and D.A. Coggan, “Fundamentals of Industrial Control”, ISA, 1992.
5. Andrew Williams, “Applied instrumentation in the process industries”, 2nd Edition, Vol. 1 & 3, Gulf publishing company.
6. Guy Borden, Paul G Friedmann , “Control Valves- ISA” style Editor
7. FESTO, “ Pneumatics workbook Basic Level”
8. Fisher, “Control Valve Handbook”, Fourth Edition.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO5011	Advanced Sensors	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (100)				Term work	Pract. and Oral	Oral	Total
		Internal Assesment(20)			End sem Exam				
		Test 1	Test2	Avg.					
ISDLO5011	Advanced Sensors	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDLO5011	Advanced Sensors	3
Course Objectives	1. To expose the students to the concepts of smart sensors and microsensors 2. To provide sufficient knowledge about the sensor fabrication. 3. To create awareness about the various application fields of smart sensors.	
Course Outcomes	The students will be able to - 1. Explain the various principles employed in transducers. 2. Examine the methods of fabricating a sensor. 3. Apply knowledge in designing smart sensors. 4. Discuss the techniques of fabrication and application of MEMS. 5. Describe the various applications of smart sensors. 6. Discuss advanced sensing technology.	

Details of Syllabus:

Prerequisite: Fundamentals of transducers**.**

Module	Content	Hrs	CO Mapping
1	**Review of Fundamental of Sensors:** Principle of physical and chemical transduction, sensor classification, characterization of mechanical, electrical, optical, thermal, magnetic, chemical and biological sensors, their calibration and determination of characteristics, sensor reliability, reliability models and testing, failure mechanisms and their evaluation, stability studies.	06	CO1
2	**Sensor Fabrication**: Design considerations and selection criterion as per standards, Sensor fabrication techniques, process details and latest trends in sensor fabrication. Thick film sensing and system design.	06	CO2

3	**Smart Sensors:** Smart sensor basics, signal conditioning and A/D conversion for sensors, examples of available ICs and their applications.	06	CO3
4	**Micro Sensors:** Introduction, Intrinsic characteristics of MEMS, common fabrication techniques, application of MEMS in sensing systems including pressure sensors, accelerometers, gyroscopes and strain gauges.	06	CO4
5	**Sensor Applications:** Sensors for different applications like mechanical, electrical, thermal, magnetic, optical, radiation, chemical and biological types.	06	CO5
6	**Advanced Sensing Technology:** Sensors, instruments and measurement techniques for emerging application areas such as environmental measurement like DO(dissolves oxygen),BOD (biological oxygen demand),COD(chemical oxygen demand)TOC(total organic carbon)Cox(carbon dioxides)NOx(nitrogen oxide),for navigation and inertial measurements, for agricultural measurements such as soil moisture, wind speed, leaf wetness duration, sensors for food processing like smell or odour, taste.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Chang Liu, “Foundations of MEMS”, Pearson Education Inc., 2012.
2. Stephen D Senturia, “Microsystem Design”, Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

4. Jacob Fraden ,"Handbook of Modern Sensors", 2nd Ed.
5. S. M. Sze," Semiconductor Sensors".
6. M J Usher, "Sensors and Transducers, MacMillan", 1985.

References:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.

2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.

3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002.

4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.

5. Thomas M. Adams and Richard A.Layton, "Introduction to MEMS, Fabrication and Application," Springer, 2010.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISDLO5012	Optimization Techniques	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO5012	Optimization Techniques	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO5012	Optimization Techniques	3
Course Objective	1. Student should understand the process of optimization, formulation of practical engineering problem into optimization problem and applying necessary and sufficient conditions of optimality to check the feasibility of the problem. 2. Students should study the concepts of linear as well as nonlinear programming methods. 3. Based on the nature of problem i.e. linear, nonlinear, one dimensional, multidimensional, students can use appropriate method to solve it. 4. Students will understand how to apply numerical unconstrained methods to solve constrained optimization problem.	
Course Outcome	Students will be able to – 1. Translate descriptive statements of the design engineering problems in to a mathematical statement of optimization. 2. Write optimality conditions for unconstrained and constrained problems and use Lagrange multiplier and KKT necessary conditions for solving problems. 3. Translating linear programming problem (LPP) in to standard form and then use simplex or two phase simplex method. 4. Use alternate form of two-phase simplex method called Big-M method also write dual problem for the given LP Problem for solving it. 5. Explain gradient-based search and direct search methods for design optimization problems. 6. Use the numerical methods for unconstrained optimization.	

Details of Syllabus:

Prerequisite: Knowledge of derivative, partial differentiation, Matrix Algebra, Taylor series.

Module	Contents	Hrs	CO mapping
1	**Introduction to Optimization:** Definition and meaning of optimization, need of optimization, optimization problem formulation – statement of an optimization problem, terminology- design vector, objective function, objective function surface, design constraints, constraint surface, Iteration, convergence, classification of optimization problem, conventional versus -optimum design process, - optimal control problem, problem formulation process, engineering applications of optimization.	04	**CO1**

2	**Classical Optimization Techniques:** Fundamental concepts- local and global minima, local and global maxima, quadratic form, necessary and sufficient condition of single and multivariable optimization with no constraints, multivariable optimization with equality and inequality constraints (Kuhn-Tucker condition), Lagrange Theorem, Convex programming problem	04	**CO2**
3	**Linear Programming – Simplex Method** Definition of linear programming problem (LPP), standard form of LPP, terminology, basic concepts, Simplex Algorithm and flowchart, simplex method, two-phase simplex method, Duality in LPP	08	**CO3**
4	**Linear Programming – Revised Simplex Method** Duality in linear programming – standard primal LP problem, dual LP problem, Treatment of equality constraints, determination of the primal solution from the dual solution, dual variables as Lagrange multipliers, KKT conditions for the LP problem,	08	**CO4**
5	**Numerical Methods for Unconstrained Optimum Design – Direct Method** General algorithm for unconstrained minimization methods, rate of convergence, unimodal and multimodal function, reduction of a single variable, one dimensional minimization methods- Equal Interval method, Golden section search method.	04	**CO5**
6	**Numerical Methods for Unconstrained Optimum Design – Indirect Method** Gradient of a function, Steepest Descent, Conjugate gradient (Fletcher-Reeves), Step size determination – polynomial interpolation, properties of gradient vector, scaling of design variables, Newton's method, Quasi Newton method, DFP method, BFGS method,	08	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books.

1. Jasbir S. Arora, "Introduction to Optimum Design", 3rd Edition, Academic Press – 2012.

Reference Books

1. S. S. Rao, "Optimization", 3rd Enlarged Edition, New Age International (P) Ltd., Publishers, New Delhi, 2010.
2. T. E. Edger and D. M. Himmeblaue, "Optimization of Chemical Processes", McGraw Hill International Editions, 1989.
3. William L. Luyben, "Process Modeling, Simulation, And Control For Chemical Engineers" McGraw-Hill Publishing Company,1990.
4. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India (P) Ltd., New Delhi, 1998.
5. Ashok D. Belegundu, "Optimization concepts and applications in Engineering", Pearson Education, 2002.

Course Code	Course Name	Teaching Scheme (Contact HOURS)			Credit Assigned			
ISDL05013	Database Management System	Theory	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract & Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISDL05013	Database Management System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDL05013	Database Management System	3
Course Objectives:	1. Learn and practice data modeling using the entity-relationship and developing database designs. 2. Understand the use of Structured Query Language (SQL) and learn SQL syntax. 3. Apply normalization techniques to normalize the database 4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.	
Course Outcomes:	The student will be able to: 1. To describe data models and schemas in DBMS. 2. Explain the features of database management systems and Relational database. 3. Use SQL- the standard language of relational databases. 4. Identify the functional dependencies and Design a database. 5. Describe the concept of Transactions Management and Concurrency. 6. Explain the concept of Query Processing and Optimization.	

Details of Syllabus:

Module	Topics	Hrs.	CO Mapping
1	**Introduction Database Concepts:** Introduction, Characteristics of databases, File system V/s Database system, Users of Database system, Concerns when using an enterprise database, Data Independence, DBMS system architecture, Database Administrator **Entity–Relationship Data Model :** Introduction, Benefits of Data Modeling, Types of Models, Phases of Database Modeling, The Entity-Relationship (ER) Model, Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model.	06	CO1

2	**Relational Model and Algebra :** Introduction , Mapping the ER and EER Model to the Relational Model , Data Manipulation , Data Integrity ,Advantages of the Relational Model, Relational Algebra , Relational Algebra Queries, Relational Calculus.	06	CO2
3	**Structured Query Language (SQL) :** Overview of SQL , Data Definition Commands, Set operations , aggregate function , null values, , Data Manipulation commands, Data Control commands , Views in SQL, Nested and complex queries .	06	CO3
4	**Integrity and Security in Database:** Domain Constraints, Referential integrity, Assertions, Trigger, Security, and authorization in SQL **Relational–Database Design :** Design guidelines for relational schema, Function dependencies, Normal Forms- 1NF, 2 NF, 3NF, BCNF and 4NF	08	CO4
5	**Transactions Management and Concurrency:** Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Implementation of isolation, Concurrency Control: Lock-based , Timestamp-based , Validation-based protocols, Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery & atomicity, Log based recovery, Shadow paging.	06	CO5
6	**Query Processing and Optimization: Overview** ,Issues in Query Optimization ,Steps in Query Processing , System Catalog or Metadata, Query Parsing , Query Optimization, Access Paths , Query Code Generation , Query Execution , Algorithms for Computing Selection and Projection , Algorithms for Computing a Join , Computing Aggregation Functions, Cost Based Query Optimization .	04	CO6

Internal Assessment:
Internal Assessment consists of two tests out of which, (on Minimum 02 Modules).

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:
1. G. K. Gupta :"Database Management Systems", McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, :"Database System Concepts", 6th Edition, McGraw – Hill
3. Elmasri and Navathe, " Fundamentals of Database Systems", 5thEdition, PEARSON Education.
4. Peter Rob and Carlos Coronel, " Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.

Reference Books :
1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g,Black Book, Dreamtech Press
2. Mark L. Gillenson, Paulraj Ponniah, " Introduction to Database Management",Wiley
3. Sharaman Shah ,"Oracle for Professional", SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, " Database Management Systems",TMH
5. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

Subject code	Subject Name	Teaching			Credits Assigned			
		Theo	Pract	Tut.	Theo	Pract	Tut.	Total
ISDLO5014	**Fiber Optic Instrumentation**	3	-	-	3	-	-	3

Subject code	Subject Name	Examination Scheme							
		Theory(100)					Pract and oral	Oral	Total
		Internal Assessment(20)			End sem Exa	Term Wor			
		Test1	Test 2	Avg.					
ISDLO5014	**Fiber Optic Instrumentation**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO5014	**Fiber Optic Instrumentation**	**3**
Course Objectives	1. To expose the students to the concepts of optical fiber and their properties. 2. To acquaint the students with the different types of sources and detectors and their selection. 3. To provide sufficient knowledge about the applications of lasers. 4. To impart adequate awareness about the fiber optic sensors.	
Course Outcomes	The students will be able to 1. Explain the principle of optical fibers and its properties. 2. Examine the various optical losses in the fiber, use OTDR for determining faults in the fiber. 3. Compare the different types of light sources and detectors and select one appropriately. 4. Explain the various principles of fiber optic sensors. 5. Use optical fiber sensors for different parameter measurement. 6. Investigate the various optical devices.	

Details of Syllabus:

Prerequisite: Awareness of light theory, Basics of fiber optics,Basics of measurement in Instrumentation.

Module	Content	Hours	CO Mapping
1.	**Optical Fibers and their properties** Ray theory, Principle of light propagation through a fiber, acceptance angle, numerical aperture, skew rays, meridional rays, different types of fibers and their properties.	04	CO1
2.	**Characteristics of Optical fiber** Attenuation, Material absorption losses, scattering losses, bending losses, intermodal and intramodal losses, overall fiber dispersion, polarization, nonlinear phenomena. Optical Fiber measurements: measurements of attenuation, numerical aperture, OTDR, optical power meter.	04	CO2

3	**Optical sources and Detectors** LED, Lasers, LD, PIN, APD their characteristics, modulation circuits, optical detection principle, LED coupling to fiber, Laser Applications: Lasers in surgery, laser pollution monitoring, laser gyros and laser induced fusion. Optical fiber connection: fiber alignment and joint loss, splices, connectors, couplers.	06	CO3
4	**Fiber Optic Sensors I** Introduction to fiber optic sensors, Advantages and disadvantages of FOS, Principle of fiber optic sensors, classification, principle of intensity modulated sensors, phase modulated sensors, wavelength modulated sensors, Fiber Bragg grating sensors, distributed optical fiber sensing	08	CO4
5	**Fiber Optic Sensors II** Various concepts used for displacement, temperature, flow, pressure, level measurement along with applications.	08	CO5
6	**Optical Amplification and Integrated Optics** Optical Amplifiers, Beam splitters, directional couplers, opto isolators, multi-mode interference coupler, optical modulators, optical switches, polarization transformation and frequency translators, optoelectronic integration.	06	CO6

Internal Assessment:
Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Gerd Keiser, : “Fiber Optics – Communication”.
2. Deboo Burros, : “Integrated circuits and semiconductor devices theory and application”, 2nd edition , McGraw Hill

Reference Books :

1. J. Wilson, J. F.B. Hawkes,: “Opto Electronics – An Introduction”, Prentice Hall of India New Delhi. 1996.
2. John M Senior, “Optical Fiber Communications Principles and Practice”,2nd edition 1996, Prentice Hall of India,
3. D.A.Krohn, “Fiber Optic Sensors- fundamentals and applications ”3rd edition, ISA
4. Cherin,: “Introduction to optical fibers”, McGraw Hill
5. J.Wilson, Hawkes,”Optoelctronics An introduction ”,Prentice Hall International series in optoelectronics.

Subject code	Subject Name	Teaching			Credits Assigned			
		Theo	Pract	Tut.	Theo	Pract	Tut.	Total
ISL501	**Business Communication & Ethics**	02Hrs. (Class wise)	02Hrs. (Batch wise)	-	-	2	-	2

Subject code	Subject Name	Examination Scheme							
		Theory(100)				Term Work	Pract and oral	Oral	Total
		Internal Assessment(20)			End sem Exa				
		Test1	Test 2	Avg.					
ISL501	**Business Communication & Ethics**	-	-	-	-	50	-	-	50

Course Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Course Outcomes:

A learner will be able to

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills.

List of Assignments:

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work:

Term work shall consist of all assignments from the list. The distribution of marks for term work shall be as follows:

Book Report……..(10) Marks
Assignments …… (10) Marks
Project Report Presentation…….. (15) Marks
Group Discussion…… (10) Marks
Attendance ……(05) Marks

TOTAL: ……(50) Marks

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

References

1. Fred Luthans, “Organizational Behavior”, McGraw Hill, edition
2. Lesiker and Petit, “Report Writing for Business”, McGraw Hill, edition
3. Huckin and Olsen, “Technical Writing and Professional Communication”, McGraw Hill
4. Wallace and Masters, “Personal Development for Life and Work”, Thomson Learning, 12th edition
5. Heta Murphy, “Effective Business Communication”, Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, “Business Correspondence and Report Writing”, Tata McGraw-Hill Education
7. Ghosh, B. N., “Managing Soft Skills for Personality Development”, Tata McGraw Hill. Lehman,
8. Dufrene, Sinha, “BCOM”, Cengage Learning, 2nd edition
9. Bell, Smith, “Management Communication” Wiley India Edition, 3rd edition.
10. Dr. Alex, K., ”Soft Skills”, S Chand and Company
11. Subramaniam, R., “Professional Ethics” Oxford University Press.
12. Robbins Stephens P., “Organizational Behavior”, Pearson Education
13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract/ Oral.	Tut.	Total
ISL502	Applications of Microcontroller Lab Practice	-	2	-	-	1	-	1

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test 1	Test2	Avg.					
ISL502	Applications of Microcontroller Lab Practice					25	25	-	50

Subject Code	Subject Name	Credits
ISL502	Applications of Microcontroller Lab Practice	1
Course objectives	1. To explain the assembly and 'c' programming concepts. 2. To explain addressing modes and instruction set of MCS-51 and develop programs using instructions. 3. To give knowledge of integrated hardware of MCS-51 4. To study different SFRs associated with integrated peripherals and to give knowledge of interfacing of MCS-51 with different peripheral devices such as LCD, keyboard, Memory, ADC, DAC etc. **5.** To develop simple application board using MCS-51. **6.** To make the students capable to develop application using learned concepts of hardware, software and interfacing	
Course Outcomes	The students will be able to: 1. Design and develop programs using instructions learned from instruction set in assembly or 'c' language. 2. Explain the comparative study of various microcontrollers and microprocessors 3. Outline the knowledge of operation of integrated hardware components. 4. Design software programs in assembly or 'C' language. 5. Solve and construct interfacing of peripheral components with MCS 51. 6. Investigate, recommend and design the sophisticated application based on MCS-51 such as Traffic light control, Digital weighing machine etc.	

Syllabus: Same as that of Subject ISC502 Applications of Microcontroller.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	To develop a program to perform 16 bit Arithmetic and Logical operations	CO1
2	To develop a program to perform Code conversion	CO1

3	To develop a program for generating square wave on port pin with and without timer.	**CO3**
4	To develop a program for interfacing 7 segments displays with MCS-51	**CO4**
5	To develop a program for interfacing LCD display with MCS-51	**CO5**
6	To develop a program for interfacing keyboard with MCS-51	**CO5**
7	To develop a program for Serial Communication with PC.	**CO3**
8	To develop a program for interfacing DAC and its application.	**CO5**
9	To develop a program for Speed control of DC Motor	**CO6**
10	To develop a program for frequency measurement.	**CO6**
11	To develop a program for Stepper motor control	**CO6**
12	To develop a program for implementing traffic light controller.	**CO6**
13	Assignment on comparison of various microcontrollers and microprocessors.	**CO2**

Any additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:
Practical/Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum 10 experiments and two assignments.
The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments): 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL503	**Control System Design Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL503	**Control Systems Design Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL503	**Control Systems Design Lab Practice**	1
Course Objective	1. To develop the skills needed to represent the system in state space form. 2. To impart knowledge required to design state feedback controller and state estimator. 3. To design the compensator in time and frequency domain. 4. To design the PID compensator.	
Course Outcome	Students will be able to - 1. Obtain state model of a system from transfer function and study similarity transformation. 2. Verify the controllability and observability of the given system. 3. Design the controller and observer for the given system with transient specifications. 4. Obtain solution of state equations. 5. Design lead, lag, and lag-lead compensator using root-locus and bode-plot techniques with given transient specifications. 6. Tune PID controller by using Ziegler-Nichols and Cohen-coon methods for a given system represented by transfer function in time and frequency domain.	

Syllabus same as that of subject ISC503 Control System Design

Suggested List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO pping
1	Obtain state models of systems and study similarity transformation.	**CO1**
2	Verify controllability and observability of a given system	**CO2**
3	Design of state feedback controller in state space using pole placement	**CO3**
4	Design an observer for a given system by using state space method.	**CO3**
5	Find state transition matrix of a given system	**CO4**
6	Design of Lead Compensator using Root-locus technique.	**CO5**
7	Design of Lag Compensator using Root-locus technique	**CO5**
8	Design of Lag-Lead Compensator using Root-locus technique	**CO5**

9	Design of Lead Compensator using Bode-plot technique.	**CO5**
10	Design of Lag Compensator using Bode-plot technique	**CO5**
11	Design of Lag-Lead Compensator using Bode-plot technique	**CO5**
12	Tuning of PID in Time domain.	**CO6**
13	Tuning of PID in Frequency domain.	**CO6**

Case Study:

1. Design a controller using time-domain/frequency domain/pole placement approach for an inverted pendulum on a cart and simulate the same using application software.
2. Design a controller using time-domain/frequency domain/pole placement approach for speed control of DC motor and simulate the same using application software.
3. Design a controller using time-domain/frequency domain/pole placement approach for Magnetic levitation system and simulate the same using application software.
4. Design a controller using time-domain/frequency domain/pole placement approach for any other physical system available in laboratory (Flow loop, pressure loop, level loop etc.) and simulate the same using application software.

Note: Student can use application software like MATLAB, SCILAB etc. for their practical/case study work.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum **Eight** Experiments.
The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL504	Control System Components Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL504	Control System Components Lab Practice	-	-	-	-	25	25	-	50

Subject Code	Subject Name	credits
ISL504	Control System Components Lab practice	1
Course objective	1. To impart knowledge of different control system components like Hydraulic, Pneumatic, Electrical & Electronics and their comparison. 2. To make the students to learn different types of Transmitters. 3. To make the students to understand concept of control valve, different types, their working & selection criteria. 4. To make the students to learn various Auxiliary process control components and its applications. 5. To give the students an overview of Industrial Control components & their Need in Instrumentation.	
Course Outcome	The students will be able to 1. Study, select & implement various pneumatic system components & circuits. 2. Select & Compare various control systems like Hydraulic, pneumatic & electric. 3. Apply knowledge to classify, select & use various Transmitters. 4. Select, classify & use various control valves & their accessories. 5. Describe the Need of Auxiliary process control components & study their industrial usage. 6. Apply knowledge of Industrial Control Components & their application.	

Syllabus: Same as that of Subject ISC504 Control System Components.

List of Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Study of various pneumatic / hydraulic / electro-pneumatic control system components.	CO1,CO2
2	Study and testing of mA / mV / universal calibrator	CO3

3	Study operation and calibration of 2-wire DP transmitter for flow or level measurement.	**CO3**
4	Study and testing of a two-wire temperature transmitter.	**CO3**
5	Study of cut-view section of pneumatically operated control valve.	**CO4**
6	Calibration of I to P / and /OR P to I converter.	**CO4**
7	Study of control valve Flow characteristics.	**CO4**
8	Study operation of valve positioner.	**CO4**
9	Study of different types of control valve actuator.	**CO4**
10	Study of pressure/temperature/level/flow switches.	**CO5**
11	Study of different types of control relay and contactor.	**CO6**
12	Study of Alarm Annunciator	**CO5**
13	Study and testing of solenoid valves.	**CO5**
14	Assignment on Hydraulic system components	**CO2**

Note: *Factory visit is advised to understand the working of the control system components.

Practical/Oral Examination:
Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on Entire subject.

Term Work:
Term work shall consist of minimum Ten Experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL505	Advanced Sensors Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL505	**Advanced Sensors– Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL505	**Advanced Sensors Lab**	**1**
Course objective	1. To expose the students to the concepts of smart sensors and microsensors 2. To provide sufficient knowledge about the sensor fabrication. 3. To create awareness about the various application fields of smart sensors	
Course Outcome	Students will be able to 1. Explain the various principles employed in transducers. 2. Examine the methods of fabricating a sensor. 3. Apply knowledge in designing smart sensors. 4. Investigate the techniques of fabrication and application of MEMS. 5. Describe the various applications of smart sensors. 6. Discuss advanced sensing technology.	

Syllabus: Same as that of Subject **ISDLO5011**Advanced Sensors

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Study and characterization of chemical/electrical/thermal sensors.	CO1
2	To study thick film sensing technique.	CO2
3	Design of smart sensors with signal conditioning.	CO3

4	To study accelerometer.	**CO4**
5	To study gyroscope.	**CO4**
6	Study of biological sensor.	**CO5**
7	Study and calibration of Dissolved Oxygen probe.	**CO6**
8	Assignment on MEMS and its applications.	**CO4**
9	Assignment on application on advanced sensing .	**CO6**
10	Assignment on sensor fabrication.	**CO2**

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL505	**Optimization Techniques Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL505	**Optimization Techniques Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL505	**Optimization Techniques Lab Practice**	1
Course objective	1. Student should understand the process of formulation of practical engineering problems and apply software tools for solving it. 2. Students should learn the linear as well as nonlinear methods of optimization for solving engineering design problems and choose appropriate tools of software for solving these problems.	
Course Outcome	**Students will be able to –** 1. Formulate practical design problems having two design variables and solve graphically and identify the nature of the problem. 2. Apply the simplex method algorithm and solve LPP by two-phase simplex method numerically. 3. Apply algorithm of simplex method to solve quadratic programming problem numerically. 4. Use necessary and sufficient conditions and verify the descent conditions for a given search direction for unconstrained optimization problem. 5. Calculate step size along search direction using search methods numerically. 6. Apply numerical methods algorithms to solve unconstrained problems.	

Syllabus same as that of subject ISDLO5012 Optimization Techniques

List of Laboratory Experiments/Assignments:

Sr. No.	Detailed Contents	CO Mapping
1	Formulate engineering system design problem as an optimization problem.	**CO1**
2	Problem formulated in Experiment No. 1 should be solved graphically and identify the nature of problem.	**CO1**
3	By using excel solver solve unconstrained and constrained optimization problems create excel worksheets.	**CO2**

4	Solve LPP by two-phase simplex method numerically and verify the results by using simulation software	**CO3**
5	Solve quadratic programming problem numerically and verify results by using simulation software.	**CO4**
6	Verify the descent conditions for a given search direction for unconstrained optimization problem and calculate step size along search direction using Equal Interval Search method numerically and verify results by using simulation software	**CO5**
7	Verify the descent conditions for a given search direction for unconstrained optimization problem and calculate step size along search direction using Golden Section Search method numerically and verify results by using simulation software	**CO5**
8	Solve nonlinear optimization problems by using numerical optimization methods (indirect) steepest-descent and conjugate-gradient methods verify the results by using simulation software.	**CO6**
9	Solve nonlinear optimization problems by using numerical optimization methods (indirect) Newton's methods verify the results by using simulation software.	**CO6**
10	Solve nonlinear optimization problems by using numerical optimization methods (indirect) DFP and BFGS methods verify the results by using simulation software.	**CO6**

Case Study: Each student shall solve one practical design optimization problem and submit the case – study report.

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus

Term Work:
Term work shall consist of minimum Eight experiments / assignments.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments/Assignments) : 10 Marks
Laboratory work (Programs/Journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Course Code	Course Name	Teaching Scheme (Contact HOURS)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
ISL505	Database Management System-Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL505	Database Management System Lab Practice	-	-	-	-	25	-	25	50

Course objectives	1. Learn and practice data modeling using the entity-relationship and developing database designs. 2. Understand the use of Structured Query Language (SQL) and learn SQL syntax. 3. Apply normalization techniques to normalize the database 4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access
Course Outcomes	The student will be able to: 1. To model or design ER diagram based on the given schema or case study. 2. Use SQL- the standard language of relational databases. 3. Use a desktop database package to create, populate, maintain, and query a database. 4. Apply the concept of integrity and Security in Database: 5. Apply the concepts of Transaction Management and Concurrency.

Syllabus: Same as that of Subject ISDLO5013 Database Management System.

Suggested List of Programming Assignments/Laboratory Work:

Sr. No.	Detailed Content	CO Mapping
1	Experiment to study different phases of database design. Design ER and EER diagram for company database and convert it into relational model (Schema).	CO1
2	Experiment to study DDL statements and Integrity constraint	CO2
3	Experiment to study DML commands.	CO2
4	Experiment to study Simple queries and Nested Queries.	CO2,CO3
5	Experiment to study complex and Co-related queries	CO2,CO3
6	Experiment to study different types of Joins.	CO2,CO3
7	Experiment to study View.	CO2,CO3
8	Execution of procedure and functions by using SQL Server	CO3

9	Execution of different types of triggers.	CO4
10	Experiment to study TCL and DCL commands.	CO5
12	Designing a database application using the overall database design process and implement queries, views, triggers, procedures and functions for the same.	CO1,CO2, CO3

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum 10 experiments. The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Sub cod	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL505	**Fiber Optic Instrumentation -Lab Practice**	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL505	**Fiber Optic Instrumentation Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	**Subject Name**	**Credits**
ISL505	**Fiber Optic Instrumentation-Lab Practice**	**1**
Course Objectives	1. To expose the students to the concepts of optical fiber and their properties. 2. To acquaint the students with the different types of sources and detectors and their selection. 3. To provide sufficient knowledge about the applications of lasers. 4. To impart adequate awareness about the fiber optic sensors.	
Course Outcomes	The students will be able to 1. Explain the principle of optical fibers and its properties. 2. Examine the various optical losses in the fiber,use OTDR for determining faults in the fiber. 3. Compare the different types of light sources and detectors and select one appropriately. 4. Explain the various principles of fiber optic sensors. 5. Use optical fiber sensors for different parameter measurement. 6. Investigate the various optical devices.	

Syllabus: Same as that of Subject ISDLO5014 Fiber Optic Instrumentation

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	To study the optical fiber system set-up	**CO1**
2	To measure numerical aperture of an optical fiber	**CO2**
3	To study attenuation losses in optical fiber	**CO2**
4	To study dispersion losses in optical fiber	**CO2**

5	To study characteristics of optical sources and detectors	**CO3**
6	To study OTDR	**CO3**
7	To study optical power meter	**CO3**
8	To study different splicing techniques	**CO3**
9	To study characteristics of opto-coupler.	**CO6**
10	Design of an optical fiber sensor.	**CO4**
11	Assignment on various applications of optical fiber sensor.	**CO5**
12	Assignment on various application of Laser technology	**CO5**

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL506	Mini Project-I	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme Theory (out of 100) Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL506	Mini Project-I	-	-	-	-	25	-	25	50

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned from the courses studied to solve/implement predefined challenging practical problems of interdisciplinary nature .The students undergo various laboratory/tutorial/simulation laboratory courses in which they do experimentation based on the curriculum requirement. The students should be encouraged to take challenging problems of interdisciplinary nature. The emphasis should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning.
- Learn the behavioral science by working in a group.

The group may be of maximum four (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The final examination will be based on demonstration in front of internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the completed task.

The students may use this opportunity to learn different design techniques in instrumentation, control and electronics. This can be achieved by making a proper selection of Mini Project.

Subject code	Subject Name	Teaching scheme (Hrs)			Credit assigned			
ISC 601	Process Instrumentation System	Theory	Pract	Tut	Theory	Pract	Tut	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract and Oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC 601	Process Instrumentation System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC 601	Process Instrumentation System	4
Course objective	1. To make the students to familiar with different Process Dynamics & process control actions. 2. Students are expected to learn classification & working of Controllers & Tuning Methods. 3. Students are expected to understand various control schemes. 4. To familiarize concept of Multivariable Control & Discrete state process control Requirement.	
Course Outcome	The students will be able to 1. Understand & Learn Process Control Terminologies, Process Dynamics & their mathematical model. 2. Understand different types of control actions & their selection. 3. Learn Features & Classify controllers like electronic, pneumatic and hydraulic & their Tuning Techniques. 4. Learn various process control schemes & their applications and selection. 5. Understand Multivariable Control systems & their Interaction 6. Develop relay logic for various processes & symbols.	

Details of Syllabus:

Prerequisite: Measurement of physical parameters, sensors/transducers and basic control system.

	Process Instrumentation System		
Module	Content	Hrs	CO Mapping
1	**Introduction to Process Control** Process Control Terminology, Development of Typical Process Control loops like Pressure, Temperature, flow & Level. Process characteristics, control system parameters, Dynamic elements in a control loop, Dead time processes and smith predictor compensator. Inverse response behaviour of processes and compensator. Dynamic behaviour of first and second order systems. Interacting and non-interacting systems. Development	08	CO1

	of Mathematical Model for first & second order system with Example.		
2	**Process Control Actions** Types-Discontinuous, continuous (P, I, D) and composite control actions (PI, PD, and PID), Effects of control actions, selection criteria.	**06**	**CO2**
3	**Process Controllers and Tuning** Need for controller, General features, specifications, classification & working of Pneumatic, Hydraulic and Electronic controllers. Need for controller Tuning. Tuning Methods-Process reaction curve method, Ziegler-Nichols method, Cohen coon correction for quarter amplitude, Frequency response method, Relay based tuning. Concept of Auto Tuning. Introduction to Model based Controller.	**08**	**CO3**
4	**Control Schemes** Feedback, Feed forward, cascade, Ratio, split range, selective control, adaptive control, inferential control, and selection Guidelines.	**12**	**CO4**
5	**Multivariable Control** Introduction to SISO & MIMO systems, Block diagram analysis of multivariable systems, Interaction, relative gain analysis, Decoupler design	**06**	**CO5**
6	**Discrete-State process control** Need for Discrete state process control systems, process specification and event sequence description, Relay Logic symbols, Development of Relay ladder Logic diagram and case study examples.	**08**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:

1. Curtis D. Johnson, “Process Control Instrumentation Technology”, PHI /Pearson Education 2002.
2. George Stephanopoulos, “Chemical process control”, PHI-1999.

Reference Books:

1. Bela G. Liptak, "Instrument Engineer's Hand Book – Process Control", Chilton Company, 3rd Edition, 1995.

2. M.Chidambaram, "Computer Control of Processes", Narosa, 2002.
3.Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press, New York, 1995.
4.D. Patranabis, "Principles of Process Control", Second edition, TMH.
5.F.G. Shinsky, "Process Control System", TMH.
6.N.E. Battikha, "Condensed Handbook of Measurement and Control",3rd Edition., ISA Publication.
7.Donald P. Eckman, "Automatic Process Control", Wiley Eastern Ltd.
8.Franklyn W. Kirk, Nicholas R. Rimboi, "Instrumentation", First edition,1996, D.

Suggested E Books:

1. Instrumentation & Controls- Process control Fundamental by PA Control.Com
2. Dr. M.J.Willis, "Conventional process control schemes"
3. Tony R Kuphaldt,"Lessons in Industrial Instrumentation"
4. W.C.Dunn, "Fundamentals of Industrial Instrumentation"

Subject code	Subject Name	Teaching			Credits Assigned			
		Theory	Prac	Tut.	Th	Pract.	Tut.	Total
ISC602	Industrial Data Communication	3	-	-	3	-	-	3

Subject Code	Subject Name	Examination Scheme							
		Theory(out of100)							
		Internal Assessment(out			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test 2	Avg.					
ISC 602	Industrial Data Communication	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC602	**Industrial Data Communication**	**3**
Course Objectives	1. To expose students to the basics of communication 2. To create awareness about the the OSI refrence model. 3. To acquaint the students with the different types of networks at various levels such as sensor level,device network and control network. 4. To provide sufficient knowledge about the HART. 5. To impart the fundamentals of foundation field bus.	
Course Outcomes	The students will be able to 1. Explain the importance of modulation in communication. 2. Examine the importance of OSI,TCP/IP model,various networking components. 3. Compare the different types of networks at various levels of field communication. 4. Use HART for communication 5. Establish Foundation fieldbus communication. 6. Investigate the various wireless devices.	

Details of syllabus:

Prerequisite: Awareness of transmitters, different process loops, Basics of communication system.

Module	Content	Hours	CO Mapping
1.	**Introduction to Communication System:** Elements of communication system, Noise in communication Systems. Amplitude Modulation: Introduction, Time and frequency domain analysis, Frequency Modulation, Phase Modulation, Effect of noise in FM. Digital Modulation, PAM,PPM,PWM,FSK,QPSK.	08	CO1
2.	**Introduction to Networks:** OSI reference model**,** TCP/IP model, Transmission media, UTP-STP cable, co-axial cable, N/W components: Repeaters, bridge, hub, switch, router, gateways. **Open Control N/W: RS232, RS422,EIA485** Modbus Structure, Implementation, GPIB. Proprietary Control N/W:Modbus Plus	05	CO2
3	**Networks at different levels:** Sensor level network: AS-i, CAN, Devicenet, Interbus and LON Device networks: Foundation Fieldbus H1-HART Profibus-PA Control Network: BACnet,control-net, FF-HSE, Profibus-DP, Ethernet, TCP/IP	08	CO3
4	**HART:** Architecture, Physical, Data Link, Application, Communication Technique, Normal and burst mode of communication, Troubleshooting, Benefits of HART	04	CO4
5	**Foundation Fieldbus:** Fieldbus requirement, features, advantages, fieldbus components, types, architecture–physical, data link, application layer, system and network management, wiring, segment functionality checking, installation in safe and hazardous area and troubleshooting, function block application process. **OPC Architecture**	06	CO5
6	**Wireless Technologies:** Satellite systems, Wireless LANs (WLANs), WiFi, VPAN, Zigbee, bluetooth GPRS and – their comparison, limitations and characteristics, Introduction to IOT and IIOT,RFID	05	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

1 . Question paper will comprise of 6 questions, each carrying 20 Marks.

2. Total 4 questions need to be solved.

3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.

4. Remaining questions will be mixed in nature.

5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Deon Reynders,Steve Mackay,Edwin Wright, : "Practical Industrial Data Communications" ,1st edition ELSEVEIR,2005.
2. Lawrence M Thompson, : "Industrial Data Communication", 2nd edition , 1997.

Reference Books:

1. Daniel T Miklovic, "Real Time Control Networks", ISA 1993.
2. Bela G Liptak, "Process Software and Digital Networks",3rd edition2002.
3. Andrew S. Tanenbaum, "Computer Networks", 4th edition, PHI/Pearson Education,2002.
4. Behrouz A. Forouzan, "Data Communications and Networking", 2nd update edition, Tata McGraw Hill Publishing Company, New Delhi,2000.
5. Douglas E.Corner, "Computer Networks and Internets"2nd edition, Pearson Education Asia,5th Indian reprint, 2001.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC603	Electrical Machines and Drives	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC603	Electrical Machines and Drives	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC603	Electrical Machines and Drives	4
Course Objective	1. To learn the basic concept and characteristics of Electrical motors. 2. To equip the students with the knowledge of semiconductor devices& their applications.	
Course Outcome	Students will be able to: 1. Explain working of DC motors and study their characteristics. 2. Describe the working principle of 3-phase I.M. 3. Discuss the constructional features of single-phase I.M. 4. Compare basic characteristics and ratings of power electronic devices. 5. Use controlled rectifiers, Inverters & choppers with different loads. 6. Illustrate working of AC & DC drives.	

Details of Syllabus:

Prerequisite: Knowledge of Faraday's laws, Lenz's law. Semiconductor devices such as diodes and transistors and their characteristics.

Module	Contents	Hrs	CO mapping
1	**DC Machines:** Types of DC motors, EMF equation generating & motoring action. Characteristics of DC motors. Speed control methods of DC motors. Applications of DC motors	08	**CO1**
2	**3-Phase Induction Motors:** Construction& working principle of3-phase IM. Slip, rotor frequency torque slip characteristic, power stages in IM	08	**CO2**
3	**Fractional HP Motors:** Construction & working principle of 1-phase I.M.split phase IM. Shaded pole IM Basic concepts of Stepper Motor, Servomotor	06	**CO3**
4	**Semiconductor Devices:**Introduction, characteristic, ratings & applications of power diode, power BJT, power MOSFET & IBGT Construction & characteristic, ratings of SCR, TRIAC Triggering methods of Thyristors using DIAC,UJT & PUT only.	08	**CO4**
5	**Applications of power semiconductor devices:** Controlled Rectifier: Principle of operation of 1-phase controlled converters, 1-phase half bridge & full bridge	12	**CO5**

	converter performance with R-L load. Basic operation of 3-phase converter AC power control with TRIAC-DIAC Inverter: Principle of operation of basic inverter, bridge inverter, PWM inverter DC-to-DC Converter: Basic operation of chopper, study of different types of chopper circuits like step up & step down chopper		
6	**Drives:** DC motor drives: 1-phase & 3-phase converter drives for continuous & discontinuous operation, chopper fed drive. AC motor drives and control: Control strategies of IM like stator voltage control & frequency control. Variable frequency VSI drives. Variable frequency CSI drives.	06	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

6) Question paper will comprise of 6 questions, each carrying 20 Marks.
7) Total 4 questions need to be solved.
8) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
9) Remaining questions will be mixed in nature.
10) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Sawhney A.K., Electrical & Electronics Measurement and Instrumentation, Dhanapat Rai &Co. Pvt Ltd
2. Nagrath I.J., Kothari D.P., Electrical Machines, second edition,Tata McGraw Hill, New Delhi.
3. B.L.Theraja, Fundamentals of Electrical & Electronics, S.Chand, Technical.
4. V.K. Mehta , Rohit Mehta, Principles of Electrical Engg. & Electronics, S.Chand
5. P.S. Bhimbra, Power Electronics, Khanna publishers, 2004
6. M. H. Rashid, Power Electronics, 2nd Edition, PHI, 2005

Reference Books:

1. Say M.G.,The performance & Design of Alternating Current Machines, 3rd edition, Oxford University
2. P.C. Sen, Power Electronics, Tata McGraw Hill, 2005
3. Mohan Undeland Robbins, Power Electronics- Converters application & Design, Wiley Eastern,1996
4. Dubey, Dorald, Thyristorised Power Controller, Wiley Eastern Ltd.1993
5. S.K. Datta, Power Electronics & control, PHI 1986
6. S.K. Bhattacharya, Industrial Electronics & Control, TATA McGraw Hill, 2007
7. B.K.Bose, Modern power Electronics & AC Drives Pearson Education Inc.2002

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC604	**Digital Signal Processing**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC604	**Digital Signal Processing**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC604	**Digital Signal Processing**	**4**
Course Objectives	1. To introduce the basic concept of discrete time signal processing and Acquired knowledge about DSP and its fundamentals. 2. To familiarize with Fourier transform algorithms and convolution of DT sequences. 3. Ability to design IIR digital filter and realization of its structures using different forms. 4. To design FIR filter using different methods. 5. To understand the basic concept of DSP processor and Adaptive filtering for practical applications.	
Course Outcomes	Students will be able to - 1. Describe the basic concept of discrete time signal processing such as sampling, aliasing, concept of DSP. 2. Demonstrate an ability to apply Discrete Fourier Transform, Fast Fourier transform and convolution techniques to signals. 3. Apply the concepts of all-pass and minimum-phase systems to analyses the LTI system, Also realization of system by direct form I, II, Cascade, Parallel and Structure form. 4. Design FIR filter by different techniques. 5. Describe how IIR filters are designed and Implemented by different methods. 6. Explain DSP processors and adaptive filters such as LMS, RLS for various applications.	

Details of Syllabus:

Prerequisite: Knowledge of Fundamentals of Engineering Mathematics, Knowledge of Signals and Systems, Basic programming skill

Module	Contents	Hrs	CO mapping
1	**Introduction**:- Review of discrete time signals and systems, Basics of Z transform, Block diagram of DSP, Advantages and applications, Sampling theorem, Reconstruction of signals, Aliasing.	04	**CO1**
2	**Discrete Fourier Analysis**: - DFT and its property, Decimation in time FFT algorithms, Decimation in frequency FFT algorithms, convolution by DFT, Overlap add and Overlap save method, Goertzel algorithm, The chirp Z transform algorithm	12	**CO2**
3	**Analysis of Digital Filter**: - Classification of filter on their pole zero diagram. Frequency response of IIR filters frequency response analysis of all types of linear phase system. Difference between IIR and FIR Filters. Realization of systems: -Realization of IIR systems by Direct Form-I, Direct form-II, Cascade and Parallel. Realization of FIR systems by Direct form, cascade and linear phase system. Lattice structures.	06	**CO3**
4	**Design of digital FIR filters**:- Classification of filters, Ideal filter characteristics, Symmetric and asymmetric FIR filters, Minimum Phase and All pass filters,FIR filter design by window technique and frequency sampling method, Linear phase and Zero phase filters, Hilbert transform.	08	**CO4**
5	**Design of digital IIR filters**:- Comparison with FIR filters, Review of Analog filters, Butterworth, Chebyshev approximations, Frequency transformation, Design of digital IIR filters using Bilinear transformation method, Impulse Invariant transformation method, Pole zero placement method, Matched Z transform (MZT) method.	10	**CO5**
6	**Recent trends in DSP system design**: - Introduction, Architecture of TMS 320C54X, CPU, Arithmetic logic unit, Multiplier/Adder unit, Engineering applications of DSP processors. Introduction to adaptive filters: -Need of Adaptive filter and its application areas, Least mean square (LMS) filter, Recursive least square(RLS) filter.	08	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Oppenheim, Schafer, "Discrete-Time Signal Processing", PHI,3rd edition, 2009.
2. John G. Proakis, "Digital Signal Processing",Pearson ,4th edition, 2007.
3. Sanjit K. Mitra, "Digital Signal Processing", McGraw Hill, 4nd edition, 2013.
4. Emmanuel Ifeachor, "Digital Signal Processing: A Practical Approach", PHI,2nd edition, 2001.
5. Vinay Ingale, "Digital signal processing using MATLAB", Cengage, 3rd edition, 2012.
6. Richard Lyons, "Understanding Digital Signal Processing" PHI, 1st edition, 2001.

Reference Books:

1. Thomas J. Cavicchi, "Digital Signal Processing" Wiley, 1st edition, 2009.
2. B. Venkataramani, M Bhaskar, "Digital Signal Processors", McGraw Hill, 2ndedition,2010.
3. Chi-Tsong Chen, "Digital Signal Processing: Spectral Computation", Oxford, 1stedition, 2007.
4. Dr.Shaila D. Apte, "Digital Signal Processing" Wiley, 2nd edition, 2009.
5. Robert A. Schilling," Introduction to Digital Signal Processing using MATLAB", Cengage, 2nd edition, 2012.
6. Ramesh Babu, "Digital Signal Processing" Scitech, 4thedition, 2011.
7. Monson H. Hayes, "Schaums Outline of Digital Signal Processing", McGraw Hill, 2ndedition,2010.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC605	Advanced Control System	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC605	Advanced Control System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC605	Advanced Control System	3
Course Objectives	To make students understand - 1. the concept of nonlinear control system, and different linearization methods to linearize the nonlinear system. 2. the concept of sliding mode control and its features. 3. the stability analysis of nonlinear control system through describing function and Lyapunov's method. 4. the concept of Internal Model Control and its application in control engineering 5. the importance of adaptive control system with their different types in control engineering as well as in process industries 6. the basic concept of Optimal Control.	
Course Outcomes	The Students will be able to - 1. Differentiate linear and nonlinear system, study characteristics of common physical nonlinearities. 2. Perform linearization of the nonlinear systems by using linearization techniques. 3. Construct phase-plane trajectories, study behavior of limit cycle and concept of sliding mode control. 4. Investigate the stability of nonlinear system by describing function method. 5. Investigate the stability of nonlinear system by Lyapunov's method 6. Design and develop the IMC structure for particular system with Uncertainty and Disturbances.	

Details of Syllabus:

Prerequisite: Knowledge of Linear algebra, Fourier Series, and Nyquist stability criterion.

Module	Contents	Hrs	CO mapping
1	**Nonlinear Control Systems** Definition of nonlinear systems, Difference between linear and nonlinear systems, characteristics of nonlinear systems, Common physical nonlinearities.	02	**CO1**
2	**Linearization Methods** Jacobian Linearization, Concept of relative degree, feedback linearization for systems with no internal dynamics.	02	**CO2**

3	**Phase plane Analysis** Basic concepts, phase trajectories, phase portrait, Constructing phase portraits by analytical method, Graphical Method -Delta Method Singular points and their classification, limit cycles and behaviour of limit cycles. Introduction to Sliding Mode Control**.**	08	**CO3**
4	**Describing Function Analysis** Describing Function Fundamentals, Describing Functions of saturation, dead zone, relay and their combinations, Stability analysis of nonlinear systems via describing function method.	08	**CO4**
5	**Lyapunov Stability Analysis** Stability of equilibria, Asymptotic stability, Lyapunov stability theorems, Stability analysis of linear systems, Construction of Lyapunov functions using Krasovskii method and variable gradient method.	08	**CO5**
6	**Internal Model Control** Introduction to Model-Based Control, Open loop controller Design, Model Uncertainty and Disturbances, Development of IMC structure, IMC-Based PID Controller Design	08	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. I. J. Nagrath and M. Gopal, Control System Engineering, 3rd Edition, New Age International (P) Ltd., Publishers - 2000.
2. K. Ogata, Modern Control Engineering, Prentice Hall of India, 4th edition, 2002.
3. Dr. K.P. Mohandas, "Modern Control Engineering", revised edition, Sanguine Publishers, Bangalore, 2006.

Reference Books:

1. Gene F. Franklin, J David Powell, Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 5th edition Pearson Educations.
2. Shankar Sastry, Marc Bodson, "Adaptive Control", Prentice Hall of India (P) Ltd., 1993.
3. John Doyle, Bruce Francis, Allen Tannenbaum, "Feedback Control Theory".
4. Pierre R. Belanger, "Control Engineering", Saunders college Publishing.

5. Norman Nise, “Control System Engineering”, 4th edition Wiley International Edition.
6. Christopher Edwards, Sarah K. Spurgeon, “Sliding Mode control: Theory and Application”, 1998.
7. Karl J. Astrom, B. Wittenmark, “Adaptive Control”, 2nd Edition, Pearson Education Asia, First Indian Reprint, 2001
8. Stanislaw H. Zak, “Systems and Control”, Indian Edition, Oxford University Press, 2003.
9. Donald E. Kirk, “Optimal Control Theory- An Introduction”,
10. M. Gopal, “Modern Control System Theory”, Wiley Eastern Ltd., New Delhi.

Sub code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pra	Tut.	Theory	Pract.	Tut.	Total
ISDLO6021	**Material Science**	3	-	-	3	-	-	3

Sub code	Subject Name	Examination Scheme							
		Theory Marks 100							
		Internal Assessment(20)			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test2	Avg.					
ISDLO6021	**Material Science**	20	20	20	80	-	-	-	100

Subject Code	**Subject Name**	**Credits**
ISDLO 6021	**Material Science**	**3**
Course Objectives	1. To understand the fundamentals of Material Science and Metallurgy. 2. To create awareness about the different mechanical testing in industry. 3. To determine the mechanical properties of metal, non-metal and alloys.	
Course Outcomes	The students will be able to 1. Classify and brief the properties of materials. 2. Describe about the mechanical testing. 3. Explain structure of materials. 4. Acquire knowledge about heat treatment of steel 5. Examine micro-macro metals. 6. Analyze different non ferrous alloys	

Details of Syllabus :

Prerequisite: Knowledge of metals ,non-metals and basic physics.

Module	Content	Hrs.	CO Mapping
1	**Classification and properties of material** Metal, non-metal such as ceramic, plastic and polymers, composite material Structure of material: Structure, general relationship of structure level to various engineering properties, atomic structure, bonding in solid, atomic arrangement in solid, crystal structure of metal, space lattice, unit cell, indexing of lattice plane and direction, plastic deformation, mechanism, deformation of single crystal and polycrystalline metals, imperfection in crystal, dislocation theory of slippage, work hardening, strengthening mechanism in	06	**CO1**
2	**Mechanical Testing** Tension test, engineering and true stress-strain curves, evaluation of properties, ductility, brittleness and toughness. Types of engineering stress-strain curve, compression test. Hardness testings- Brinell hardness Test, Poldi hardness Test, Rockwell hardness Test, Vickers hardness Test. Durometers, micro hardness. Relation among the various hardness test and hardness to tensile	06	**CO2**
3	**Equilibrium diagrams:** Related terms and their definitions, construction, common types of equilibrium diagrams, rules of solid solubility, Gibb's phase rules and non-equilibrium cooling. Plane carbon steel, iron-carbon phase diagram, classification of iron carbon alloys, classification, properties & application of steel. Alloy steel: effects of alloying element, function and uses of alloying elements.	06	**CO3**
4	**Heat transfer of steel:** Principal of heat treatment, phase transformation in steel during heating, transformation of Austenite during cooling, time-temperature transformation diagram, critical cooling rate, continuous transformation diagram, Heat treatment Process: annealing, normalizing, hardening, tempering, and case hardening, Hardenability of steel, significance of hardenability, the jominy-end quench test, other hardening heat treatment such as hardening, tempering, annealing.	06	**CO4**

5	**Macro and micro examination of metals** Macro examination: Specimen preparation, Sulphar painting, flow lines, welded section, Micro examination: Grinding, polishing, etching, optical metallurgical microscopy. Cast Iron: Classification, grey and white cast iron, modular and ductile iron, malleable cast iron, alloyed cast iron, effects of various parameter on structure and properties of cast iron, Application and heat treatment of cast iron.	06	**CO5**
6	**Engineering non-ferrous alloys** Brass, Bronze, Tin, Aluminum, Silicon, Beryllium bronze, Copper nickel alloy, aluminum alloys, titanium and its alloy, solder and bearing material, Common applications and some specification of various non-ferrous alloys in field such as 1. Die casting industry, 2. Automobile 3. Aircraft industry	06	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books :

1. Davis H.E. Trcxell G.E. &Wickocil C.T., "Testing of Engg. Materials", McGrawHill Book Co. Inc.
2. Smith W. F.,:"Principles of material science", Addison Welsey Publishing Co. Inc
3. V. D. Kodgire,:" Material Science and Metallurgy for engineers", Everest publishing House, Pune
4. Van Valck L.H. ,:"Principle of material science and engineering", Addison Wesley Publication Co. Inc.
5. B. K. Agrawal ,:" Introduction to engineering materials", Tata Mcgraw Hill Co. Ltd

Reference Books :

1. ASM Handbook : Surface Engineering Volume 5.
2. TME Handbook : Material, Finishing and coating Volume 3.

Subject code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ISDL06022	**Computer Organization and Architecture**	3	-	-	3	-	-	3

Subject code	Subject Name	Examination Scheme							
		Theory (out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg					
ISDL06022	**Computer Organization and Architecture**	20	20	20	80	-	-	-	**100**

Subject Code	Subject Name	Credits
ISDL06022	**Computer Organization and Architecture**	3
Course Objectives	1. To conceptualize the basics of organizational and architectural issues of a digital computer. 2. To analyse performance issues in processor and memory design of a digital computer. 3. To understand various data transfer techniques in digital computer. 4. To analyse processor performance improvement using instruction level parallelism.	
Course Outcomes	The students will be able to: 1. To describe basic structure and operation of a digital computer. 2. To design fixed-point and floating-point addition, subtraction, multiplication & division and other arithmetic unit algorithms. 3. To describe the different ways of communicating with I/O devices and standard I/O interfaces. 4. To analyze the hierarchical memory system including cache memories and virtual memory. 5. To describe pipelining and its Hazards 6. To Explain the Pentium processor Hardware design	

Details of Syllabus :

Module	Topics	Hrs.	CO Mapping
1	**Basic Structure of Computers**: Functional UNIT computer, Difference between CO & CA. System Bus, Data Types, Instruction Cycle, Instruction cycle with interrupt	04	CO1
2	**Computer Arithmetic Introduction:** Fixed Point Representation, Floating - Point Representation (IEEE-754) Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations.	08	CO2
3	**Micro Programmed Control:** Control Memory, micro code Sequencing, Micro program Examples, Functional description of Control Unit, Hard Wired Control unit, Micro programmed Control unit.	06	CO3
4	**The Memory System:** Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Memory hierarchy, Cache Memories organization, Virtual Memories, Introduction to RAID basic structure. Input-Output Organization: Peripheral Devices, Input-Output Interface, Direct Memory Access, Input-Output Processor (IOP), Serial Communication; Introduction to Interconnect (PCI) Bus.	09	CO4
5	**Pipeline And Vector Processing:** Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline and Pipeline Hazards.	05	CO5
6	**Case Study :Pentium architecture** Overview, Bus operations , Pipelining, Branch Prediction , Instruction and Data Cache ,Floating Point Unit	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

1. Question paper will comprise of 1 compulsory question of 10 marks and 5 questions, each carrying 20 marks, out of which 3 questions need to be solved.
2. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books :

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw-Hill.
2. John P. Hayes, “Computer Architecture and Organization”, Third Edition.
3. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Eighth Edition, Pearson.

Reference Books:

1. B. Govindarajulu, “Computer Architecture and Organization: Design Principles and Applications”, Second Edition, Tata McGraw-Hill.
2. Dr. M. Usha and T. S. Srikanth, “Computer System Architecture and Organization”, First Edition, Wiley-India.
3. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Fifth Edition,Penram.
4. The Intel Family Of Microprocessors: Hardware and Software Principles and Applications Author: James L. Antonakos

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO6023	Bio-Sensors and Signal Processing	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination Scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test 1	Test2	Avg.					
ISDLO6023	Bio-Sensors and Signal Processing	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO6023	Bio-Sensors and Signal Processing	3
Course objectives	1. To provide basic knowledge of various bio-sensors and their uses in biomedical applications. 2. To provide understanding of principle and operation of different types of bio-sensors like potentiometric, optical and amperiometric sensors. 3. To introduce the students to basic signal processing methods used in bio-signal measurement and analysis.	
Course Outcomes	Students would be able 1. To describe the basic concept behind bioelectric phenomena. 2. To classify the different types of bio-sensors and describe their characteristics. 3. To distinguish between the different biosensors used for physical and chemical measurands. 4. To explain the various types of transducers found in biosensors and their significance. 5. To explain about the various basic signal processing techniques used in bio-signal acquisition and analysis. 6. To apply the appropriate biosensor for different applications.	

Details of Syllabus :

Prerequisite: Knowledge about bio-signals and their specifications, Knowledge about the basic working principle of various transducers

Module	Contents	Hrs	CO Mapping
1	**Bioelectricity and Bio-electric Phenomena** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism and circuit processing. Electrode theory, electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, electrical conductivity of electrode jellies and creams.	04	CO1
2	**Introduction to biological sensors** Sensor architecture and Classification of biosensors: Medically significant measurands, functional specifications of medical sensors; Bio-sensor characteristics: linearity, repeatability, hysteresis, drift; Bio-sensor models in the time & frequency domains.	04	CO2
3	**Physical and Chemical Biosensors** Bio-sensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and bio potentials. Bio-sensors for measurement of chemicals: Potentiometric sensors, ion selective electrodes, Amperometric sensors, Clark Electrode biosensors, Catalytic biosensors, Immuno-sensors.	09	CO3
4	**Transducers in Biosensors** Various types of transducers; principles and applications - Resistive, Capacitive, Inductive, Photoelectric, piezoelectric, mechanical and molecular electronics based transducers in biosensors. Chemiluminiscene - based biosensors, Liquid and solid ion exchange membrane electrode, Enzyme electrode, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors in biomedical field.	09	CO4
5	**Bio-signal Acquisition and Processing** Measuring ultra-small signals, noise. Electrical signals produced by cells, Various types of signal processing techniques used for bio-signals.	05	CO5
6	**Applications of Biosensors** Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food, Low cost-biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.	05	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.

5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Richard S.C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications", John Wiley & Sons, 1992.
2. A.P.F. Turner, I. Karube & G.S. Wilson, "Biosensors: Fundamentals & Applications", Oxford University Press, Oxford, 1987.
3. Rangan C.S., Sarma G.R., and Mani V.S.V., "Instrumentation devices and system", Tata McGraw Hill Publishing Company limited, New Delhi, 2006.
4. John G.Webster, "Medical Instrumentation: Application and Design", John willey and sons, 1999.
5. Jacob Kline, "Handbook of Bio Medical Engineering", Academic press Inc., Sandiego, 1988.

Reference Books:

1. Richard Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
2. Ernest O. Doeblin: Measurement Systems, Application and Design, McGraw-Hill, 1985.
3. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.

Subject code	Subject Name	Teaching Scheme		Credit Assigned		
		Theory	Pract. / Tut.	Theory	Pract. / Tut.	Total
ISDL06024	**Nuclear Instrumentation**	3	-	3	-	3

Sub Code	**Subject Name**	**Examination Scheme**							
		Theory(out of 100)				**Term work**	**Pract. and Oral**	**Oral**	**Total**
		Internal Assessment			**End sem Exam**				
		Test1	**Test2**	**Avg.**					
ISDLO6024	**Nuclear Instrumentation**	20	20	20	80	-	-	-	100

Subject Code	**Subject Name**	**Credits**
ISDL06024	**Nuclear Instrumentation**	**3**
Course Objectives	1. To introduce the basic concept of radioactivity, properties of alpha, beta and gamma rays and study various radiation detectors 2. To study the electronics and counting systems 3. To study applications of nuclear instrumentation in medicines, Industry and in Agriculture.	
Course Outcomes	Students would be able 1. To explain basics of radioactivity, properties of alpha, beta and gamma rays. 2. To compare construction and working of various radiation detectors. 3. To describe electronics and counting systems used in nuclear instrumentation to process nuclear detector signal. 4. To list various factors influencing resolution of gamma energy spectrum and specifications of nuclear ADC. 5. To apply nuclear radiation detectors in medicine 6. To apply nuclear instrumentation in industry.	

Pre-Requisites: Students should know the basics of digital, analog electronics and signal conditioning circuits which is required in understanding the working of nuclear instruments.

Module	Topics	Hrs.	CO
1	**Radioactivity** : General properties of Nucleus, Radioactivity, Nature of Nuclear Radiation's, Properties of Alpha, Beta and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half-life period, radioactive series, Isotopes and Isobars, Various effects-photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.	06	**CO1**
2	**Radiation Detectors** : Techniques for radiation detection, Detectors for Alpha, beta and gamma rays, Detector classification, Gas filled detectors - volt ampere characteristics, Ionization chamber, Proportional counter, Geiger Muller counter, Designing features, Scintillation detectors, Photomultiplier tube, dark currents, pulse resolving power, efficiency of detection, Solid state detectors (Lithium ion drifted – Si-Li, Ge-Li, Diffused junction, surface barrier detectors)	12	**CO2**
3	**Electronics and Counting systems:** Pre-amp, shaping amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, peak stretchers, photon counting system block diagram, single channel analyser SCA (pulse height analyser - PHA), Coincidence detection	04	**CO3**
4	**Nuclear Spectroscopy systems:** Factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, Multichannel analysers (MCA), Role of Nuclear ADC's – performance parameters.	04	**CO4**
5	**Radiation Monitors &Application in Medicines**: Radiation uptake studies – block diagram and design features. Gamma camera – design, block diagram, medical usage. Nuclear instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).	06	**CO5**
6	**Industrial Applications**: Basic Nuclear Instrumentation system – block diagram, Personal monitors like Thermo Luminescence Detectors (TLD). Dosimeters, Tele-detectors. Nuclear Instrumentation for power reactor. Nuclear Instrumentation for Toxic fluid tank level measurement, weighing, thickness gauges, Agriculture applications like food irradiation, Underground Piping Leak detection, water content measurement etc.	04	**CO6**

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

4. G.F. Knoll, "Radiation Detection & Measurement", 2nd edition, John Wiley & Sons, 1998.
5. P.W. Nicholson, "Nuclear Electronics", John Wiley, 1998.
6. S.S. Kapoor & V.S. Ramamurthy, "Nuclear Radiation Detectors", Wiley Easter Limited, 1986.

Reference Books:

1. Gaur & Gupta, "Engineering Physics", Danpat Rai & Sons, 2001.
2. Irvin Kaplan, "Nuclear Physics", Narosa, 1987.
3. M.N. Avdhamule & P.G. Kshirsagar, "Engineering Physics", S.Chand & Co., 2001.
4. R.M. Singru, "Introduction to Experimental Nuclear Physics", Wiley Eastern Pvt. Ltd., 1974.
5. Hand Book of Nuclear Medical Instruments, Edited by B.R.Bairi, Balvinder Singh, N.C. Rathod, P.V. Narurkar, TMH Publishing New Delhi, 1974.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL601	Process Instrumentation System- Lab Practice	Theory	Pract	Tut	Theory	Pract	Tut	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test 1	Test 2	Avg					
ISL 601	Process Instrumentation System- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL 601	Process Instrumentation System- Lab Practice	1
Course objective	1. To make the students to familiar with different Process Dynamics & process control actions. 2. Students are expected to learn classification & working of Controllers & Tuning Methods. 3. Students are expected to understand various control schemes. 4. To familiarize concept of Multivariable Control & Discrete state process control Requirement.	
Course Outcome	The students will be able to 1. Understand & Learn Process Control Terminologies, Process Dynamics & their mathematical model. 2. Understand different types of control actions & their selection. 3. Learn Features & Classify controllers like electronic, pneumatic and hydraulic & their Tuning Techniques. 4. Learn various process control schemes & their applications and selection. 5. Understand Multivariable Control systems & their Interaction 6. The students will be able to develop relay logic for various processes & symbols.	

Syllabus: Same as that of Subject ISC601 Process Instrumentation System.

List of Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Study Features & operation of ON-OFF Controller & its Application.	CO3
2	Familiarization of various control actions (pure and composite) using PID controller with Real time Process OR Simulator.	CO2
3	Testing Features, specifications, wiring & operation of an electronic PID controller.	CO3
4	Tuning of an Electronic PID controller.	CO3
5	Analysis of Feedback Control using Level / Pressure / Flow / Temperature Control Loop.	CO4
6	Study Feed Forward Control system using Temperature control Loop.	CO4
7	Study of split range control system using Pressure Control set up.	CO4
8	Study of Ratio control system using Flow Control Loop.	CO4
9	Study of Cascade control system.	CO4
10	Study Dynamic behaviour of First Order Hydraulic system.	CO1
11	Study Dynamic behaviour of Second Order Hydraulic system.	CO1
12	Development & Implementation of Relay Ladder Logic for Discrete state process control system.	CO6
13	Assignment on Relative gain analysis.	CO5

Note:

*Factory / Industrial visit is suggested to understand the Practical knowledge of the subject.

Oral Examination:
Oral examination will be based on Laboratory work & Entire syllabus.

Term Work:
Term work shall consist of minimum eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs/assignments / journal)	: 10 Marks
Attendance (Class Room & Laboratory)	: 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Sub code	Subjec tName	Teaching Scheme(Hrs)			CreditsAssigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL602	**Industrial Data Communication-Lab Practice**	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination Scheme							
		Theory(out of100)							
		Internal Assessment(out of20)			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test 2	Avg.					
ISL602	**Industrial Data Communication-Lab Practice**	-	-	-	-	25	-	-	25

Subject Code	**Subject Name**	**Credits**
ISL602	**Industrial Data Communication-Lab Practice**	**1**
Course Objectives	1. To expose the students to the basics of communication 2. To create awareness about the the OSI refrence model . 3. To acquaint the students with the different types of networks at various levels such as sensor level,device network and control network. 4. To provide sufficient knowledge about the HART. 5. To impart the fundamentals of foundation field bus.	
Course Outcomes	The students will be able to 1. Explain the importance of modulation in communication. 2. Examine the importance of OSI,TCP/IP model,various networking components. 3. Compare the different types of networks at various levels of field communication. 4. Use HART for communication 5. Establish Foundation fieldbus communication. 6. Investigate the various wireless devices.	

Syllabus: Same as that of Subject ISC602 **Industrial Data Communication**.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	To Study the various modulation techniques(AM,FM,PWM)	CO1
2	To Study the networking components	CO2
3	To understand LAN	CO3
4	To study HART Protocol.	CO4
5	To calibrate various transmitters using HART	CO4
6	To study the components of Foundation Field Bus.	CO5
7	To study Zigbee	CO6
8	Assignment on MODBUS protocol.	CO3
9	Assignment onEthernet.	CO3
10	Assignment on application of IOT	CO6

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL603	**Electrical Machines and Drives – Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg					
ISL603	**Electrical Machines and Drives– Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL603	**Electrical Machines and Drives – Lab Practice**	1
Course Objectives	1. To learn operation & speed control methods of electric motors. 2. To learn operations of semiconductor devices & their applications.	
Course Outcomes	Students will be able to 1. Perform speed control of DC motor by different methods 2. Describe working principle of three-phase and single -phase induction motors. 3. Study the characteristics of semiconductor devices 4. Use semiconductor devices to build different circuits.. 5. Apply drives for speed control of DC motor. 6. Discuss the working of AC drive for I.M.	

Syllabus same as that of subject ISC603 Electrical Machines and Drives

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Speed control methods of DC motor	CO1
2	Starting of 3-phase IM by DOL/Autotransformer/rotor resistance method	CO2
3	Study of different types of fractional horse power motor	CO2
4	Plot V-I characteristics of SCR	CO3
5	Plot V-I characteristics of Triac	CO3

6	Triac based AC power control circuit.	**CO3**
7	Half wave & full wave controlled rectifier	**CO4**
8	SCR Based Inverter	**CO4**
9	MOSFET/IGBT Based Inverter	**CO4**
10	DC motor speed control drive	**CO5**
11	AC drive for I.M.	**CO6**

**Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum Eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL604	**Digital Signal Processing- Lab Practice**	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL604	**Digital Signal Processing- Lab Practice**	-	-	-	-	25	25	-	50

Subject Code	Subject Name	credits
ISL604	**Digital Signal Processing- Lab Practice**	1
Course objectives	1. Study simulation software platform for digital signal processing and Plot different type of signals. 2. To understand the concept of linear, circular convolution, correlation and simulate it by computer software. 3. To understand Fourier transform and its algorithms such as FFT and IFFT and simulate it. 4. To design and implement filters both FIR and IIR using computer simulation. 5. To study DSP processors, adaptive filters and their applications.	
Course Outcomes	Students will be able to - 1. Verify sampling theorem using simulation software. 2. Demonstrate DT Fourier analysis, convolution and correlation concept using simulation software. 3. Perform Fast Fourier Transform of signals. 4. Design and implement FIR and IIR filters using computer simulation software platform. 5. Realize filters by direct form I, II, Cascade and Parallel form. 6. Study DSP processors, Adaptive filters and their applications.	

Syllabus same as that of subject ISC604 Digital Signal Processing

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Generation of DT sinusoidal signal and verification of sampling theorem.	**CO1**
2	Finding the Impulse response of the system.	**CO2**
3	Program for finding linear convolution, Circular convolution, and linear convolution by using circular convolution technique.sequences.	**CO2**
4	Program for finding correlation (auto and cross).	**CO2**
5	Computation of N point DFT of a given sequence and to plot magnitude and	**CO3**

6	Computing circular convolution by DFT and IDFT of signals.	**CO3**
7	Implementation of FFT algorithms (DIT, DIF) etc.	**CO3**
8	Designing of FIR filter using windowing technique.	**CO4**
9	Design and Implement IIR filter to meet given specifications.	**CO4**
10	Assignment on Filter Implementation direct form I, II, Cascade, Parallel	**CO5**
11	Study of Adaptive filters such as LMS, RLS and its applications.	**CO6**
12	Study of DSP processor and its applications.	**CO6**

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum Eight experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL605	**Advanced Control System - Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL605	**Advanced Control System - Lab Practice**	-	-	-	-	25	25	-	50

Subject Code	Subject Name	credits
ISL605	**Advanced Control System- Lab Practice**	1
Course objectives	1. Students should be able to examine stability of limit cycle 2. The students should be able to examine stability of nonlinear system using DF techniques and Lyapunov's functions 3. The students should be able to design the IMC structure. 4. The students should able to examine the stability using sliding mode control 5. Students can be able to optimize the any particular system.	
Course Outcomes	Students will be able to 1. Construct the phase-plane trajectories using Delta Method. 2. Classify stability of limit cycle as per obtained response of the system 3. Derive DF for common nonlinearities and investigate stability of system with limit cycle. 4. Determine Lyapunov's function and also able to investigate the stability of nonlinear system 5. Design the IMC structure and apply same for stability analysis. 6. Design IMC based PID controller.	

Syllabus same as that of subject ISC605 Advanced Control System

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Construct the trajectory for system represented by second order differential equation and for any initial condition by using Delta Method.	CO1
2	Study behaviour of limit cycle with the help of Vander Pol's equation.	CO2
3	Derivation of DF for nonlinearities – relay with saturation, relay with dead-zone, dead-zone and saturation etc.	CO3
4	Investigate the stability of system with nonlinearities – relay, saturation, dead-zone and existence of limit cycle using DF technique.	CO3
5	Verify Sylvester theorem for the definiteness of the Lyapunov Function.	CO4

6	Determine the stability of the system and construct the Lyapunov function for Linear Time invariant system	**CO4**
7	By using Krasovskii method determine the stability of the system and construct the Lyapunov function.	**CO4**
8	By using Variable Gradient method determine the stability of the nonlinear system	**CO4**
9	Effect of filter tuning parameter on step response of the first and second order systems	**CO5**
10	Design of IMC controller for a system subject to step input.	**CO5**
11	Design of IMC controller for a system subject to ramp input.	**CO5**
12	Design of IMC based PID controller.	**CO6**
13	Design of IMC controller for delay and non-minimum phase systems.	**CO5**

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL606	Mini Project-II	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100) Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL606	Mini Project-II	-	-	-	-	25#	-	-	25

Mini Project will be based on internal oral and project report.

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned from the courses studied to solve/implement predefined challenging practical problems of interdisciplinary nature .The students undergo various laboratory/tutorial/simulation laboratory courses in which they do experimentation based on the curriculum requirement. The students should be encouraged to take challenging problems of interdisciplinary nature. The emphasis should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning.
- Learn the behavioral science by working in a group.

The group may be of maximum four (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The TW marks will be allocated based on the internal examination of demonstration in front of the examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the completed task.

The students may use this opportunity to learn different design techniques in instrumentation, control and electronics. This can be achieved by making a proper selection of Mini Project.

AC 05/05/2018
Item No. 4.56

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Instrumentation Engineering

Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

From Co-Coordinator's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai, has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's), course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of Studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enable a much-required shift in focus from teacher-centric to learner-centric education. Since the workload estimated is based on the investment of time in learning, not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. **Choice Based Credit and Grading System** were implemented for First Year of Engineering (Undergraduate) from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year of Engineering (Undergraduate) in the academic year 2017-2018 and so on.

Dr. Suresh K. Ukarande
Coordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and to achieve recognition of the institution or program meeting certain specified standards. The main-focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as a Chairman, Board of Studies in Instrumentation Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Instrumentation Engineering, more than ten senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs and POs of undergraduate program in Instrumentation Engineering are listed below;

Program Educational Objectives (PEOs)

- Graduates will have successful career in industry or pursue higher studies to meet future challenges of technological development.
- Graduates will develop analytical and logical skills that enable them to analyze and design Instrumentation and Control Systems.
- Graduates will achieve professional skills to expose themselves by giving an opportunity as an individual as well as team.
- Graduates will undertake research activities in emerging multidisciplinary fields.

Program Outcomes (POs)

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Dr. S. R. Deore,
Chairman,
Board of Studies in Electrical Engineering,
Member - Academic Council
University of Mumbai

Program Structure for
BE Instrumentation Engineering
University of Mumbai
(With Effect from 2019-20)

Scheme for Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC701	Industrial Process Control	4	-	-	4	-	-	4
ISC702	Biomedical Instrumentation	4	-	-	4	-	-	4
ISC703	Industrial Automation	4	-	-	4	-	-	4
ISDLO703X	Department Level Optional Course III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	-	3
ISL701	Industrial Process Control – Lab Practice	-	2	-	-	1	-	1
ISL702	Biomedical Instrumentation – Lab Practice	-	2	-	-	1	-	1
ISL703	Industrial Automation – Lab Practice	-	2	-	-	1	-	1
ISL704	Department Level Optional Course III – Lab Practice	-	2	-	-	1	-	1
ISL705	Project I	-	6	-	-	3	-	3
Total		**19**	**14**	**-**	**19**	**07**	**-**	**26**

Examination Scheme for Semester VII

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC701	Industrial Process Control	80	20	-	-	-	100
ISC702	Biomedical Instrumentation	80	20	-	-	-	100
ISC703	Industrial Automation	80	20	-	-	-	100
ISDLO703X	Department Level Optional Course III	80	20	-	-	-	100
ILO701X	Institute Level Optional Course I	80	20	-	-	-	100
ISL701	Industrial Process Control – Lab Practice	-	-	25	25	-	50
ISL702	Biomedical Instrumentation – Lab Practice	-	-	25	25	-	50
ISL703	Industrial Automation – Lab Practice	-	-	25	25	-	50
ISL704	Department Level Optional Course III – Lab Practice	-	-	25	25	-	50
ISL705	Project I	-	-	50	50	-	100
	Total	**400**	**100**	**150**	**150**	**-**	**800**

Program Structure for
BE Instrumentation Engineering
University of Mumbai
(With Effect from 2019-20)

Scheme for Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC801	Instrumentation Project Documentation and Execution	4	-	-	4	-	-	4
ISC802	Instrument and System design	4	-	-	4	-	-	4
ISDLO804X	Department Level Optional Course IV	4	-	-	4	-	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	-	3
ISL801	Instrumentation Project Documentation and Execution	-	2	-	-	1	-	1
ISL802	Instrument and System design	-	2	-	-	1	-	1
ISL803	Department Level Optional Course IV – Lab Practice	-	2	-	-	1	-	1
ISL804	Project II	-	12	-	-	6	-	6
Total		**15**	**18**	**-**	**15**	**09**	**-**	**24**

Examination Scheme for Semester VIII

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC801	Instrumentation Project Documentation and Execution	80	20	-	-	-	100
ISC802	Instrument and System design	80	20	-	-	-	100
ISDLO804X	Department Level Optional Course IV	80	20	-	-	-	100
ILO802X	Institute Level Optional Course II	80	20	-	-	-	100
ISL801	Instrumentation Project Documentation and Execution	-	-	25	25	-	50
ISL802	Instrument and System design	-	-	25	25	-	50
ISL803	Department Level Optional Course IV– Lab Practice	-	-	25	25	-	50
ISL804	Project II	-	-	100	50	-	150
Total		**320**	**80**	**175**	**125**	**-**	**700**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC701	Industrial Process Control	4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks (100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment (20)			End Sem Exam				
		Test1	Test2	Avg.					
ISC701	Industrial Process Control	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC701	Industrial Process Control	4
Course objectives	1. To impart the knowledge of different industrial unit operations. 2. To make the students capable to design and develop instrumentation and control schemes for industrial processes. 3. To give them overview of various process industries, hazardous areas and their classification.	
Course Outcomes	The students will be able to: 1. Explain working and control of various heat transfer unit operations 2. Explain working and control of various heat and mass transfer unit operations 3. Explain the miscellaneous process equipment and their control 4. Describe the processes of various continuous process industries and instrumentation involved in them. 5. Describe the processes of various batch process industries and instrumentation involved in them. 6. Classify hazardous areas in the industry.	

Details of Syllabus:

Prerequisite: Temperature, flow, pressure sensors, fundamentals of process instrumentation and control, control schemes like feedback, feedforward, cascade, split range, selective etc., basics of unit operations.

Module	Content	Hrs	CO Mapping
1	**Control System for Heat transfer unit operations:** Introduction to unit operations and processes, concept of heat transfers and energy balance, heat transfer coefficient. **Heat exchanger control:** classification as per fluid flow arrangement and construction, feedback, feed-forward, bypass control schemes, fouling in heat exchangers. **Boiler control:** Types, working and operation of boilers, Terms related- Shrink and swell effect and excess oxygen, boiler efficiency, boiler performance terminology. Boiler controls- Drum level control- Single, two and three elements, and Combustion Control-Type 1, 2, 3 and 4, steam temperature control, boiler pressure control, furnace draft control, Burner Management System. **Evaporator control:** Evaporator terminologies, Types of Evaporator, mathematical model for evaporator, control systems for Evaporator – feedback, cascade, feed forward and selective control. **Furnace control:** Start- up heaters, fired re-boilers, process and safety controls.	13	CO1
2	**Control System for Heat and mass transfer unit operations:** **Distillation column:** Basic principle, Distillation equipment and its accessories. Batch and continuous distillation, Binary product distillation, multi-product distillation, side-draw product distillation column. Distillation column control strategies- Top and bottom product composition controls, Using chromatograph, Pressure controls, Vacuum distillation, Vapors recompression and pressure control, Feed controls- Column feed controls and Feed temperature control, economizer. **Dryer control:** Process of drying, types of dryer- Tray, Vacuum dryer, fluidized bed, Double drum dryer, rotary, turbo and spray, and their control strategies. **Crystallizers:** Process of crystallization, Super-saturation methods, types of crystallizer, control of evaporating crystallizer, cooling crystallizers, vacuum crystallizers. **Reactor control:** Reactor characteristics, runaway reaction, various schemes of temperature control of reactors.	12	CO2
3	**Miscellaneous process equipment:** **Compressor-** Classification, Phenomenon of Surge for centrifugal compressors, Methods of surge control for compressors. **Gas turbine-** Introduction, gas turbine layouts, closed cycle gas turbine, Engine controls.	05	CO3
4	**Continuous Process Industries:** **Refinery Industry:** Process flow diagram, separation, Treatment-Hydro-desulphurization unit, conversion methods- Fluid Catalytic Cracking, blending, sensors and control schemes.	07	CO4

	Iron and steel Industry: Process flow diagram, Sensors and Control schemes.		
5	**Batch Process Industries:** **Food processing:** Milk pasteurization. **Pharmaceutical industries**- Penicillin-G production, sensors and control schemes.	07	CO5
6	**Safety in Instrumentation control systems:** Area and material classification as per IEC and NEC standard, techniques used to reduce explosion hazards, intrinsic safety, and installation of intrinsically safe systems.	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.

2. Total 4 questions need to be solved.

3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of

   4 to 5 marks will be asked.

4. Remaining questions will be mixed in nature.

5. In question paper weight age of each module will be proportional to number of respective

   Lecture hours as mentioned in the syllabus.

Text Books:

1. W. L. McCabe and Julian Smith, "Unit operation and chemical engineering", Tata McGraw Hill, Sixth edition, 2001.
2. Bela G. Liptak, "Instrument engineers handbook - Process control", Chilton book company, third edition, 1995.
3. Bela G. Liptak, "Instrumentation in the processing industries", Chilton book company-first edition, 1973.

Reference Books:

1. Douglas M. Considine, "Process industrial instruments and controls handbook", McGraw Hill- 4th edition, 1993.
2. George T. Austin, "Shreve's chemical process industries", Mc-GrawHill- fifth edition, 1984.
3. George Stephenopoulos, "Chemical process control", PHI-1999.
4. David Lindsey, "Power Plant control and instrumentation – control of boilers HRSG", Institution of Engineering and Technology,
5. G.F. Gilman "Boiler Control Systems Engineering", ISA Publication, 2005,
6. A.M.Y.Razak, Industrial gas turbines Performance and operability", CRC Press Woodhead

Publishing Limited and CRC Press LLC, 2007.

Sub code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ISC702	Biomedical Instrumentation	4	-	-	4	-	-	4

Sub code	Subject Name	Examination Scheme							
		Theory (out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg					
ISC702	Biomedical Instrumentation	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC702	Biomedical Instrumentation	4
Course Objectives	To make students understand the Identification, classification, and working principle of various Biomedical Instruments used for Bio-potential measurement To make students understand the application of the various biomedical instruments in diagnosis, therapeutic and imaging fields.	
Course Outcomes	The students will be able 1. To identify various Bio-potential with their specifications and perform their measurements. 2. To discuss various Physiological systems and to identify their parameters and related measurements. 3. To explain the principle and working of various cardiovascular parameters and their measurement techniques with applications. 4. To relate between the different life support instruments and to describe their applications. 5. To distinguish between the various medical imaging techniques based on the principles and concepts involved in them. 6. To describe the significance of electrical safety in biomedical measurement.	

Module	Topics	Hrs.	CO Mapping
1	**Bio-Potentials and their Measurement:** Structure of Cell, Origin of Bio-potential, electrical activity of cell and its characteristics and specifications. Measurement of RMP and AP. Electrode-Electrolyte interface and types of bio-potential electrodes.	06	CO1
2	**Physiological Systems and Related Measurement:** • Respiratory system- Physiology of respiration and measurements of respiratory related parameters. • Nervous system- Nerve cell, neuronal communication, nerve-muscle physiology, CNS, PNS. Generation of EEG and study of its characteristics. Normal and abnormal EEG, evoked potential and epilepsy. • Muscular system- Generation of EMG signal, specification and measurement. • Cardiovascular system- Structure of Heart, Electrical and Mechanical activity of Heart, ECG measurements and Cardiac arrhythmias. • Design of ECG amplifier.	12	CO2
3	**Cardiovascular Measurement:** • Blood Pressure- Direct and Indirect types. • Blood Flow- Electromagnetic and Ultrasonic types. • Blood Volume- Types of Plethysmography. (Impedance, Capacitive and Photoelectric) • Cardiac Output- Flicks method, Dye-dilution and Thermo-dilution type. • Heart sound measurement.	08	CO3
4	**Life support Instruments:** • Patient monitoring system - Bedside monitors, Central nurse station • Pacemaker- Types of Pacemaker, mode of pacing and its application. • Defibrillator- AC and DC Defibrillators and their application. • Heart Lung machine and its application during surgery. • Hemodialysis system and the precautions to be taken during dialysis. • Ventilator system and its important parameters for monitoring	10	CO4
5	**Imaging Techniques: *** • X-Ray machine and its application. CT Scan- CT Number, Block Diagram, scanning system and application. • Ultrasound Imaging- Modes of scanning and their application. • MRI- Concepts and image generation, block diagram and its application. • Introduction to Functional imaging.	10	CO5
6	**Significance of Electrical Safety:** Physiological effects of electrical current, Shock Hazards from electrical equipment and methods of accident prevention.	02	CO6

*** A Hospital Visit is recommended for Imaging Techniques.**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1) Leslie Cromwell, "Biomedical Instrumentation and Measurements", 2nd Edition, Pearson Education, 1980.
2) John G. Webster, "Medical Instrumentation", John Wiley and Sons, 4th edition, 2010.
3) R. S. Khandpur, "Biomedical Instrumentation", TMH, 2004

Reference Books:

1) Richard Aston, "Principles of Biomedical Instrumentation and Instruments", PH, 1991.
2) Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", PHI/Pearson Education, 4th edition, 2001.
3) John E Hall, Gyton's Medical Physiology, 12th edition, 2011
4) L. E. Baker L. A. Geddes, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, 1991.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC703	Industrial Automation	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4		-	4

Sub Code	Subject Name	Examination scheme							
		Theory (100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End sem Exam				
		Test1	Test 2	Avg.					
ISC703	Industrial Automation	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC703	Industrial Automation	4
Course objective	• To impart knowledge about the fundamentals of automation and various automation systems used in industry. • To impart the knowledge about the architecture, working and applications of PLC, DCS and SCADA • To make the students understand the requirements of Safety Instrumented System (SIS).	
Course Outcome	The students will be able to 1. Describe automation, need, importance and applications in industry. 2. Identify components of PLC, and develop PLC ladder using instructions of PLC and design PLC based application by proper selection and sizing criteria 3. Explain evolution and architecture of DCS, hierarchical control in DCS, programming DCS through Function Block Diagram (FBD) method. 4. Describe SCADA architecture, communication in SCADA and develop any application based on SCADA along with GUI using SCADA software. 5. Explain database and alarm management system 6. Recognize the need of SIS and describe risk reduction methods.	

Details of Syllabus:

Prerequisite: Knowledge of Digital Electronics, Process Instrumentation and Control.

Module	Content	Hrs.	CO Mapping
1	**Automation Fundamentals** Automation, Need for automation and its importance, Types of automation, Automation applications, Expectations of automation. Process and factory automation. Types of plant and control – categories in industry, open loop and closed loop control functions, continuous processes, discrete processes, and mixed processes. Automation hierarchy – large control system hierarchy, data quantity & quality and hierarchical control. Control system architecture – evolution and current trends, comparison of different architectures.	04	**CO1**
2	**Programmable Logic Controller** **Hardware** Evolution of PLC, Definition, functions of PLC, Advantages, Architecture, working of PLC, Scan time, Types & Specifications. Safety PLC DI-DO-AI-AO examples and ratings, I/O modules, local and remote I/O expansion, special purpose modules, wiring diagrams of different I/O modules, communication modules, Memory & addressing- memory organization (system memory and application memory), I/O addressing, hardware to software interface. **Software** Development of Relay Logic Ladder Diagram, introduction to PLC Programming, programming devices, IEC standard PLC programming languages, LD programming-basic LD instructions, PLC Timers and Counters: Types and examples, data transfer & program control instructions, advanced PLC instructions, PID Control using PLC. **Case study:** PLC selection and configuration for any one process applications**.**	14	**CO2**
3	**Distributed Control System (DCS)** Introduction to DCS. Evolution of DCS, DCS flow sheet symbols, architecture of DCS. Controller, Input and output modules, Communication module, data highway, local I/O bus, Workstations, Specifications of DCS. Introduction of Hierarchical control of memory: Task listing, Higher and Lower computer level task. Supervisory computer tasks, DCS configuration, Supervisory computer functions, Control techniques, Supervisory Control Algorithm. DCS & Supervisory computer displays, advanced control Strategies, computer interface with DCS. DCS System integration with PLCs computer: HMI, Man machine interface sequencing, Supervisory control, and integration with PLC, personal computers and direct I/O, serial linkages, network linkages, link between networks. Introduction to DCS Programming, Function Block Diagram method for DCS programming.	12	**CO3**

4	**Supervisory Control and Data Acquisition (SCADA)** SCADA introduction, brief history of SCADA, elements of SCADA. Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Protocol Detail, Specifications of SCADA SCADA as a real time system Communications in SCADA- types & methods used, components, Protocol structure and Mediums used for communications. SCADA Development for any one typical application. Programming for GUI development using SCADA software.	10	**CO4**
5	**Database and Alarm Management, MES, ERP** Database management, Philosophies of Alarm Management, Alarm reporting, types of alarms generated and acceptance of alarms. Manufacturing Execution System , Enterprise Resource Planning, Integration with enterprise system.	04	**CO5**
6	**Safety Instrumented System (SIS)** Need for safety instrumentation- risk and risk reduction methods, hazards analysis. Process control systems and SIS. Safety Integrity Levels (SIL) and availability. Introduction to the international functional safety standard IEC 61508.	04	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Samuel M. Herb, “Understanding Distributed Processor Systems for Control”, ISA Publication, 1999.
2. Thomas Hughes, “Programmable Logic Controller”, ISA Publication, 2001.
3. Stuart A. Boyer, “SCADA supervisory control and data acquisition”, ISA Publication, 2010.
4. Gruhn and Cheddie, “Safety Shutdown Systems” – ISA, 1998,

Reference Books:

1. Poppovik Bhatkar, “Distributed Computer Control for Industrial Automation”, Dekkar Publication, 1990.
2. S.K. Singh, “Computer Aided Process Control”, Prentice Hall of India, 2004.
3. Krishna Kant, “Computer Based Process Control”, Prentice Hall of India
4. N.E. Battikha, “The Management of Control System: Justification and Technical Auditing”, ISA.

5. Gary Dunning, “Introduction to Programmable Logic controller”, Thomas Learning, edition, 2001.
6. John. W. Webb, Ronald A Reis, “Programmable Logic Controllers – Principles and Applications”, 3rd edition, Prentice Hall Inc., New Jersey, 1995.
7. Bela G. Liptak “Instrument engineer’s handbook- Process control” Chilton book company- 3rd edition.
8. D.J. Smith & K.G.L. Simpson, “Functional Safety: A Straightforward Guide to IEC61508 and Related Standards”, -Butterworth-Heinemann Publications.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO7031	Image Processing	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO7031	Image Processing	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO7031	Image Processing	4
Course Objectives	1. To explain basic principles of Image processing. 2. To apply time and frequency domain transformation method on 2D Images 3. To study different Image enhancement techniques in spatial and frequency domain. 4. To study Image restoration techniques to reduce the noise and recover original Image. 5. To study Lossy and lossless Image compression by different methods. 6. To study Image morphology and segmentation techniques to represent images into more meaningful and easier to analyze.	
Course Outcomes	Students will be able to - 1. Describe general terminology of Image processing. 2. Examine Images and their analysis by various transformation techniques. 3. Apply basic Image enhancement operations on Images. 4. Evaluate mathematical tools such as Image morphology and Image segmentation to extract various Image components. 5. Discuss Image compression methods 6. Discuss Image degradation and restoration model.	

Details of Syllabus:

Prerequisite: Knowledge of Fundamentals of Engineering Mathematics, Basic Operation with Matrices, Signals and Systems and Digital Signal Processing.

Module	Contents	Hrs	CO mapping
1	**Introduction to Image processing**: -Concept of Digital Image, Fundamental steps in Image processing, Components of Image processing systems, Elements of visual perception, Image formation model, Sampling and Quantization of Image, Relationships between pixels like neighbours of pixel, Adjacency, Connectivity, Distance measures, Translation, Scaling , Rotation and Perspective projection of Image.	08	CO1

2	**Image Transformation**: -Orthogonal and Orthonormal Function, 2D Discrete Fourier transform and its properties, Fast Fourier transform of Image, Discrete Cosine and Sine transform (2D), Walsh-Hadamard transform, Haar transform, Slant transform, Karhunen-Loeve transform, Introduction to Wavelet transform and its application.	07	CO2
3	**Image Enhancement**: -Image enhancement in spatial domain, Basic gray level transformation like Image Negatives, Log transformations, Power Law transformations, Contrast stretching, Gray level and Bit plane slicing, Histogram processing, Enhancement using Arithmetic/Logic operation, Smoothing spatial filters, Sharpening spatial filters, Image enhancement in frequency domain, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.	10	CO3
4	**Morphological Image Processing**: Logic operations of Binary Images, Dilation and Erosion, Opening and Closing, Hit or Miss transformation, Boundary extraction, Region filling, Extraction of connected component, Thinning, Thickening, Skeletons. **Image Segmentation**: Point, Line and Edge detection, Edge linking and boundary detection (Hough Transform), Thresholding, Region based segmentation. **Image Registration**: Introduction, Geometric transformation, Plane to plane transformation, Image Mapping models, Mutual Information, Entropy, Registration using MI, Introduction to Stereo Imaging	10	CO4
5	**Image Compression**: -Need of Image compression, Data redundancy, Image compression model, Difference between Lossy and Lossless compression, Image compression technique(Huffman, Arithmetic, Run length, LZW coding),Predictive coding(DPCM),JPEG and MPEG compression standard.	08	CO5
6	**Image Restoration**: -Image degradation/Restoration model, Noise models, Probability density function of important noises (Gaussian, Rayleigh, Gamma, Exponential, Uniform, Salt and Pepper), Restoration in presence of noise by spatial filtering (Mean, Median, Midpoint filter), Periodic noise reduction in frequency domain filtering (Band reject, Band pass, Notch filter), Point spread function, Inverse filtering, Weiner filtering.	05	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books.

1. Richard E. Woods, Rafael C. Gonzalez, “Digital Image Processing”, Pearson,3rd edition, 2012.
2. Jain A.K, “Fundamentals of Digital Image Processing”, Pearson,1st edition, 2015.
3. B. Chanda, D. Dutta Majumder, “Digital Image Processing and Analysis”,PHI, 2nd edition, 2011.

Reference Books

1.M. Sonka, Hlavac, “Image Processing, Analysis, and Machine Vision” Cengage,4th edition, 2014.
2. Tamal Bose, “Digital Signal and Image Processing”, Wiley, 1st edition,2003.
3. William K. Pratt,“Digital Image Processing”, Wiley, 4th edition, 2007.
4. Jayaraman , Veerakumar, Esakkirajan, “Digital Image Processing”, McGraw Hill, 1st edition, 2009.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO7032	Digital Control System	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO7032	Digital Control System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO7032	Digital Control System	4
Course Objective	1. To equip the students with the basic knowledge of digital systems 2. To obtain the canonical forms of digital control systems 3. To test the stability and steady state performance of digital control system. 4. To design the controller and observer for digital control systems.	
Course Outcome	Students will be able to 1. Understand the advantages and examples of digital control systems. 2. Understand the basics of Discretization. 3. Represent digital control system as pulse transfer function. 4. Determine stability, and steady-state error of discrete time systems. 5. Represent given system in different canonical forms. 6. Design controller and observer with state space approach.	

Details of Syllabus:

Prerequisite: Knowledge of Linear algebra, Fourier Series, Matrix Algebra, and Nyquist stability criterion.

Module	Contents	Hrs	CO
1	**Introduction** Block diagram of Digital Control System, Advantages &limitations of Digital Control System, comparison of continuous data & discrete data control system, Examples of digital control system, data conversion and quantization, sampling period considerations, sampling as impulse modulation, sampled spectra &aliasing, Reconstruction of analog signals, zero order hold, first order hold.	12	CO1
2	**Principles of discretization-** impulse invariance, finite difference approximation of derivatives, rectangular rules for integration, Bilinear transformation, Mapping between s-plane and z-plane, Discrete PID controller.	06	CO2
3	**Representation of digital control system** Linear difference equations, pulse transfer function, input output model, examples of first order continuous and discrete time systems, Signal flow graph applied to digital control systems.	06	CO3
4	**Stability of digital control system in z-domain and Time domain analysis** Jury's method, R.H. criteria, Comparison of time response of continuous data and digital control system, steady state analysis of digital control system,	08	CO4

	Effect of sampling period on transient response characteristics.		
5	**State space analysis** Discrete time state equations in standard canonical forms, similarity transformation, state transition matrix, solution of discrete time state equation, Discretization of continuous state space model & its solution.	08	CO5
6	**Pole placement and observer designs** Concept of reachability, Controllability, Constructability & Observability, Design of controller via Pole placement method, dead beat controller design, concept of duality, state observer design.	10	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books.

1. M. Gopal, "Digital Contol and State Variable Methods", Tata McGraw Hill, 2nd Edition, March 2003.
2. K. Ogata, "Discrete Time Control Systems", Pearson Education Inc., 1995.
3. B.C. Kuo, "Digital Control Systems", Saunders College Publishing, 1992.

Reference Books

1. Richard J. Vaccaro, "Digital Control", McGraw Hill Inc., 1995.
2. Ashish Tewari, "Modern Control System Design with MATLAB", John Wiley, Feb. 2002.
3. Joe H. Chow, Dean K. Frederick, "Discrete Time Control Problems using MATLAB", Thomson Learning, 1st Edition, 2003.
4. Eronini Umez, "System Dynamics and Control", Thomson Learning, 1999.
5. Franklin Powel, "Digital Control of Dynamic Systems", Pearson Education, 3rd Edition, 2003.
6. Digital Control Systems vol. I & II - Isermann, Narosa publications

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
ISDLO7033	Advanced Microcontroller Systems	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO7033	Advanced Microcontroller Systems	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDLO7033	Advanced Microcontroller Systems	4
Course objectives	1. To explain the fundamentals of PIC 18F Microcontroller and working of the system. 2. To discuss and explain the integrated hardware of the PIC 18F Microcontroller 3. To illustrate various programming tools and development of software using assembly and higher level language. 4. To examine and design, interfacing of PIC 18F Microcontroller with different peripheral devices such as LCD, keyboard, ADC, DAC etc. 5. To design applications using learned concepts of hardware, software and interfacing. 6. To describe the working of RTOS and related tasks	
Course Outcomes	The students will be able to: 1. Describe working of PIC 18F Microcontroller Architecture and Programming model. 2. Discuss programming tools and construct software programs in assembly or 'C' language. 3. Illustrate the knowledge of operation of integrated hardware components such as (CCP) module, ECCP module. Master Synchronous Serial Port (MSSP) Module, Enhanced Universal Synchronous, Asynchronous Receiver Transmitter (EUSART), Analog-To-Digital Converter (A/D) Module. 4. Investigate and construct circuits for interfacing of peripheral components with PIC 18F Microcontroller. 5. Design and develop sophisticated application based on PIC 18F Microcontroller such as Temperature controller, PID controller, RTC etc. 6. Describe the principle of working of RTOS and related tasks.	

Details of Syllabus:

Prerequisite: Knowledge of digital electronics, microcontrollers, programming skills

Module	Contents	Hrs	CO Mapping
1	**Introduction to PIC 18F Microcontroller** PIC 18F Microcontroller architecture, Hardware PIC 18F Microcontroller family, PIC18F architecture, features PIC18F4520, Block diagram, Oscillator configuration, power saving modes. Memory model, EEPROM and RAM, Program Memory. Hardware multiplier, Interrupt structure.	06	CO1
2	**PIC 18F Software** PIC18F addressing modes, Instruction set, Instruction format, Integrated Development Environment (IDE), Assembling, Debugging, and Executing a program using MPLAB IDE in assembly and embedded C. Data copy operation, Arithmetic operation, Branch and Skip operation, Logic operations, bit Operation, Stack and Subroutine, Code conversion programs and Software Design, Programming practice using assembly & C compiler.	10	CO2
3	**Integrated peripherals of PIC 18F Microcontroller** I/O ports, Timer, capture/compare/PWM (CCP) module, ECCP module. Master Synchronous Serial Port (MSSP) Module, Enhanced Universal Synchronous, Asynchronous Receiver Transmitter (EUSART), Analog-To-Digital Converter (A/D) Module, Comparator module.	08	CO3
4	**PIC 18F Interfacing** Interfacing to LCD, 7 segment display, Keyboard, ADC, DAC, relay, DC motor, Stepper Motor.	08	CO4
5	**Case Studies** PWM Generation, Digital encoder, PID Controller, Temperature controller, RTC, Speed Control of DC motors and similar system design	08	CO5
6	**Introduction to Real Time Operating System** Introduction to RTOS concept. Tasks and task states, task and data, Semaphores and shared data. Multitasking operating systems, Context switching, task tables, and kernels, Task swapping methods (Time slice, Pre-emption, Co-operative multitasking) Scheduler algorithms (Rate monotonic, Deadline monotonic scheduling) Priority inversion, Tasks, threads and processes, Exceptions, Example of any tiny RTOS.	08	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.

2. Total 4 questions need to be solved.

3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of

   4 to 5 marks will be asked.

4. Remaining questions will be mixed in nature.

5. In question paper weightage of each module will be proportional to number of respective

   Lecture hours as mentioned in the syllabus.

Text Books:

1. Mazidi M.A., PIC 18F Microcontroller & Embedded systems, Pearson Education Second edition.
2. Ramesh Gaonkar, Fundamentals of Microcontrollers and application in Embedded system (With PIC 18 Microcontroller family) Penram International Publishing.
3. Steve Heath, Embedded Systems Design, Newnes publication, Second edition, ISBN 0 7506 5546

Reference Books:

1. John B. Peatman, Design with PIC Microcontroller, Pearson Education
2. Han-way Huang, PIC Microcontroller: An Introduction to Software & Hardware Interfacing, Thomson Delmar Learning, India Edition.
3. David Simon, Embedded Software Primer, Pearson Education, ISBN 81-7808-045-1.
4. Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley Student Edition.
5. Rajkamal, Embedded Systems, TMH, Second Edition.

Subject code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO 7034	Mechatronics	4	-	-	4	-	-	4

Subject code	Subject Name	Examination Scheme							
		Theory(out of 100)				Theory	Pract. And Oral	Oral	Total
		Internal Assessment (out of 20)			End Sem. Exam				
		Test 1	Test 2	Avg.					
ISDLO 7034	Mechatronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO7034	Mechatronics	4
Course Objectives	1. To present architecture of the mechatronics system design 2. To study on broad spectrum the characteristics of the mechanical and electrical actuators and their selection for mechatronic systems. 3. Development of process plan and templates for design of mechatronic systems.	
Course Outcomes	The students will be able to 1. Describe mechatronics system. 2. Apply the concept of system modeling 3. Identify the suitable sensor and actuator for a mechatronic system. 4. Explain feedback and intelligent controllers 5. Learn mechatronics system validation 6. Integrate the components in mechatronics system	

Details of Syllabus:

Prerequisites: Signal conditioning, controllers and signals and systems, communication protocols.

Module	Contents	Hrs.	CO Mapping
1	**Introduction to mechatronics systems:** Definition and evolution levels of mechatronics, integrated design issues in mechatronics, key elements of mechatronics, mechatronics design process- modeling and simulation, prototyping, deployment /life cycle, advanced approaches in mechatronics.	06	CO1
	Modeling and Simulation of physical systems: Simulation and block diagrams, Analogies and impedance diagrams, electrical system-bridge circuit system, transformer, mechanical	10	CO2

	translational and rotational systems-sliding block with friction, elevator cable system, mass-damper system, automobile suspension system, mechanical lever system, geared elevator system, electromechanical coupling- DC motor, fluid systems-three tank liquid system, hydraulic actuator and hydraulic pressure regulator.		
3	**Hardware components:** Sensors: motion and position measurement, force, torque and tactile sensors, ultrasonic and range sensors, fiber optic sensors, micro sensors. Actuators: Pneumatic and hydraulic-directional and pressure control valves, cylinders, servo proportional control valves, rotary actuators, Electrical actuation: A.C and DC motors, stepper motors, mechanical switches and solid state switches. Mechanical Actuation: types of motion, kinematic chain, cams, gears, ratchets and pawl, belt and chain drives, bearings, mechanical aspects of motor selection, piezoelectric actuators, magnetostrictive actuators, memory metal actuators, Programmable Logic Controller	10	CO3
4	**Intelligent control:** Automatic control methods, Artificial Neural Network(ANN) – Modeling, basic model of neuron, characteristics of ANN, perceptron, learning algorithms, fuzzy logic – propositional logic, membership function, fuzzy logic and fuzzy rule generation, defuzzification, time dependent and temporal fuzzy logic.	10	CO4
5	**Components based modular design and system validation:** Components based modular design view, system validation, validation methodology- integrated and design dependence, distributed local level, validation schemes, fusion technique	06	CO5
6	**Integration:** Advanced actuators, consumer mechatronic products, hydraulic fingers, surgical equipment, industrial robot, autonomous guided vehicle, drilling machine, 3D Plotter, Motion Control Systems-Printing machines, coil winding machines, machine tools, and robotics, IC, and PCB manufacturing.	06	CO6

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 question need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus where in sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Reference Books:

1. Devdas Shetty and Richard Kolk, “Mechatronics System Design”, Thomson Learning, 2nd reprint, 2001.
2. W. Bolton, “Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education Ltd, 4th edition, 2010.
3. Nitaigour Mahalik, “Mechatronics- Principles, Concepts and Applications”, Tata McGraw Hill .
4. Stamatios V.Kartalopoulos,“Understanding Neural Networks and fuzzy Logic”, PHI,3rd reprint, 2013.
5. Zhijun Li, Shuzhi Sam Ge, “Fundamentals in Modeling and Control of Mobile Manipulators", March 30, 2017, by CRC Press.
6. Sergey Edward Lyshevski, “Mechatronics and Control of Electromechanical Systems", May 30, 2017, by CRC Press.
7. Bodgan Wilamowski, J. David Irwin, “Control and Mechatronics", October 12, 2017, by CRC Press.
8. Takashi Yamaguchi, Mitsuo Hirata, Justin Chee Khiang Pang, "High-Speed Precision Motion Control", March 29, 2017, by CRC Press.
9. David Allan Bradley, Derek Seward, David Dawson, Stuart Burge, “Mechatronics and the Design of Intelligent Machines and Systems", November 17, 2000, by CRC Press.
10. Clarence W. de Silva, Farbod Khoshnoud, Maoqing Li, Saman K. Halgamuge, “Mechatronics: Fundamentals and Applications", November 17, 2015, by CRC Press.
11. Clarence W. de Silva,“Mechatronics: A Foundation Course", June 4, 2010 by CRC Press.
12. GENERAL CATALOGUE 2011 Motion & Drives, OMRON.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO 7035	Building Automation	4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO 7035	Building Automation	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDLO7035	Building Automation	4
Course objectives	1. To brief students with origin and evolution of building automation. 2. To train them with architecture and operation of BAS. 3. To facilitate them for designing automation system for intelligent building. 4. Develop technique for preparation of various documents required for design requirement of safety building.	
Course Outcomes	The students will be able to: 1. Explain the concept of intelligent building and BAS. 2. Select the hardware and design of HVAC in building automation system. 3. Discuss the concept of energy management system. 4. Design and implement the safety system for building. 5. Design security and video management system for building. 6. Design and integrate the different system in BAS.	

Details of Syllabus:

Prerequisite: Fundamental of measurement and control, industrial automation, smart buildings.

Module	Contents	Hrs	CO Mapping
1	**Introduction to intelligent buildings:** Definitions of intelligent building, Intelligent architecture and structure, Facilities management vs. intelligent buildings, Technology systems and evolution of intelligent buildings. **Introduction to Building Automation System:** Features, Characteristics, Drawbacks of Building Automation system. Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System.	06	CO1

2	**HVAC system:** Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Concept of Controller IOs, Std Signals, Signal Compatibility between Controller & Field Devices. AHU – Concept, Components, Working Principle. AC Plant Room – Concept, Components, Refrigeration Cycle Working Principle, Chiller Sequencing, AC Plant Sequencing. Feedback Control Loops, Heat – Types, Heat Transfer Principles, Measurement of Heat Transfer. Psychrometry –Concept, ASHRAE Psychrometric Chart, Meaning of Various Terms – DBT, WBT, ST, RH, DPT, Sensible & Latent Cooling & Heating, Numericals. Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI. Logic Examples, CL Programming.	12	CO2
3	**Energy Management System:** Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving.	06	CO3
4	**Safety Systems:** Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming.	08	CO4
5	**Security Systems:** Introduction, Access Control – Concept, Generic Model, Components, Types, Features, Card Technologies, Protocols, Controllers, Concept of Antipassback, Biometrics, Issues With Biometrics, Cabling, Video Door phone, Intrusion Detection System – Sensors, Working Principle, Access Control System Programming. **Video Management:** Introduction, CCTV Cameras, CCD Camera Basics, Traditional	10	CO5

	CCTV System, Video Recording, Drawbacks, Digital Video Recording, Features, Functionalities, Digital Vs Analog Recording, Digital Video Management System – Introduction, Features, Advancements & Differences from Earlier Video Techniques, TCP/IP Networking Fundamentals, System Network Load Calculations, Network Design.		
6	**Integrated Systems:** Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Shengwei Wang, Intelligent Buildings and Building Automation, 2009.
2. Reinhold A. Carlson Robert A. Di Giandomenico, 'Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building',1st edition (R.S. Means Company Ltd), (1991).

Reference Books:

1. Roger W. Haines, "HVAC system Design Handbook", fifth edition.
2. National Joint Apprenticeship & Training Committee, Building Automation System Integration With Open Protocols: System Integration With Open Protocols
3. John I. Levenhagen and Donald H. Spethmann, HVAC Controls and Systems (Mechanical Engineering) , 1992.
4. James E.Brumbaugh, "HVAC fundamentals", vol: 1 to 3.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7011	**Product Lifecycle Management (abbreviated as PLM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7011	Product Lifecycle Management	20	20	20	80	03	-	100

Course Objectives	• To familiarize the students with the need, benefits and components of PLM • To acquaint students with Product Data Management & PLM strategies • To give insights into new product development program and guidelines for designing and developing a product • To familiarize the students with Virtual Product Development
Course Outcomes	Student will be able to… • Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation. • Illustrate various approaches and techniques for designing and developing products. • Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc. • Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plan

Module	Contents	Hours
1	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	12
2	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent	09

	Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	06
4	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	06
5	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	06
6	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06

Books Recommended:

Reference Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7012	**Reliability Engineering (abbreviated as RE)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7012	Reliability Engineering	20	20	20	80	03	-	100

Course Objectives	• To familiarize the students with various aspects of probability theory • To acquaint the students with reliability and its concepts • To introduce the students to methods of estimating the system reliability of simple and complex systems • To understand the various aspects of Maintainability, Availability and FMEA procedure
Course Outcomes	Student will be able to… • Understand and apply the concept of Probability to engineering problems • Apply various reliability concepts to calculate different reliability parameters • Estimate the system reliability of simple and complex systems • Carry out a Failure Mode Effect and Criticality Analysis

Module	Contents	Hours
1	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	10
2	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	10
3	**System Reliability** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
4	**Reliability Improvement** Redundancy Techniques: Element redundancy, Unit redundancy,	10

	Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
5	**Maintainability and Availability** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
6	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Books Recommended:

Reference Books:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7013	**Management Information System (abbreviated as MIS)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7013	Management Information System	20	20	20	80	03	-	100

Course Objectives	• The course is blend of Management and Technical field. • Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built • Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage • Identify the basic steps in systems development • Define and analyze various MIS management responsibilities, including planning, budgeting, project management, and personnel management • Discuss critical ethical and social issues in information systems
Course Outcomes	Student will be able to… • Explain how information systems Transform Business • Identify the impact information systems have on an organization • Describe IT infrastructure and its components and its current trends • Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making • Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Contents	Hours
1	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	7
2	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	9

3	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	6
4	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
5	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
6	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	10

Books Recommended:

Reference Books:

1. Management Information Systems: Kelly Rainer, Brad Prince by Wiley
2. Management Information Systems: Managing the Digital Firm (10th Edition). K.C. Laudon and J.P. Laudon, Prentice Hall, 2007.
3. Managing Information Systems: Strategy and Organization, D. Boddy, A. Boonstra, Prentice Hall, 2008

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7014	**Design of Experiments (abbreviated as DoE)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7014	Design of Experiments	20	20	20	80	03	-	100

Course Objectives	1. To understand the issues and principles of Design of Experiments (DOE). 2. To list the guidelines for designing experiments. **3.** To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization
Course Outcomes	Student will be able to… • Plan data collection, to turn data into information and to make decisions that lead to appropriate action. • Apply the methods taught to real life situations. • Plan, analyze, and interpret the results of experiments

Module	Contents	Hours
1	**Introduction:** Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	6
2	**Fitting Regression Models:** Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	8
3	**Two-Level Factorial Designs:** The 2^2Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^kDesign, The Addition of Center Points to the 2^kDesign, Blocking in the 2^kFactorial Design, Split-Plot Designs.	7
4	**Two-Level Fractional Factorial Designs:** The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	7
5	**Conducting Tests:** Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.	7
6	**Taguchi Approach:** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.	4

Books Recommended:

Reference Books:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Philip J Ross, "Taguchi Technique for Quality Engineering," McGraw Hill.
7. Madhav S Phadake, "Quality Engineering using Robust Design," Prentice Hall.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7015	**Operation Research (abbreviated as OR)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7015	Operation Research	20	20	20	80	03	-	100

Course Objectives	• Formulate a real-world problem as a mathematical programming model. • Understand the mathematical tools that are needed to solve optimization problems. • Use mathematical software to solve the proposed models.
Course Outcomes	Student will be able to… • Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand. • Understand the relationship between a linear program and its dual, including strong duality and complementary slackness. • Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change. • Solve specialized linear programming problems like the transportation and assignment problems. • Solve network models like the shortest path, minimum spanning tree, and maximum flow problems. • Understand the applications of, basic methods for, and challenges in integer programming • Model a dynamic system as a queuing model and compute important performance measures

Module	Contents	Hours
1	**Introduction to Operations Research***:* Introduction, Historical Background, Scope of Operations Research , Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools , Structure of the Mathematical Model, Limitations of Operations Research	2
2	**Linear Programming***:* Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, *Simplex Method* Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, ***Duality***, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	6
3	**Transportation Problem***:* Formulation, solution, unbalanced	6

	Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem***:* Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	
4	**Integer Programming Problem***:* Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	6
5	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	6
6	**Simulation***:* Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation *Monte-Carlo Method:* Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	4
7	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	4
8	**Games Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	4
9	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	4

Books Recommended:

Reference Books:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7016	**Cyber Security and Laws (abbreviated as CSL)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7016	Cyber Security and Laws	20	20	20	80	03	-	100

Course Objectives	• To understand and identify different types cyber crime and cyber law • To recognized Indian IT Act 2008 and its latest amendments • To learn various types of security standards compliances
Course Outcomes	Student will be able to… • Understand the concept of cyber crime and its effect on outside world • Interpret and apply IT law in various legal issues • Distinguish different aspects of cyber law • Apply Information Security Standards compliance during software design and development

Module	Contents	Hours
1	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
2	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	10
3	**Tools and Methods Used in Cyberline:** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
4	**The Concept of Cyberspace:** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to	8

	Electronic Banking , The Need for an Indian Cyber Law	
5	**Indian IT Act.:** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000,IT Act. 2008 and its Amendments	8
6	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Books Recommended:

Reference Books:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7017	**Disaster Management and Mitigation Measures (abbreviated as DMMM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7017	Disaster Management and Mitigation Measures	20	20	20	80	03	-	100

Course Objectives	• To understand the various types of disaster occurring around the world • To identify extent and damaging capacity of a disaster • To study and understand the means of losses and methods to overcome /minimize it. • To understand role of individual and various organization during and after disaster • To know warning systems, their implementation and based on this to initiate training to a laymen • To understand application of GIS in the field of disaster management • To understand the emergency government response structures before, during and after disaster
Course Outcomes	Student will be able to… • Understand natural as well as manmade disaster and their extent and possible effects on the economy. • Planning of national importance structures based upon the previous history. • Understand government policies, acts and various organizational structure associated with an emergency. • Know the simple do's and don'ts in such extreme events and act accordingly

Module	Contents	Hours
1	***Introduction: Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.***	03
2	***Natural Disaster and Manmade disasters: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion . Manmade Disasters:***	06

	Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	
3	***Disaster Management, Policy and Administration: Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.***	06
4	***Institutional Framework for Disaster Management in India: Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.***	06
5	***Financing Relief Measures: Ways to raise finance for relief expenditure,*** ***Role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters.*** ***Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.*** ***International relief aid agencies and their role in extreme events.***	09
6	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general, Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication. Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Books Recommended:

Reference Books:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications

7. Concepts and Techniques of GIS –C.P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7018	**Energy Audit and Management (abbreviated as EAM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7018	Energy Audit and Management	20	20	20	80	03	-	100

Course Objectives	• To understand the importance of energy security for sustainable development and the fundamentals of energy conservation. • To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management • To relate the data collected during performance evaluation of systems for identification of energy saving opportunities
Course Outcomes	Student will be able to… • To identify and describe present state of energy security and its importance. • To identify and describe the basic principles and methodologies adopted in energy audit of an utility. • To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. • To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities • To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Contents	Hours
1	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	4
2	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	8

3	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
4	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities	10
5	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	4
6	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	3

Books Recommended:

Reference Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO7019	**Development Engineering (abbreviated as DE)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO7019	**Development Engineering**	20	20	20	80	03	-	100

Course Objectives	• To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural • To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas • An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals • To understand the Nature and Type of Human Values relevant to Planning Institutions
Course Outcomes	Student will be able to… • Apply knowledge for Rural Development • Apply knowledge for Management Issues. • Apply knowledge for Initiatives and Strategies. • Develop acumen for higher education and research. • Master the art of working in group of different nature. • Develop confidence to take up rural project activities independently.

Module	Contents	Hours
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local. Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	04
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring	06

	organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Books Recommended:

Reference Books:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.

2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL701	Industrial Process Control-Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
		Test 1	Test 2	Avg.					
ISL701	Industrial Process Control –Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL701	Industrial Process Control-Lab Practice	1
Course objectives	1. To impart the knowledge of different industrial unit operations. 2. To make them capable to design and develop instrumentation and control scheme for industrial processes. 3. To give them exposure to work in process industry. 4. To explain students about hazardous area and safety design system.	
Course Outcomes	The students will be able to 1. Explain working and control of various heat transfer unit operations 2. Explain working and control of various heat and mass transfer unit operations 3. Explain the miscellaneous process equipment and their control 4. Describe the processes of various continuous process industries and instrumentation involved in them. 5. Describe the processes of various batch process industries and instrumentation involved in them. 6. Classify hazardous areas in the industry.	

Syllabus: Same as that of Subject ISC701 Industrial Process Control.

List of Laboratory Experiments/Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Demonstrate the operation and control scheme of Heat exchanger	CO1
2	Learn working of various Unit Operations (Boilers/furnace / Distillation column etc.) using online learning resources.	CO2
3	Demonstrate the reactor control system.	CO2
4	Demonstrate the operation & control scheme of a compressor.	CO3
5	Prepare a report on any one industry.	CO4 and CO5
6	Develop some charts on hazardous area classification.	CO6
7	Assignment/Exercise on heat transfer unit operations- heat exchanger, boilers	CO1
8	Assignment/Exercise on heat transfer unit operations-evaporator, furnace	CO1
9	Assignment/Exercise on heat and mass transfer unit operations-Distillation, dryers	CO2
10	Assignment/Exercise on heat and mass transfer unit operations-Crystallization, reactor	CO2
11	Assignment/Exercise on miscellaneous equipment	CO3
12	Assignment/Exercise on hazardous area classification	CO6
13	Assignment/Exercise on continuous process industries	CO4
14	Assignment/Exercise on batch process industries	CO5

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

- Industry visit is advised to understand the unit operations, industrial processes and their control.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of

Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL702	Biomedical Instrumentation - Lab Practice	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL702	Biomedical Instrumentation- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL702	Biomedical Instrumentation- Lab Practice	1
Course objective	1. To make students perform experiments based on the principle and working of various Biomedical Instruments used for Bio-potential measurements 2. To develop skills in the design of various biomedical instruments used in diagnosis and life-support.	
Course Outcome	Students will be able 1. To measure and identify various Bio-potentials with their specifications. 2. To observe and plot various Physiological parameters with their specifications. 3. To measure the various cardiovascular parameters by Designing the related circuitry. 4. To realise the circuitry of different life support instruments, like pacemaker, defibrillator. 5. To distinguish between the various medical imaging techniques by comparing, principle and concept involved in each of the technique. 6. To describe the significance of electrical safety in biomedical measurement.	

Syllabus: Same as that of Subject ISC702 Biomedical Instrumentation.

List of Suggested Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Demonstration and working of instruments like ECG and PCG.	CO1

2	Demonstration and working of instruments like EMG and EEG.	**CO1**
3	Study of electrodes for various biomedical applications.	**CO1**
4	To measure Blood pressure by indirect method.	**CO2**
5	To study Pacemaker and various waveforms or Design and implement pacemaker circuit.	**CO4**
6	To study Defibrillator and voltage waveforms or Design and implement Defibrillator circuit.	**CO4**
7	Design of ECG amplifier and testing of gain frequency response with weak input signal.	**CO3**
8	To design and implement ECG signal conditioning circuits with different parameter.	**CO3**
9	To design and implement EMG Quantification circuit.	**CO2**
10	To study Hemodialysis, Heart/Lung machine based models.	**CO4**
11	ECG simulation on PC / Microcontroller.	**CO3**
12	Study of working of pulse oxymeter / Heart rate meter.	**CO3**
13	To study respiration rate meter / respiration parameter measurement.	**CO2**
14	Study on Medical Imaging Techniques	**CO5**
15	Study on Electrical Safety	**CO6**

Any other additional experiment based on syllabus which will help students to understand topic/concept

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 08 experiments from the above given list and 02 assignments from imaging techniques module and electrical safety module.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/Assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL703	Industrial Automation-Lab Practice	-	02	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL703	Industrial Automation-Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL703	Industrial Automation -Lab Practice	1
Course objective	1. To give the students fundamentals of automation and various automation systems used in industry such as PLC, DCS, and SCADA. 2. To impart the knowledge about the architecture, working of PLC, DCS and SCADA 3. To make the students capable to apply knowledge to identify hardware and software requirements of PLC, DCS and SCADA 4. To give the students a comprehension of the aspects related to Safety Instrumented system (SIS).	
Course Outcome	The students will be able to 1. Describe automation, need, importance and applications in industry. 2. Identify components of PLC, and develop PLC ladder using instructions of PLC and design PLC based application by proper selection and sizing criteria 3. Explain evolution and architecture of DCS, hierarchical control in DCS, programming DCS through Function Block Diagram (FBD) method. 4. Describe SCADA architecture, communication in SCADA and develop any application based on SCADA along with GUI using SCADA software. 5. Explain database and alarm management system 6. Recognize the need of SIS and describe risk reduction methods.	

Syllabus: Same as that of Subject ISC703 Industrial Automation.

List of Laboratory Experiments/Assignments:

Sr. No.	Detailed Content	CO Mapping
1.	Processing of sensor signals by the PLC to drive various end effectors such as pneumatic/electric/hydraulic.	CO2
2.	PLC programs for process control applications (minimum 4 nos)	CO2
3.	DCS programming using Function block diagram method	CO3
4.	GUI development for any one application using SCADA software.	CO4
5.	Assignment/Exercise based on Automation Fundamentals	CO1
6.	Assignment/Exercise based on DCS	CO3
7.	Assignment /Exercise based on SCADA	CO4
8.	Assignment/Exercise based on Database and Alarm management	CO5
9.	Assignment/Exercise based on Safety Instrumented System	CO6

Any other additional experiment based on syllabus which will help students to understand topic/concept

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum 4 experiments and 4 assignments.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments/Assignments): 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL704	Image Processing-Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL704	Image Processing-Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL704	Image Processing-Lab Practice	1
Course objectives	1. Familiarize with computer simulation software for Image processing and its analysis and basic Image operations. 2. To Study the Fourier and Cosine transformation of images in the simulation platform and display the result 3. Write advanced image processing algorithms such as Image enhancement, Image restoration by using computer simulations. 4. Develop program for extract the features of images by segmentation and image morphology.	
Course Outcomes	Students will be able to - 1. Simulate various operations on Images. 2. Perform Discrete Fourier transform and Discrete Cosine transform on Image. 3. Perform Image enhancement techniques. 4. Perform morphological operations on images and display the result. 5. Implement Image compression techniques. 6. Implement restoration techniques on degraded images.	

Syllabus same as that of subject ISDLO7031 Image Processing

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Basic Image operations such as Reading, Displaying, Writing, Flipping, Cropping Images. Introduction to M file, Basic Matrix operations.	CO1
2	Spatial transformation of images like Translation, Rotation and Scaling.	CO1
3	Compute and visualize 2-D DFT, DCT of Images.	CO2

4	Point processing operations like Image negative, brightness adjustment, contrast stretching, Threshold, Log transformation, Power law transformations, Gray level slicing with or without background.	**CO3**
5	Image Enhancement techniques by arithmetic and logic operations.	**CO3**
6	Generate and plot Image Histogram and Histogram Equalization.	**CO4**
7	Image Analysis and interpret the result by using Spatial filter.	**CO5**
8	Image smoothing and Sharpening in frequency domain.	**CO5**
9	Implementing Image acquisition and degradation process by different noises and	**CO5**
10	Edge detection by using Robert operator, Prewitt operator, Sobel operator and compare the result.	**CO6**
11	Morphological operation of Images like Dilation, Erosion, Opening, Closing, Boundary Detection.	**CO6**
12	Image segmentation such as point, line, edge detection.	**CO6**

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Note: Students can use any Computer simulation software programing platform like MATLAB/SCILAB.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of Eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL704	Digital Control System-Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL704	Digital Control System- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL704	Digital Control System-Lab Practice	1
Course objective	1. The students should be able to determine response of ZOH and FOH 2. The students should be able to descretize continuous data system. 3. The students will be able to represent given system into different canonical form. 4. The students should able to determine state transition matrix 5. Students can be able to design controller and observer	
Course Outcome	Students will be able to - 1. Understand the difference in response with reconstruction due to ZOH and FOH . 2. Discretize the analog systems and signals with different methods 3. Design controller and observer for the given system. 4. Demonstrate their knowledge to obtain different canonical forms analytically and verify using simulation software. 5. Determine state transition matrix using simulation software and verify the results analytically 6. Measure and record the experimental data, analyze the results, and prepare a formal laboratory report.	

Syllabus same as that of subject ISDLO7032 Digital Control System

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO Mapping
1	To determine response of zero order hold and first order hold using simulation software	CO1
2	Mapping from S- plane to Z-plane analytically and verification using simulation software	CO2
3	Discretization of continuous data system using i) Step invariance method, ii) Impulse invariance method, and iii) Bilinear transformations, analytically and verification using simulation software	CO3
4	To represent given system in different canonical forms, analytically and verification using simulation software	CO4
5	To determine pulse transfer function of a given system analytically and its verification using simulation software	CO4,CO6
6	Determination of state transition matrix analytically and its verification using simulation software	CO5,CO6
7	To check controllability and observability of a given system analytically and verify the result using simulation software.	CO3,CO6
8	To design the controller by any method	CO3
9	To design an observer by any method	CO3

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Note: Student can use simulation software such as MATLAB, MATHCAD, SCILAB or any other open source software.

Oral Examination:
Oral examination will be based on entire syllabus

Term Work:

Term work shall consist of Eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL704	Advanced Microcontroller Systems- Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract and Oral	Oral	Total
		Test 1	Test 2	Avg.					
ISL704	Advanced Microcontroller Systems- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL704	**Advanced Microcontroller Systems- Lab Practice**	**1**
Course objectives	1. To explain the fundamentals of PIC 18F Microcontroller and working of the system. 2. To discuss and explain the integrated hardware of the PIC 18F Microcontroller 3. To illustrate various programming tools and development of software using assembly and higher level language. 4. To examine and design, interfacing of PIC 18F Microcontroller with different peripheral devices such as LCD, keyboard, ADC, DAC etc. 5. To design applications using learned concepts of hardware, software and interfacing. 6. To describe the working of RTOS and related tasks.	
Course Outcomes	The students will be able to: 1. Simulate, Analyze and develop programs using assembly language. 2. Simulate, Analyze and develop programs using embedded C 3. Develop program to use PIC18 integrated peripherals. 4. Design and Develop programs for interfacing of external peripheral components with PIC 18F Microcontroller. 5. Design and develop sophisticated application using the PIC18 integrated peripherals and external peripherals 6. Show the uses and features of RTOS	

Syllabus: Same as that of Subject ISDLO7033 Advanced Microcontroller Systems.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1.	To develop assembly program	**CO1**
2.	To develop embedded C program	**CO2**
3.	To develop a program for generating square wave on port pin with and without timer.	**CO3**
4.	To develop a program for interfacing 7 segments displays with PIC18	**CO4**
5.	To develop a program for interfacing LCD display with PIC18	**CO4**
6.	To develop a program for interfacing keyboard with PIC18	**CO4**
7.	To develop a program for Serial Communication with PC.	**CO3**

8.	To develop a program for interfacing DAC and its application.	**CO4**
9.	To develop a program for implementing RTC.	**CO3**
10.	To develop a program for Speed control of DC Motor	**CO5**
11.	To develop a program for temperature measurement.	**CO5**
12.	To develop a program for Stepper motor control	**CO5**
13.	To develop a program for implementing PID controller.	**CO5**
14.	Assignment on understanding operation of integrated peripherals	**CO5**
15.	Case study on various types of RTOS	**CO6**

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments): 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of

Laboratory work and minimum passing in the term work.

Sub code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL704	Mechatronics	-	2	-	-	1	-	1

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Theory	Pract. And Oral	Oral	Total
		Internal Assessment (out of 20)			End Sem. Exam				
		Test 1	Test 2	Avg.					
ISL704	Mechatronics	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL704	Mechatronics Lab	1
Course Objectives	1. To present architecture of the mechatronics system design 2. To study on broad spectrum the characteristics of the mechanical and electrical actuators and their selection for mechatronic systems. 3. Development of process plan and templates for design of mechatronic systems.	
Course Outcomes	The students will be able to 1. Apply the concept of system modeling 2. Calculate performance characteristics of sensors 3. Learn the working of actuators for a mechatronic system. 4. Design feedback and intelligent controllers 5. Describe mechatronics system validation 6. Integrate the components in mechatronics system	

Syllabus: Same as that of Subject ISDLO7034 Mechatronics.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Modeling and simulation of basic electrical, hydraulic and pneumatic systems using any virtual instrumentation software like LabVIEW.	CO1
2	Calculate static and dynamic characteristics of position/force/tactile sensors	CO2
3	Design of circuits with logic sequence using Electro pneumatic trainer kits.	CO3
4	Simulation of basic Hydraulic, Pneumatic and Electric circuits using any software	CO3

5	Electro pneumatic applications using PLC	CO3
6	Speed Control of AC & DC drives	CO3
7	Servo controller interfacing for DC motor	CO4
8	PID controller interfacing	CO4
9	Implementation of fuzzy controller for level or temperature control	CO4
10	Stepper motor interfacing with Micro controller (i) Full step resolution (ii) half step resolution	CO4
11	Assignment on Components based modular design and system validation	CO5
12	Computerized data logging system with control for process variables like pressure, flow and temperature.	CO6
13	Case study on any one mechatronics system	CO6

Any other additional experiments / case studies based on syllabus which will help students to understand topic/concept.

**Industry visit is advised to understand the Mechatronics subject.

Practical/Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum seven experiments and 01 case study.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL704	Building Automation-Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
		Test 1	Test 2	Avg.					
ISL704	Building Automation-Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL704	Building Automation Lab Practice	1
Course objectives	1. To brief students with origin and evolution of building automation. 2. To train them with architecture and operation of BAS. 3. To facilitate them for designing automation system for intelligent building. 4. Develop technique for preparation of various documents required for design requirement of safety building.	
Course Outcomes	The students will be able to: 1. Explain the concept of intelligent building and BAS. 2. Select the hardware and design of HVAC in building automation system. 3. Discuss the concept of energy management system. 4. Design and implement the safety system for building. 5. Design security and video management system for building. 6. Design and integrate the different system in BAS.	

Syllabus: Same as that of Subject ISDLO7035 Building Automation.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Assignment on intelligent building.	CO1
2	Assignment on BAS.	CO1
3	Assignment on HVAC.	CO2
4	Assignment on Direct Digital Control of an HVAC system.	CO2

5	Assignment on BACnet and its features.	CO2
6	Assignment on lighting- control systems.	CO3
7	Assignment on fire alarm systems.	CO4
8	Assignment on access Control System.	CO5
9	Assignment on CCTV systems.	CO5
10	Assignment on building system integration.	CO6
11	Case study – Intelligent building of hospital/hotel/airport.	CO1, CO2

Any other experiments/assignments based on syllabus which will help students to understand topic/concept.

- Visit to intelligent building of hotel/hospital/airport is advised to understand the Building Automation subject.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments. The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL705	Project-I	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	6	-	-	3	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL705	Project-I	-	-	-	-	50	-	50	100

Term Work:

The final year students have already under gone project assignment in their third year in Mini Project I and II. In final year, group of maximum **four** students will be completing a comprehensive project work based on the courses studied. The project work may be internally assigned or externally assigned by the research institutes and industry etc. Each group will be assigned one faculty as a supervisor. This project work in final year may be extension of the Mini Project work done in third year.

The main intention of project work is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The project work may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be

- Learning additional skills
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning
- Learn the behavioral science by working in a group
- The project area may be selected in which the student intend to do further education and/or may be either intend to have employment or self employment
- The topic of project should be different and/or may be advancement in the same topic of Mini Project
- The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of project work.

The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding TW marks. The TW should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Report in prescribed University format.

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC801	Instrumentation Project Documentation and Execution	4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC801	Instrumentation Project Documentation and Execution	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC801	**Instrumentation Project Documentation and Execution**	4
Course objective	1. To provide knowledge of Instrumentation Project & Detailed Engineering techniques in the EPC Consultancy. 2. To make the students capable of executing Project Deliverables and Engineering activities of Project Documentation.	
Course Outcome	The students will able to: 1. Interpret types of project and execute it by knowing relationship between customer, designer and constructor. 2. Use standards in instrumentation project. 3. Design engineering documents such as loop diagram, hook-up, JB schedule. 4. Develop and test system integration. 5. Schedule and evaluate activities like procurement, commissioning, installation. 6. Support and evaluate documentation software packages used in industry.	

Details of Syllabus:

Prerequisite: Knowledge of standards, basics of Sensor, transducer, process loops, control valve.

Module	Content	Hrs	CO Mapping
1	**The Project and Project Team:** Introduction, Types of project, constraint's predictability, structure, flow and deliverables, Need and techniques used for Project Planning and Scheduling, software used for Project Planning and Scheduling **The Project Team**: Customer, designer and constructor	10	CO1
2	**Standards used in instrumentation project:** ISA, ANSI, & ASTM, ASME, NFPA, NEMA, SAMA. **Engineering Documents Part-I:** Need for engineering document, general guidelines for development of document, project stage**,** purpose, scope, contents, references for document, team of creation and users. 1) Process Flow Diagram (PFD) and Material Balance Sheet (MBS) 2) Piping and Instrumentation diagrams (P&ID) – practical applications. 3) Instrument Index Sheet 4) Instrument specifications sheet- for temperature, pressure, level, flow instruments and control valves.	08	CO2
3	**Engineering Documents Part-II** 1) Loop diagrams- pneumatic, electronic and digital data types. 2) Instrument Location Plan 3) Cable and Tray Routing and Cable Schedule 4) JB Schedule 5) Air header schedule 6) Instrument Hook- up diagrams - for control valve, transmitters (DP in liquid service, dry gas service,) Thermocouple, Temperature switch line mounted, flow transmitter, connections for air supply and output. etc. 7) BOM for erection 8) Logic diagrams, 9) SAMA flow diagram	10	CO3
4	**Systems Integration:** Division of labour, control logic specification, HMI specification (development of mimic and graphic), System Architecture design, Network single line diagram generation, I/O address assignment (Partitioning)-Hardware & software address, Other tasks like -System testing, Safety Instrumented System (SIS), Safety Integrated Level (SIL), control room layout design, types of control system cabinet design.	07	CO4
5	**Procurement, Installation and Commissioning:** **Procurement:** Engineering Procurement procedure, PO format, preparation of tender documents, bids, technical bid evaluation. **Installation of instruments-** Installation standards (stanchion, impulse tubing, clamping) installation of instrument junction box, earthing system, cable laying (cable trays, cable types, cable glands), tubing, instrument installation guidelines (for pressure instruments, DP transmitter, temperature and flow instruments, control valve.) **Inspection**: Need for Inspection, General Inspection Guidelines	10	CO5

	Documents for Inspection- Factory acceptance test (FAT) ,Site acceptance test (SAT). **Commissioning:** Pre-commissioning Procedures, stages, check out procedure of control valve, DP transmitter etc. Calibration, testing of instruments, operation and maintenance manual.		
6	**Documentation Software Packages:** Advantages of using software packages for documentation. Overview of documentation software packages used in industry.	03	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Andrew Williams, "Applied instrumentation in the process industries", 2nd Edition, Vol. 2, Gulf publishing company, 1979.
2. Michael D. Whitt, "Successful Instrumentation and Control Systems Design", ISA Publication, 2012.
3. Installation of Instrumentation & Process control systems- EEUA Handbook, 1977.
4. D. N. Pawar, D. K. Nikam, Fundamentals of Project Planning and Engineering, 1st Edition, Penram International Publishing-2017.

Additional References :

- Specification forms- ISA-20-1981- ISA Publication
- Piping and Instrumentation Diagram Documentation Criteria- Process Industry
- Practices Instrumentation Design Criteria-ONGC, Mumbai
- Commissioning Procedures -ONGC, Mumbai

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC802	Instrument and System Design	4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISC802	Instrument and System Design	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC802	Instrument and System Design	4
Course objectives	1. To impart knowledge of selection and design considerations of transducers along with its calibration techniques. 2. To make the students capable of sizing the control valve. 3. To impart the students' knowledge about the types, sizing of control panels and standards. 4. To make the students capable to design electronic product, control room layout and its environment. 5. To familiarize students with the concept of reliability engineering.	
Course Outcomes	The students will be able to: 1. Select, design and calibrate transducers 2. Select and size control valves and actuators. 3. Apply knowledge to size the control panels. 4. Apply knowledge to design electronic product and enclosure design 5. Describe the terms used in Reliability engineering. 6. Apply knowledge in designing control room layout and its environment.	

Details of Syllabus:

Prerequisite: Knowledge of sensors, control valves, PLC and DCS.

Module	Content	Hrs	CO Mapping
1	**Design of Transducers:** An overview of static and dynamic performance characteristics of instruments. Selection criteria, design considerations, calibration and installation for flow, temperature, pressure and level transducers.	08	CO1
2	**Design of Control Valve:** Review of flow equations. Valve selection and sizing for liquid service, gas or vapor service, flashing liquids, Newtonian fluids and mixed phase flow, Control valve noise estimation and Control valve cavitations. Actuator sizing. Selection criteria and design consideration of safety relief valves and rupture discs.	16	CO2

3	**Control Panel Design:** Panel selection-size, type, construction and IP classification, NEMA standard. GA Diagrams, Power wiring and distribution, Typical wiring diagrams for AI,DI,AO,DO,RTD, and T/C modules. Earthing scheme. Panel ventilation, cooling and illumination. Operating consoles- ergonomics. Wiring accessories- ferules, lugs, PVC ducts, spiral etc. Wire sizes and color coding. Packing, Pressurized panels- X, Y, and Z Purging for installation in hazardous areas. Ex-proof panels.	08	CO3
4	**Electronic product design:** System Engineering, ergonomics, phases involved in electronic product design. **Enclosure Design :** Packing and enclosures design guidelines, Grounding and shielding, front panel and cabinet design of an electronic product.	08	CO4
5	**Reliability engineering:** Reliability concepts, causes of failures, bath tub curve, Quality and reliability, MTTF, MTBF, and MTTR. Availability and Maintainability. Redundancy and redundant systems.	04	CO5
6	**Control Room Design:** Layout and environment, modern control room layout	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Les Driskell, "Control valve sizing", ISA.
2. Kim R Fowler, "Electronic Instrument Design", Oxford University- 1996.
3. Bela G. Liptak, "Instrument Engineer's Hand Book – Process Control", Chilton Company, 3rd Edition, 1995.
4. Andrew Williams, "Applied instrumentation in the process industries", 2nd Edition, Vol. 1 & 3, Gulf publishing company,1979.

Reference Books:

1. Harshvardhan, “Measurement Principles and Practices”, Macmillan India Ltd-1993
2. Balaguruswamy E, “Reliability”, Tata McGraw-Hill Pub.co. New Delhi, 1999.
3. Mourad Samiha & ZorianYervant,” Principles of Testing Electronic Systems”, New York. John Wiley & Sons, 2000.
4. Lewis E E,” Introduction to Reliability Engineering (2nd)”, New York. John Wiley & Sons, 1996.
5. Anand M S,” Electronic Instruments and Instrumentation Technology”, New Delhi. Prentice Hall of India, 2004.
6. Ott H W,” Noise Reduction Techniques in Electronic System. ,” (2) John Wiley & Sons New York, 1988.
7. Manual on product design: IISc C.E.D.T.
8. C.L.Albert and D.A. Coggan,””Fundamentals of Industrial Control”,ISA, 1992.
9. R. W. Zape, “Valve selection hand book third edition”, Jaico publishing house,2003.
10. Curtis Johnson, “Process Control Instrumentation Technology”, PHI /Pearson Education 2002.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO8041	Expert System	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment (20)			End sem Exam				
		Test 1	Test2	Avg.					
ISDLO8041	Expert System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDLO801	Expert System	4
Course objective	1. To provide an understanding on the fundamentals of neural network and fuzzy systems. 2. To learn the different intelligent techniques for control 3. To gain knowledge in Expert systems 4. To gain knowledge in genetic algorithm.	
Course Outcome	The students will able to 1. Identify various networks and learning algorithms in artificial neural network (ANN). 2. Define Fuzzy set, rules and membership function and also defuzzification for a given problem. 3. Identify areas of application for Expert Systems. 4. Apply the concepts of ANN and Fuzzy Logic in solving engineering problems and implementing controllers. 5. Discuss various concepts of Genetic Algorithm 6. Identify various hybrid control strategies.	

Details of syllabus:

Prerequisite: Knowledge of control systems, optimization technique, expert system, Neural network and Genetic algorithm.

Module	Contents	Hrs	CO Mapping
1	**Introduction to Artificial Neural Network (ANN)** Neuron, nerve structure and synapse –Artificial Neuron and its model, activation functions, neural network architecture –Single Layer Perceptron– Multi Layer Perceptron – Back propagation algorithm (BPA). Supervised and Unsupervised learning. Associative Networks - Hopfield networks, Boltzmann machines.	09	CO1
2	**Introduction to Fuzzy Logic** Fuzzy set theory – Fuzzy sets – Operation on Fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition, decomposition, cylindrical extension, fuzzy relation – Fuzzy membership functions, De- fuzzification.	09	CO2
3	**Introduction to Expert System** What are Expert Systems, Features of Expert System, Basic activities of expert system and the areas in which they solve problems, Prospector systems-features, working. Knowledge representation in expert systems- using rules semantic nets, frames, Types of tools available for expert system building, Stages in the development of expert system tools. Building an Expert system.	09	CO3
4	**Neural Networks and Fuzzy Logic for Control** Familiarization of Neural Network Control and Fuzzy Tool Box. Development of PID control using ANN and Fuzzy Logic.	06	CO4
5	**Genetic Algorithm** Basic concept of Genetic algorithm – flow chart of GA – Genetic representations – encoding – Initialization and selection, Genetic operators– Mutation, Generational Cycle, applications – Concepts on search techniques – Tabu search, Ant-colony search and Particle Swarm Optimization (PSO).	09	CO5
6	**Hybrid Control Schemes** Neuro fuzzy systems –Adaptive neuro fuzzy inference system (ANFIS) – Optimization of membership function and rule base using Genetic Algorithm and PSO – Case study – Introduction to Support Vector Regression – Familiarization of ANFIS Tool Box.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Stamatios V. Kartalopolous, .Understanding Neural Network and Fuzzy Logic., PHI Pvt Ltd.
2. Kishan Mehrotra, .Elements of ANN., 2nd Editon, Penram International Publishing (I) Pvt.Ltd.
3. Donald A. Waterman, "A Guide to Expert Systems", Addison-Wesley Publishing Company
4. David Goldberg. V "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009

References:

1. Laurene. V, Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Pearson Education, 2008.
2. Timothy. J, Ross, "Fuzzy Logic with Engineering Applications", Wiley, Third Edition, 2010.
3. Zimmermann. H.J, "Fuzzy set theory-and its Applications"- Springer international edition, 2011.
4. Miller W.T, Sutton . R.S and Webrose . P.J, "Neural Networks for Control", MIT Press, 1996.
5. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill-2008.
6. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).
7. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
8. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007
9. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.
10. Laurance Fausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education,1992.
11. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
12. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition,2013
13. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
14. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson

Education,New Delhi, 2003.
15.M.Gen and R,Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design and Automation, 2000.
16. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
17. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press 2011.
18.http://nptel.ac.in

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISDLO8042	Optimal Control System	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISDLO8042	Optimal Control System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO8042	Optimal Control System	4
Course Objective	1. To make students understand the optimal control problems their types and how to solve them by calculus of variation and dynamic programming approaches. 2. To make student to understand the linear regulator and tracking systems, discrete time optimal control systems.	
Course Outcome	The students will be able to 1. Identify various optimal control problems with performance measure with minimum time, minimum fuel, minimum energy, terminal cost and general problems. 2. Describe the principle of calculus of variation, wherein to determine a function that minimizes a specified functional. 3. Derive the necessary conditions for optimal control problem, and optimal law for the linear regulator problem. 4. Apply variational calculus for solving discrete linear quadratic regulator and tracking problems. 5. Explain the method of dynamic programming leading to a functional equation that is amenable to solution by using simulation software. 6. Solve optimal control problems.	

Details of Syllabus:

Prerequisite: Knowledge of Linear algebra, Fourier Series, and differential calculus.

Module	Topic	Hrs	CO
1	**Introduction**: Formulation of optimal control problem, Performance measure, selecting a performance measure.	04	CO1
2	**Calculus of variation I** Fundamental concepts: functional, Linearity of functional, closeness, increment, variation, maxima and minima of functional, fundamental theorem of calculus of variation. Extremum of functional of single function: fixed and free end point problems, Extremum of functional of several independent function: fixed and free end point problems.	10	CO2

3	**Calculus of variation II** Constrained extremum of functions: elimination method, Lagrange multiplier method Constrained extremum of functionals: point constraint, differential equation constraints, isoperimetric constraints. The Variational approach to optimal control problems: necessary conditions for optimal control for different boundary conditions	10	CO3
4	**Linear Regulator and Tacking Systems:** Linear Quadratic Regulator(LQR): Finite time LQR and infinite time LQR Linear Quadratic Tracking Systems: Finite and infinite time Cases	06	CO4
5	**Discrete time Optimal control systems**: variational calculus for discrete time systems, Discrete time LQR and tracking systems	06	CO5
6	**Dynamic Programming**: Principle of optimality, application of principle of optimality to decision making, dynamic programming applied to routing problem, Hamilton-Jacobi-Bellman (HJB) equation, LQR system using HJB equation	12	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books.

1. D. S. Naidu, Optimal Control System, CRC Press LLC - 2003,
2. D. E. Kirk, Optimal Control Theory - An Introduction, Dover Publication, New York – 1998.

Reference Books

1. B.D.O. Anderson and J.B. Moore. Optimal Control, Linear Quadratic Methods. Prentice-Hall Inc., Englewood Cliffs, NJ, 1989.
2. H. Kwakernaak and R. Sivan. Linear Optimal Control Systems. Wiley-Interscience, New York, 1972.
3. A. Sage. Optimum systems control. Prentice Hall, 2nd edition, 1977
4. F. L. Lewis and V. L. Syrmos. Optimal Control theory. Wiley Interscience, 2nd edition, 1995.
5. R. D. Robinett, D. G. Wilson, G. R. Eisler, and J. E. Hurtado. Applied dynamic programming for optimization of dynamical systems. Advances in Design and Control. SIAM,Philadelphia, 2005.
6. K. Ogata, Discrete Time Control System, Second Edition, PHI, Inc. 1995.

Course Code	Course Name	Teaching Scheme (Contact HOURS)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
ISDLO8043	Internet of Things (IOT)	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISDLO8043	Internet of Things (IOT)	20	20	20	80	-		-	100

Subject Code	Subject Name	credits
ISDLO8043	Internet of Things (IOT)	4
Course objective	1. To teach fundamentals of IoT 2. To study data and knowledge management and use of devices in IoT technology. 3. To understand IoT architecture and Integration of embedded devices with IoT 4. To understand concept of IoT. 5. To learn designing of industrial internet systems. 6. To study overview of Android/ IOS app development tools and Internet of Everything	
Course Outcome	Students will be able to- 1. Demonstrate the knowledge of operation of IoT architecture 2. Identify the various technologies for implementing IoT 3. Discuss various communication Technologies used in IoT 4. Discuss various communication models and protocols used in IoT 5. Discuss about the role of cloud computing in IoT 6. Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.	

Details of Syllabus:

Module	Content	Hrs	CO Mapping
1	**Introduction to Internet of Things: An Overview** Introduction – Definition and characteristics of IoT, Physical design of IoT- Things in IoT, IoT protocol, Logical design of IoT – IoT functional blocks, IoT Communication Models, IoT communication APIs.	06	CO1
2	**IoT Enabling Technology** Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems. **IOT Levels and Deployment Templates.**	06	CO2

3	**Introduction to Communication Technologies** 802.15.4,ZigBee, BLE, WiFi, LORA,GSM basic protocol ,topologies, data rate, range, power, computations/bandwidth, QoS	12	CO3
4	**Communication Model and Protocols** M2M vs IOT ,Resource Management, Registration, Discovery Data Exchange Formats - XML & JSON , MQTT Protocol , RESTFul Architecture , HTTP REST Model , CoAP Protocol	12	CO4
5	**Basics of Cloud Computing** Cloud Based Architecture, Basics of Virtualization º Specific Characteristics that Define a Cloud , Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) Cloud Delivery Models , Public Cloud, Private Cloud, Hybrid Cloud and Community Cloud Deployment Models ,Benefits, Challenges and Risks of Cloud Computing Platforms and Cloud Services	06	CO5
6	**Case Studies of IOT** Home (Smart Lighting and Intrusion detection), Cities(Smart Parking, Garbage collection),Environment(Pollution detection, Forest Fire Detection), Power (Smart Grid) , Retail(Inventory Management) , Logistics(Fleet Tracking) Industry(Machine Diagnosis & Prognosis), Heath(Monitoring and Detection) , Agriculture(Green House Monitoring ,Animal Husbandry.	06	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Cloud Computing Black Book Edition-2014 by Jagannath Kallakurchi Wiley India

Reference Books:

1. Francis DaCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
2. Wimer Hazenberg, Menno Huisman and Sara Cordoba Rubino, "Meta Products: Building the Internet of Things", BIS publishers.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
ISDLO8044	Power Plant Instrumentation	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Subject Code	Subject Name	Examination scheme							
		Theory Marks(100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment(20)			End Sem Exam				
		Test1	Test2	Avg.					
ISDL08044	Power Plant Instrumentation	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISDLO8044	Power Plant Instrumentation	4
Course objectives	1. To create awareness of energy resources and its scenario in India and worldwide. 2. To study the concept of power generation using various resources. 3. To study the role of Instrumentation in various power plants. 4. To study and compare various power plants for optimal performance. 5. To acquire students the knowledge about hazards and safety in handling power plants.	
Course Outcomes	The students will be able to: 1. Identify the energy sources and explain power generation. 2. Describe operation and control of various equipment in thermal power plant. 3. Select the sites for hydroelectric power plants and explain its operation. 4. Explain the power generation and control of Nuclear power plant. 5. Describe the non-conventional energy resources. 6. Compare different types of power plants.	

Details of Syllabus:

Prerequisite: Knowledge of energy resources, types of power plants and power generation.

Module	Content	Hrs	CO Mapping
1	**Introduction:** Energy sources, their availability, worldwide energy production, energy scenario of India. Introduction to Power generation, load curve, load factor. Classification of energy generation resources.	04	CO1
2	**Thermal Power Plant**- Method of power generation, layout and energy conversion process. Types of Turbines & their control. Types of Boilers and their control. Types of Generators and their control, Condensers. Types of Pumps and Fans, variable speed pumps and Fans, Material handling system, study of all loops-water, steam, fuel etc. Schematics of Gas turbine and Diesel power plant. Application of DCS in power plants.	14	CO2
3	**Hydroelectric Power Plant**- Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants. Types of Turbines for hydroelectric power plant, pumped storage plants, storage reservoir plants.	06	CO3
4	**Nuclear Power Plant –** Concept of energy generation from nuclear fission, control of chain reaction. Schematics of Nuclear power plant, types of reactors, reactor control, safety measures.	08	CO4
5	**Non-conventional Energy Resources** – **Wind Energy:** Power in wind, Conversion of wind power, Aerodynamics of wind turbine, types of wind turbine and their modes of operation, power control of wind turbines, Betz limit, Pitch & Yaw control, wind mill, wind pumps, wind farms, different generator protections, safety. **Solar Energy:** Solar resource, solar energy conversion systems. Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety. Introduction to Modern Biomass, Bio-fuels, Geothermal energy, Tidal energy and Ocean thermal energy.	12	CO5
6	Comparison of different types of power plant: thermal power plant, hydro electric power plant, wind, solar, nuclear power plant on the basis of: Performance, efficiency, site selection, Economics-capital and running, safety. Introduction to Hybrid Power Generation concept.	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. P. K. Nag, Power plant engineering, 3rd edition, 2010. McGraw Hill.
2. K. Krishnaswamy, M. Ponni Bala, ,Power Plant Instrumentation, 2011, Prentice Hall India.
3. R. K. Rajput, A Textbook of Power Plant Engineering, 2010, Laxmi Publications.

Reference Books:

1. Domkundwar, Power Plant Engg.
2. B. H. Khan, Non-conventional energy resources, McGraw Hill, New Delhi.
3. Chetan Singh Solanki, Renewable energy Technology, Prentice Hall Publication.
4. S. P. Sukhatme, Solar Energy, Tata McGraw Hill, New Delhi.
5. G. D. Rai, Nonconventional energy sources, Khanna Publication.
6. Dickinson & Cheremision off, Solar Energy Technology vol I & II.
7. Tony Burton, David Sharpe, Nick Jenkins, Ervin Bossanyi ,Wind Energy Handbook (2001), John Wiley & Sons, ISBN: 0471489972.
8. James Manwell, J. F. Manwell, J. G. McGowan, Wind Energy Explained: Theory, Design and Application (2002), John Wiley and Sons Ltd, ISBN: 0471499722
9. Z. Lubosny, Wind Turbine Operation in Electric Power Systems (2003), Springer-Verlag New York, Inc ; ISBN: 354040340X.
10. Z. Lubosny, Wind Turbine Operation in Electric Power Systems (2003), Springer-Verlag New York, Inc ; ISBN: 354040340X.
11. G.F. Gilman, Boiler Control Systems Engineering, 2005, ISA Publication.

Sub code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract	Tut.	Total
ISDLO8045	Functional Safety	4	-	-	4	---	--	4

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISDLO8045	Functional safety	20	20	20	80	--	-	--	100

Subject Code	Subject Name	Credits
ISDLO8045	Functional Safety	4
Course Objectives	To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.	
Course Outcomes	The students will be able to 1. Define the role of Safety instrumented system in the industry. 2. Describe steps involved in Safety life cycle 3. Explain process and safety control with SIS technologies. 4. Learn types of events and combined probability calculations. 5. Identify and analyse the hazards 6. Determine the Safety integrity level.	

Details of Syllabus:

Prerequisite: Digital Electronics, transducers and Process Control.

Module	Contents	Hrs.	CO Mapping
1	**Introduction :** Safety Instrumented System (SIS) - need, features, components, difference between basic process control system and SIS, Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions. Standards and Regulation – HSE-PES, AIChE-CCPS, IEC-61508, IEC 61511 (2-16), ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996.9, NFPA 85.10, API RP 556,11 , API RP 14C,11, OSHA (29 CFR 1910.119 – Process Saftey Management of Highly Hazardous Chemicals)	06	CO1
2	**Safety life cycle:** Standards and safety life cycle, analysis phase, realisation phase, operations phase Allocation of Safety Functions to Protection Layers, Develop Safety Requirements Specifications, SIS Design and Engineering, Installation,	06	CO2

	Commissioning and Validation, Operations and Maintenance, Modification, De-commissioning.		
3	**Process Control** Active / Dynamic , Safety Control – Passive / Dormant, Demand Mode vs. Continuous Mode, Separation of Control and Safety Systems - HSE-PES, AIChE-CCPS, IEC-61508, Common Cause and Systematic or Functional Failures, **Protection Layers**: Prevention and mitigation layers, SIS Technologies: Pneumatic Systems, Relay Systems, Solid State Systems, Microprocessors / PLC (Software based) Systems	08	CO3
4	**Rules of Probability:** Assigning probability to an event, types of events and event combination, combining event probabilities, fault tree analysis, failure rate and probability, simplifications and approximations.	08	CO4
5	**Process Hazard Analysis:** Consequence analysis: Characterisation of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools. Likelihood analysis: estimation and statistical analysis, fault propagation, event tree analysis and fault tree analysis, Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities HAZOP and SIL calculation and verification.	12	CO5
6	**Determining the Safety Integrity Level (SIL) :** Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA) .	08	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Reference Books:

1. Paul Gruhn and H Jarry L. Cheddie," Safety Instrumented systems: Design, Analysis and Justification", ISA , 2nd edition, 2006
2. Dr. Eric W Scharpf, Heidi J Hartmann, Harlod W Thomas, " Practical SIL target selection : Risk analysis per the IEC 61511 safety Lifecycle", exida,2012.
3. Ed Marszal, Eric W Scharpf , "Safety Integrity Level Selection", ISA.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8021	**Project Management (abbreviated as PM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8021	Project Management	20	20	20	80	03	-	100

Course Objectives	• To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. • To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.
Course Outcomes	Student will be able to… • Apply selection criteria and select an appropriate project from different options. • Write work break down structure for a project and develop a schedule based on it. • Identify opportunities and threats to the project and decide an approach to deal with them strategically. • Use Earned value technique and determine & predict status of the project. • Capture lessons learned during project phases and document them for future reference

Module	Contents	Hours
1	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
2	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
3	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and	8

	bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	
4	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
5	**Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **Project Contracting** Project procurement management, contracting and outsourcing,	8
6	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Books Recommended:

Reference Books:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8022	**Finance Management (abbreviated as FM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8022	Finance Management	20	20	20	80	03	-	100

Course Objectives	• Overview of Indian financial system, instruments and market • Basic concepts of value of money, returns and risks, corporate finance, working capital and its management • Knowledge about sources of finance, capital structure, dividend policy
Course Outcomes	Student will be able to… • Understand Indian finance system and corporate finance • Take investment, finance as well as dividend decisions

Module	Contents	Hours
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	6
2	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	6
3	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market	9

	Ratios; Limitations of Ratio Analysis.	
4	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10

Books Recommended:

Reference Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8023	**Entrepreneurship Development and Management (abbreviated as EDM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8023	Entrepreneurship Development and Management	20	20	20	80	03	-	100

Course Objectives	• To acquaint with entrepreneurship and management of business • Understand Indian environment for entrepreneurship • Idea of EDP, MSME
Course Outcomes	Student will be able to… • Understand the concept of business plan and ownerships • Interpret key regulations and legal aspects of entrepreneurship in India • Understand government policies for entrepreneurs

Module	Contents	Hours
1	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	4
2	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	9
3	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	5
4	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies	8

	of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
5	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	8
6	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	5

Books Recommended:

Reference Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai			
Course	**Course Name**	**Teaching Scheme**	**Credits Assigned**

Code		(Contact Hours)				
		Theory	Tutorial	Theory	Tutorial	Total
ILO8024	**Human Resource Management (abbreviated as HRM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8024	Human Resource Management	20	20	20	80	03	-	100

Course Objectives	• To introduce the students with basic concepts, techniques and practices of the human resource management. • To provide opportunity of learning Human resource Management (HRM) processes, related with the functions, and challenges in the emerging perspective. • To familiarize the students about the latest developments, trends & different aspects of HRM. • To acquaint the student with the importance of behavioral skills, Inter-personal, inter- group in an organizational setting. • To prepare the students as future organizational change facilitators, stable leaders and managers, using the knowledge and techniques of human resource management.
Course Outcomes	Learner will be able to… • Gain knowledge and understand the concepts about the different aspects of the human resource management. • Understand and tackle the changes and challenges in today's diverse, dynamic organizational setting and culture. • Utilize the behavioral skill sets learnt, in working with different people, teams & groups within the national and global environment. • Apply the acquired techniques, knowledge and integrate it within the engineering/ non engineering working environment emerging as future engineers and managers.

Module	Contents	Hours
1	**Introduction to HR:** Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	05
2	**Organizational Behavior (OB) :** Introduction to OB Origin, Nature and	07

	Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues, Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness, Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	
3	**Organizational Structure & Design:** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	06
4	**Human resource Planning:** Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	05
5	**Emerging Trends in HR :** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment, Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	06
6	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Books Recommended:

Reference Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8025	**Professional Ethics and Corporate Social Responsibility (abbreviated as PECSR)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8025	Professional Ethics and Corporate Social Responsibility	20	20	20	80	03	-	100

Course Objectives	• To understand professional ethics in business • To recognized corporate social responsibility
Course Outcomes	Student will be able to… • Understand rights and duties of business • Distinguish different aspects of corporate social responsibility • Demonstrate professional ethics • Understand legal aspects of corporate social responsibility

Module	Contents	Hours
1	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
2	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
3	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
4	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business;	05

	Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	
5	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
6	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Books Recommended:

Reference Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8026	**Research Methodology (abbreviated as RM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8026	Research Methodology	20	20	20	80	03	-	100

Course Objectives	• To understand Research and Research Process • To acquaint students with identifying problems for research and develop research strategies • To familiarize students with the techniques of data collection, analysis of data and interpretation
Course Outcomes	Student will be able to… • Prepare a preliminary research design for projects in their subject matter areas • Accurately collect, analyze and report data • Present complex data or situations clearly • Review and analyze research findings

Module	Contents	Hours
1	**Introduction and Basic Research Concepts:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences , Objectives of Research, **Issues** and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	10
2	**Types of Research:** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	08
3	**Research Design and Sample Design :** Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	08
4	**Research Methodology :** Meaning of Research Methodology, Stages in Scientific Research Process **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis	08

	e. Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	
5	**Formulating Research Problem:** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
6	**Outcome of Research:** Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	04

Books Recommended:

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2^{nd}ed), Singapore, Pearson Education

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8027	**IPR and Patenting (abbreviated as IPRP)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8027	IPR and Patenting	20	20	20	80	03	-	100

Course Objectives	• To understand intellectual property rights protection system • To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures • To get acquaintance with Patent search and patent filing procedure and • applications
Course Outcomes	Student will be able to… • understand Intellectual Property assets • assist individuals and organizations in capacity building • work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Contents	Hours
1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
2	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
3	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	06
4	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications	07

	(e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
6	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Books Recommended:

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield,2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph&Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar andmohdIqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. KompalBansal and PraishitBansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005,Intellectual Property Rights for Engineers,IET

15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8028	**Digital Business Management (abbreviated as DBM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8028	Digital Business Management	20	20	20	80	03	-	100

Course Objectives	• To familiarize with digital business concept • To acquaint with E-commerce • To give insights into E-business and its strategies
Course Outcomes	Student will be able to ….. • Identify drivers of digital business • Illustrate various approaches and techniques for E-business and management • Prepare E-business plan

Module	Contents	Hours
1	**Introduction to Digital Business:** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce: E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system, **Application Development:** Building Digital business Applications and Infrastructure	06

4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business, Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, ryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**M Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Books Recommended:

Reference Books:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-en OECD Publishing

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

University of Mumbai						
Course Code	**Course Name**	**Teaching Scheme (Contact Hours)**		**Credits Assigned**		
		Theory	**Tutorial**	**Theory**	**Tutorial**	**Total**
ILO8029	**Environmental Management (abbreviated as EVM)**	**3**	**-**	**3**	**-**	**3**

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
ILO8029	Environmental Management	20	20	20	80	03	-	100

Course Objectives	• Understand and identify environmental issues relevant to India and global concerns • Learn concepts of ecology • Familiarise environment related legislations
Course Outcomes	Student will be able to… • Understand the concept of environmental management • Understand ecosystem and interdependence, food chain etc. • Understand and interpret environment related legislations

Module	Contents	Hours
1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
2	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
3	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
4	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
5	Total Quality Environmental Management, ISO-14000, EMS certification.	05
6	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Books Recommended:

Reference Books:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3: Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining question will be randomly selected from all the modules.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL801	Instrumentation Project Documentation and Execution- Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Theory(out of 100)				Term work	Pract. And oral	Oral	Total
		Internal Assessment			End sem exam				
		Test1	Test2	Avg.					
ISL801	Instrumentation Project Documentation and Execution- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL801	Instrumentation Project Documentation and Execution	1
Course objective	1. To provide knowledge of types and execution of I&C type project 2. This Course aims to explain Project deliverables and engineering activities of project documentation. 3. To get acquainted with commercial software used for documentation.	
Course Outcome	The students will able to 1. Apply standards used in instrumentation project for preparation of deliverables. 2. Interpret, design and construct documents such as PFD , P&ID, Index sheet. 3. Apply ISA specification data sheet / loop standard, to prepare Instrument specification sheet and construct loop wiring diagram. 4. Interpret, design and construct Hook-up diagram, and develop skill to prepare different project schedule. 5. Select and apply procurement, installation procedure and pre-commissioning and commissioning activities with Inspection. 6. Select and support documentation software packages used in industry.	

Syllabus: Same as that of Subject ISC801 Instrumentation Project Documentation and Execution.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Summarize instrument/unit symbols and identification, tagging and line designation procedure from ISA/ANSII Standard	CO1
2	Apply symbols and identification standard for preparation of graphical document such as Process Flow Diagrams.	CO2
3	To develop of Piping & Instrumentation Diagram using PFD of Expt-2.	CO2
4	Prepare instrument index sheet for tags used in P&ID of Expt-3.	CO2
5	Prepare ISA specification forms (for temperature, pressure, level ,flow instruments, CV)	CO3
6	Develop loop wiring diagram of pneumatic and electronic loops.	CO3
7	Develop sample hook-up drawing and prepare BOM.	CO4
8	Study and Development of Detailed Engineering schedules.(Project schedule / Cable schedule / JB schedule / AH schedule)	CO4
9	Learn procedure to perform pre-commissioning activities.(Hydro Test / Loop checking / Trouble shooting /calibration of DPT or Control valve etc)	CO5
10	Survey of instrumentation software and study different features	CO6

Practical/Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of Laboratory work which includes minimum study of eight experiments/ assignments / Creation of Documents
Other task: (Optional) Visit to any one Engineering consultants office /organizations to understand their Working Environment & submission of Report.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments/Assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance (Theory and Practical) : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL802	Instrument and System Design Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL802	Instrument and System Design Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL802	Instrument and System Design Lab Practice	1
Course objective	1. To impart knowledge of selection and design considerations of transducers along with its calibration techniques. 1. To make the students capable of sizing the control valve. 2. To give the students knowledge about the types, sizing of control panels and standards. 3. To make the students capable to apply knowledge to design electronic product, control room layout and its environment. 4. To give the students a comprehension of the aspects of reliability engineering.	
Course Outcome	The students will able to 1. Calculate performance characteristics of a given transducer and calibrate transducers 2. Select and size control valves and actuators. 3. Apply knowledge to size the control panels. 4. Apply knowledge in electronic product and enclosure design 5. Describe the terms used in Reliability engineering. 6. Apply knowledge in designing control room layout and its environment.	

Syllabus: Same as that of Subject ISC802 Instrument and System Design.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	To study the performance characteristics of transducer/ instrument	CO1
2	To calibrate temperature, flow, pressure or level transducers	CO1
3	To calculate Cv of a given valve (use Cv characteristic set up)	CO2
4	To size the control panel for any one application.	CO3
5	To design the layout of a control room.	CO6
6	Assignment on design of transducers.	CO1
7	Assignment on valve sizing for liquid services and gas/vapors.	CO2
8	Assignment on valve sizing for flashing, Newtonian fluids and mixed flow services	CO2
9	Assignment on estimation of control valve Noise and Cavitations	CO2
10	Assignment: examples on actuator sizing	CO2
11	Assignment on control panel design	CO3
12	Assignment on electronic product design and enclosure design	CO4
13	Assignment on reliability engineering.	CO5
14	Assignment on control room design and its environment	CO6

Any other experiments/assignments based on syllabus which will help students to understand topic/concept.

Note:

1) Minimum of four experiments and four assignments can be performed during the semester for term work and oral examination.
2) Industry visit is advised to understand the Instrument and System Design subject.

Practical/Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:
Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments)	: 10 Marks
Laboratory work (programs / journal)	: 10 Marks
Attendance	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL 803	Expert System- Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Theory(out of 100)				Term work	Pract. And oral	Oral	Total
		Internal Assessment			End sem exam				
		Test1	Test2	Avg.					
ISL 803	Expert System- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL803	Expert System- Lab Practice	1
Course objective	1. To provide an understanding on the fundamentals of neural network and fuzzy systems. 2. To learn the different intelligent techniques for control 3. To gain knowledge in Expert systems 4. To gain knowledge in genetic algorithm.	
Course Outcome	The students will able to 1. Identify various networks and learning algorithms in artificial neural network. 2. Define Fuzzy set, rules and membership function and also defuzzification for a given problem. 3. Identify areas of application for Expert Systems. 4. Apply the concepts of ANN and Fuzzy Logic in solving engineering problems and implementing controllers. 5. Discuss various concepts of Genetic Algorithm 6. Identify various hybrid control strategies.	

Syllabus: Same as that of Subject ISDLO8041 Expert System.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Example for Perceptron learning	CO1
2	Multilayer Feedforward neural networks	CO1
3	Hopfield model for pattern storage task	CO1
4	Solution to travelling salesman problem using ANN	CO1
5	Temperature controller using Fuzzy logic	CO2
6	Washing machine control using Fuzzy logic	CO2
7	Design of PID control using ANN and Fuzzy Toolbox.	CO4
8	Assignment on Expert systems	CO3
9	Assignment on Expert Systems	CO3
10	Assignment on Genetic algorithm	CO5
11	Assignment on Hybrid control schemes	CO6

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL803	Internet of Things- Lab Practice	-	02	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL803	Internet of Things- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL803	Internet of Things- Lab Practice	1
Course objectives	1. To impart knowledge about fundamentals of IoT 2. To describe data and knowledge management and use of devices in IoT technology. 3. To give knowledge of IoT architecture and Integration of embedded devices with IoT 4. To explain the concept of IIoT. 5. To impart knowledge about designing of industrial internet systems. 6. To describe overview of Android/ IOS app development tools and Internet of Everything	
Course Outcomes	The students will be able to : 1. Use microcontroller based embedded platforms in IOT 2. Use microprocessor based embedded platforms in IOT 3. Use wireless peripherals for exchange of data. 4. Make use of Cloud platform to upload and analyse any sensor data 5. Use of Devices, Gateways and Data Management in IoT. 6. Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.	

Syllabus: Same as that of Subject **ISDLO8043 Internet of Things**.

List of Suggested Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Introduction to Arduino platform and programming	CO1
2	Interfacing Arduino to Zigbee module	CO1,CO3
3	Interfacing Arduino to GSM module	CO1,CO3
4	Interfacing Arduino to Bluetooth Module	CO1,CO3
5	Introduction to Raspberry PI platform and python programming	CO2

6	Interfacing sensors to Raspberry PI	CO2
7	Communicate between Arduino and Raspberry PI using any wireless medium	CO1,CO2,CO3
8	Setup a cloud platform to log the data	CO4
9	Log Data using Raspberry PI and upload to the cloud platform	CO5
10	Design an IOT based system	CO6

Any other additional experiment based on syllabus which will help students to understand topic/concept

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 08 experiments from the above given list and 02 assignments from imaging techniques module and electrical safety module.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL803	Power Plant Instrumentation -Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
		Test 1	Test 2	Avg.					
ISL803	Power Plant Instrumentation- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL803	**Power Plant Instrumentation- Lab Practice**	**1**
Course objectives	To create awareness of energy resources and its scenario in India and worldwide. 1. To study the concept of power generation using various resources. 2. To study the role of Instrumentation in various power plants. 3. To study and compare various power plants for optimal performance. 4. To acquire students the knowledge about hazards and safety in handling power plants.	
Course Outcomes	The students will be able to: 1. Identify the energy sources and explain power generation. 2. Describe operation and control of various equipment in thermal power plant. 3. Select the sites for hydroelectric power plants and explain its operation. 4. Explain the power generation and control of Nuclear power plant. 5. Describe the non-conventional energy resources. 6. Compare different types of power plants.	

Syllabus: Same as that of Subject ISDLO8044 Power Plant Instrumentation.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Assignment on Energy Sources	**CO1**
2	Assignment on Thermal Power plant	**CO2**
3	Assignment on Hydroelectric power plant	**CO3**
4	Assignment on Nuclear Power plant	**CO4**
5	Assignment on Nonconventional Energy Resources	**CO5**
6	Assignment on Comparison of various power plants	**CO6**
7	Assignment on Introduction to Hybrid Power generation concept	**CO6**

Additional experiments/assignments based on syllabus which will help students to understand topic/concept can be considered.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL803	Functional Safety- Lab Practice	-	02	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL803	Functional Safety - Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL803	**Functional Safety- Lab Practice**	**1**
Course objectives	To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.	
Course Outcomes	The students will be able to 1. Define the role of Safety instrumented system in the industry. 2. Describe steps involved in Safety life cycle 3. Explain process and safety control with SIS technologies. 4. Learn types of events and combined probability calculations. 5. Identify and analyse the hazards 6. Determine the Safety integrity level.	

Syllabus: Same as that of Subject ISDLO8045 Functional Safety.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Assignment on Introduction to Functional safety	CO1
2	Assignment on Safety Life cycle	CO2
3	Assignment on Protection layers and SIS technologies	CO3
4	Assignment on Rules of Probability- types of events, numerical	CO4
5	Assignment on Rules of Probability – numerical on event tree and fault tree analysis	CO4
6	Assignment on Consequence analysis	CO5
7	Assignment on Process hazard	CO5
8	Assignment on SIL determination methods	CO6
9	Assignment on Fault propagation modelling techniques using Excel	CO5
10	Assignment on SIL determination using Excel	CO6
11	Case study	CO1-CO6

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

- Industry visit is advised to understand the Functional Safety subject.

Practical/Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of

Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL804	Project-II	-	12	-	-	6	-	6

Sub Code	Subject Name	Examination scheme Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL804	Project-II	-	-	-	-	100	-	50	150

Term Work:

The final year students have already under gone project assignment in their seventh semester and in this semester the students are expected to continue the project work of stage I.
The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding TW marks. The TW should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

1. Scope and objective of the project work.
2. Extensive Literature survey.
3. Progress of the work (Continuous assessment)
4. Design, implementation, and analysis of the project work.
5. Results, conclusions and future scope.
6. Report in prescribed University format.

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained.

UG- Electronics and Telecommunication Engineering

Sr. No.	Subject Code	Subject Name	Count
1	ECC302,ECL301	Electronic Devices & Circuits,Electronic Devices & Circuits Lab	2
2	ECC303,ECL302	Digital System Design,Digital System Design Lab	2
3	ECC305,ECL303	Electronic Instrumentation & Control Systems,Electronic Instrumentation & Control Systems Lab	2
4	ECL304	Skill Lab: C++ and Java Programming	1
5	ECM301	Mini Project 1A	1
6	ECC402,ECL401	Microcontrollers,Microcontrollers Lab	2
7	ECC403,ECL402	Linear Integrated Circuits,Linear Integrated Circuits Lab	2
8	ECC405,ECL403	Principles of Communication Engineering,Principles of Communication Engineering Lab	2
9	ECL404	Skill Lab: Python Programming	1
10	ECM401	Mini Project 1B	1
11	ECC501,ECL501	Microprocessor & Peripherals InterfacingMicroprocessor & Peripherals Interfacing Lab	2

12	ECC502,ECL502	Digital Communication,Digital Communication Lab	**2**
13	ECC503	Electromagnetic Engineering	**1**
14	ECC504	Discrete Time Signal Processing	**1**
15	ECCDLO501X,ECLDLO501X	Department Level Optional Course I,Department Level Optional Lab I	**2**
16	ECL504	Open Source Technology for Communication Lab	**1**
17	ECC601,ECL601	Microcontrollers & Applications,Microcontroller & Applications Lab	**2**
18	ECC602,ECL602	Computer Communication Networks,Computer Communication Network Lab	**2**
19	ECC603,ECL603	Antenna & Radio Wave Propagation,Antenna & Radio Wave Propagation Lab	**2**
20	ECC604,ECL604	Image Processing and Machine Vision,Image Processing and Machine Vision Lab	**2**
21	ECCDLO602X,ECLDLO 602X	Department Level Optional Course II,Department Level Optional Lab II	**2**
22	ECC701,ECL701	Microwave Engineering,Microwave Engineering Lab	**2**
23	ECC702,ECL702	Mobile Communication System,Mobile Communication System Lab	**2**
24	ECC703,ECL703	Optical Communication,Optical Communication Lab	**2**
25	ECCDLO 703X,ECLDLO 703X	Department Level Optional Course III, Department Level Optional Lab III	**2**

26	ECL704	Project-I	**1**
27	ECC801,ECL801	RF Design, RF Design Lab	**2**
28	ECC802,ECL802	Wireless Networks, Wireless Networks Lab	**2**
29	ECCDLO804X, ECLDLO804X	Department Level Optional Course IV, Department Level Optional Lab IV	**2**
30	ECL803	Project-II	**1**
		Total	**51**

Item No. 145
AC – 23/07/2020

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Electronics and Telecommunication Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Item No. 145
AC – 23/07/2020

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year B.E. Electronics and Telecommunication Engineering**
2	Eligibility for Admission	**After Passing First Year Engineering as per the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	**New** / ~~Revised~~ (Strike out which is not applicable)
9	To be implemented from Academic Year	**With effect from Academic Year: 2020-2021**

Date 02-07-2020

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 171, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface By BoS

Technological developments in the field of electronics and telecommunication engineering have revolutionized the way people see the world today. Hence, there is a need for continuously enriching the quality of education by a regular revision in the curriculum, which will help our students achieve better employability, start-ups, and other avenues of higher studies. The current revision in the Bachelor of Engineering program (REV- 2019 'C' Scheme) aims at providing a strong foundation with required analytical concepts in the field of electronics and telecommunication engineering.

Some of the salient features of this revised curriculum are as below and they fall in line with the features in AICTE Model Curriculum.

1. The curriculum is designed in such a way that it encourages innovation and research as the total number of credits has been reduced from around 200 credits in an earlier curriculum to 171 credits in the current revision.
2. In the second and third-year curriculum, skill-based laboratories and mini-projects are introduced.
3. It will result in the students developing a problem-solving approach and will be able to meet the challenges of the future.
4. The University of Mumbai and BoS – Electronics and Telecommunication Engineering will ensure the revision of the curriculum on regular basis in the future as well and this update will certainly help students to achieve better employability; start-ups and other avenues for higher studies.

The BoS would like to thank all the subject experts, industry representatives, alumni, and various other stakeholders for their sincere efforts and valuable time in the preparation of course contents, reviewing the contents, giving valuable suggestions, and critically analyzing the contents.

Board of Studies in Electronics and Telecommunication Engineering

Dr. Faruk Kazi: Chairman

Dr. V. N. Pawar: Member

Dr. Ravindra Duche: Member

Dr. Milind Shah: Member

Dr. R. K. Kulkarni: Member

Dr. Baban U. Rindhe: Member

Dr. Mrs. Nair: Member

Dr. Nalbarwar: Member

Dr. Sudhakar Mande: Member

Dr. S. D. Deshmukh: Member

Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC301	Engineering Mathematics-III	3	--	1*	3	--	1	4
ECC302	Electronic Devices & Circuits	3	--	--	3	--	--	3
ECC303	Digital System Design	3	--	--	3	--	--	3
ECC304	Network Theory	3	--	1	3	--	1	4
ECC305	Electronic Instrumentation & Control Systems	3	--	--	3	--	--	3
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1
ECL302	Digital System Design Lab	--	2	--	--	1	--	1
ECL303	Electronic Instrumentation & Control Systems Lab	--	2	--	--	1	--	1
ECL304	Skill Lab: C++ and Java Programming	--	4	--	--	2	--	2
ECM301	Mini Project 1A	--	4$	--	--	2	--	2
Total		**15**	**14**	**2**	**15**	**07**	**2**	**24**

*** Should be conducted batch wise.**
$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ECC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ECC302	Electronic Devices & Circuits	20	20	20	80	3	--	--	100
ECC303	Digital System Design	20	20	20	80	3	--	--	100
ECC304	Network Theory	20	20	20	80	3	25	--	125
ECC305	Electronic Instrumentation & Control Systems	20	20	20	80	3	--	--	100
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	--	25	25	50
ECL302	Digital System Design Lab	--	--	--	--	--	25	--	25
ECL303	Electronic Instrumentation & Control Systems Lab	--	--	--	--	--	25	--	25
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	--	25	25	50
ECM301	Mini Project 1A	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**175**	**75**	**750**

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC401	Engineering Mathematics-IV	3	--	1*	3	--	1	4
ECC402	Microcontrollers	3	--	--	3	--	--	3
ECC403	Linear Integrated Circuits	3	--	--	3	--	--	3
ECC404	Signals & Systems	3	--	1	3	--	1	4
ECC405	Principles of Communication Engineering	3	--	--	3	--	--	3
ECL401	Microcontrollers Lab	--	2	--	--	1	--	1
ECL402	Linear Integrated Circuits Lab	--	2	--	--	1	--	1
ECL403	Principles of Communication Engineering Lab	--	2	--	--	1	--	1
ECL404	Skill Lab: Python Programming	--	4	--	--	2	--	2
ECM401	Mini Project 1B	--	4$	--	--	2	--	2
Total		**15**	**14**	**2**	**15**	**7**	**2**	**24**

*** Should be conducted batch wise.**

$ Indicates work load of a learner (Not Faculty) for Mini Project 1B. Faculty Load: 1 hour per week per four groups.

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ECC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
ECC402	Microcontrollers	20	20	20	80	3	--	--	100
ECC403	Linear Integrated Circuits	20	20	20	80	3	--	--	100
ECC404	Signals & Systems	20	20	20	80	3	25	--	125
ECC405	Principles of Communication Engineering	20	20	20	80	3	--	--	100
ECL401	Microcontrollers Lab	--	--	--	--	--	25	--	25
ECL402	Linear Integrated Circuits Lab	--	--	--	--	--	25	25	50
ECL403	Principles of Communication Engineering Lab	--	--	--	--	--	25	25	50
ECL404	Skill Lab: Python Programming	--	--	--	--	--	25	25	50
ECM401	Mini Project 1B	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**175**	**100**	**775**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ECC301	Engineering Mathematics-III	03	-	01*	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Exam Dura-tion (in Hrs.)	Term Work	Pract & Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ECC301	Engineering Mathematics-III	20	20	20	80	03	25	-	125

*** Should be conducted batch wise.**

Pre-requisite:

1. FEC101-Engineering Mathematics-I
2. FEC201-Engineering Mathematics-II
3. Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives: The course is aimed

1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications.
2. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.
3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra.
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: After successful completion of course student will be able to:

1. Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2. Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
5. Use matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t,* Laplace Transform of derivatives and integrals (Properties without proof). Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	7
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	7
04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z)Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	7
05	**Module: Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	6
06	**Module: Vector Differentiation and Integra**l 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector	6

	fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	
Total		39

References:

1. Advanced engineering mathematics, H.K. Das, S . Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Internal Assessment Test (20-Marks):

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Question No: 01 will be compulsory and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. Total 04 questions need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC302	Electronic Devices & Circuits	3	-	--	3	--	--	3

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC302	Electronic Devices & Circuits	20	20	20	80	03	--	--	100

Course pre-requisite:

FEC: 102 - Engineering Physics-I
FEC: 201 - Engineering Physics-II
FEC:105 - Basic Electrical Engineering

Course Objectives:

1. To explain functionality different electronic devices.
2. To perform DC and AC analysis of small signal amplifier circuits.
3. To analyze frequency response of small signal amplifiers.
4. To compare small signal and large signal amplifiers.
5. To explain working of differential amplifiers and it's applications in Operational Amplifiers

Course Outcomes:

After successful completion of the course student will be able to:

1. Know functionality and applications of various electronic devices.
2. Explain working of various electronics devices with the help of V-I characteristics.
3. Derive expressions for performance parameters of BJT and MOSFET circuits.
4. Evaluate performance of Electronic circuits (BJT and MOSFET based).
5. Select appropriate circuit for given application.
6. Design electronic circuit (BJT, MOSFET based) circuits for given specifications.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction of Electronic Devices**	**05**
	1.1	Study of pn junction diode characteristics & diode current equation. Application of zener diode as a voltage regulator.	
	1.2	Construction, working and characteristics of BJT, JFET, and E-MOSFET	
2.0		**Biasing Circuits of BJTs and MOSFETs**	**06**
	2.1	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias)	
	2.2	DC load line and region of operation for MOSFETs. Analysis and design of biasing circuits for JFET (self bias and voltage divider bias), E-MOSFET (Drain to Gate bias & voltage divider bias).	
3.0		**Small Signal Amplifiers**	**06**
	3.1	Concept of AC load line and Amplification, Small signal analysis (Zi, Zo, Av and Ai) of CE amplifier using hybrid pi model.	
	3.2	Small signal analysis (Zi, Zo, Av) of CS (for EMOSFET) amplifiers.	
	3.3	Introduction to multistage amplifiers.(Concept, advantages & disadvantages)	
4.0		**Frequency response of Small signal Amplifiers:**	**08**
	4.1	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance.	
	4.2	High and low frequency analysis of CE amplifier.	
	4.3	High and low frequency analysis of CS (E-MOSFET) amplifier.	
5.0		**Large Signal Amplifiers:**	**06**
	5.1	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier	
	5.2	Analysis of Class A power amplifier (Series fed and transformer coupled).	
	5.3	Transformer less Amplifier: Class B power amplifier. Class AB output stage with diode biasing	
	5.4	Thermal considerations and heat sinks.	
6.0		**Introduction to Differential Amplifiers**	**08**
	6.1	E-MOSFET Differential Amplifier, DC transfer characteristics, operation with common mode signal and differential mode signal	
	6.2	Differential and common mode gain, CMRR, differential and common mode Input impedance.	
	6.3	Two transistor (E-MOSFET) constant current source	
		Total	**39**

Text books:

1. D. A. Neamen, “Electronic Circuit Analysis and Design,” Tata McGraw Hill, 2ndEdition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, “Microelectronic Circuits Theory and Applications,” International Version, OXFORD International Students, 6thEdition
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

References:

1. Boylestad and Nashelesky, “Electronic Devices and Circuits Theory,” Pearson Education, 11th Edition.
2. A. K. Maini, “Electronic Devices and Circuits,” Wiley.
3. T. L. Floyd, “Electronic Devices,”Prentice Hall, 9th Edition, 2012.
4. S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, Tata Mc-Graw Hill, 3rd Edition
5. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

NPTEL/ Swayam Course:

1. Course: Analog Electronic Circuit By Prof. Shouribrata chatterjee (IIT Delhi); https://swayam.gov.in/nd1_noc20_ee89/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC303	Digital System Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (Hrs.)	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
ECC303	Digital System Design	20	20	20	80	03	--	--	100

Course Pre-requisite:

FEC105 – Basic Electrical Engineering

Course Objectives:

1. To understand number system representations and their inter-conversions used in digital electronic circuits.
2. To analyze digital logic processes and to implement logical operations using various combinational logic circuits.
3. To analyze, design and implement logical operations using various sequential logic circuits.
4. To study the characteristics of memory and their classification.
5. To learn basic concepts in VHDL and implement combinational and sequential circuits using VHDL.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand types of digital logic, digital circuits and logic families.
2. Analyze, design and implement combinational logic circuits.
3. Analyze, design and implement sequential logic circuits.
4. Develop a digital logic and apply it to solve real life problems.
5. Classify different types of memories and PLDs.
6. Simulate and implement basic combinational and sequential circuits using VHDL/Verilog.

Module No.	Unit No.	Topics	Hrs.
1.0		**Number Systems and Codes**	**04**
	1.1	Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code, Binary Arithmetic, Addition, Subtraction using 1's and 2's Complement	04
2.0		**Logic Family and Logic Gates**	**05**
	2.1	Difference between Analog and Digital signals, Logic levels, TTL and CMOS Logic families and their characteristics	03
	2.2	Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem	02
3.0		**Combinational Logic Circuits**	**12**
	3.1	SOP and POS representation, K-Map up to four variables and Quine-McClusky method for minimization of logic expressions	04
	3.2	Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Carry Look ahead adder and BCD adder, Magnitude Comparator	04
	3.3	Multiplexer and De-Multiplexer: Multiplexer operations, cascading of Multiplexer, Boolean function implementation using MUX, DEMUX and basic gates, Encoder and Decoder	04
4.0		**Sequential Logic Circuits**	**12**
	4.1	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register	04
	4.2	Counters: Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N, BCD Counter	04
	4.3	Applications of Sequential Circuits: Frequency division, Ring counter, Johnson counter, Introduction to design of Moore and Mealy circuits	04
5.0		**Different Types of Memories and Programmable Logic Devices**	**04**
	5.1	Classification and Characteristics of memory, SRAM, DRAM, ROM, PROM, EPROM and Flash memories	02
	5.2	Introduction: Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic (PAL)	02
6.0		**Introduction to VHDL**	**02**
	6.1	Basics of VHDL/Verilog Programming, Design and implementation of adder, subtractor, multiplexer and flip flop using VHDL/Verilog	02
		Total	**39**

Text Books:

1. John F. Warkerly, “Digital Design Principles and Practices”, Pearson Education, Fifth Edition (2018).
2. Morris Mano, Michael D. Ciletti, “Digital Design”, Pearson Education, Fifth Edition (2013).
3. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill Education, Forth Edition (2010).
4. A. Anand Kumar, “Fundamentals of Digital Circuits”, PHI, Fourth Edition (2016).
5. Volnei A. Pedroni, “Digital Electronics and Design with VHDL” Morgan Kaufmann Publisher, First Edition (2008).
6. Stephen Brown & Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, Third Edition, MGH (2014).

Reference Books:

1. Thomas L. Floyd, “Digital Fundamentals”, Pearson Prentice Hall, Eleventh Global Edition (2015).
2. Mandal, “Digital Electronics Principles and Applications”, McGraw Hill Education, First Edition (2010).
3. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss “Digital Systems Principles and Applications”, Ninth Edition, PHI (2009).
4. Donald P. Leach / Albert Paul Malvino/Gautam Saha, “Digital Principles and Applications”, The McGraw Hill, Eight Edition (2015).
5. Stephen Brown & Zvonko Vranesic, “Fundamentals of Digital Logic Design with VHDL”, Second Edition, TMH (2009).
6. J. Bhasker, “A Verilog HDL Primer”, Star Galaxy Press, Third Edition (1997).

NPTEL / Swayam Course:

1. Course: Digital Circuits By Prof. Santanu Chattopadhyay (IIT Kharagpur); https://swayam.gov.in/nd1_noc20_ee70/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC304	Network Theory	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam. Duration (in Hrs)	Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of Test 1 and Test 2					
ECC304	Network Theory	20	20	20	80	03	25	--	125

Course Pre-requisite:

1. FEC105 - Basic Electrical Engineering
2. FEC201 - Engineerring Mathematics II

Course Objectives:

1. To evaluate the Circuits using network theorems.
2. To analyze the Circuits in time and frequency domain.
3. To study network Topology, network Functions and two port networks.
4. To synthesize passive network by various methods.

Course Outcomes:

After successful completion of the course student will be able to:

1. Apply their knowledge in analyzing Circuits by using network theorems.
2. Apply the time and frequency method of analysis.
3. Evaluate circuit using graph theory.
4. Find the various parameters of two port network.
5. Apply network topology for analyzing the circuit.
6. Synthesize the network using passive elements.

Module No.	Unit No.	Topics	Hrs.
1.0		**Electrical circuit analysis**	**08**
	1.1	Circuit Analysis: Analysis of Circuits with and without dependent sources using generalized loop and node analysis, super mesh and super node analysis technique Circuit Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems (Use only DC source).	
	1.2	Magnetic circuits: Concept of Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using mesh analysis (for Two Loops only).	
2.0		**Graph Theory**	**06**
	2.1	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix.	
	2.2	Relationship between sub matrices A, B & Q. KVL & KCL using matrix.	
3.0		**Time and frequency domain analysis**	**07**
3.0	**3.1**	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equation with step signals.	
	3.2	Frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor. Solution using second order equation for step signal.	
4.0		**Network functions**	**06**
	4.1	Network functions for the one port and two port networks, driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions, calculation of residues by graphical methods, testing for Hurwitz polynomial.	
	4.2	Analysis of ladder & symmetrical lattice network (Up to two nodes or loops)	
5.0		**Two port Networks**	**05**
	5.1	Parameters: Open Circuits, short Circuit, Transmission and Hybrid parameters, relationship among parameters, conditions for reciprocity and symmetry.	
	5.2	Interconnections of Two-Port networks T & π representation.	
6.0		**Synthesis of RLC circuits**	**07**
	6.1	Positive Real Functions: Concept of positive real function, necessary and sufficient conditions for Positive real Functions.	
	6.2	Synthesis of LC, RC & RL Circuits: properties of LC, RC & RL driving point functions, LC, RC & RL network Synthesis in Cauer-I & Cauer-II , Foster-I & Foster-II forms (Up to Two Loops only).	
		Total	**39**

Textbooks:

1. Franklin F Kuo, “Network Analysis and Synthesis”, Wiley Toppan, 2nd ed. ,1966.
2. M E Van Valkenburg, “Network Analysis”, Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.

Reference Books:

1. A. Chakrabarti*, “Circuit Theory”,* Dhanpat Rai & Co., Delhi, 6th Edition.
2. A. Sudhakar, Shyammohan S. Palli “Circuits and Networks”, Tata McGraw-Hill education.
3. Smarajit Ghosh “Network Theory Analysis & Synthesis”, PHI learning.
4. K.S. Suresh Kumar, “Electric Circuit Analysis” Pearson, 2013.
5. D. Roy Choudhury, “Networks and Systems” , New Age International, 1998.

NPTEL / Swayam Course:

1. Course: Basic Electrical Circuits By Prof. Nagendra Krishnapura (IIT Madras); https://swayam.gov.in/nd1_noc20_ee64/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Term Work (25-Marks):

At least **10 assignments** covering entire syllabus must be given during the **“Class Wise Tutorial”**. The assignments should be students’ centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per **“Credit and Grading System”** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC305	Electronic Instrumentation & Control Systems	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of Test 1 and Test 2					
ECC305	Electronic Instrumen-tation & Control Systems	20	20	20	80	03	--	--	100

Course pre-requisites:

1. FEC105 – Basic Electrical Engineering

Course Objectives:

1. To provide basic knowledge about the various sensors and transducers
2. To provide fundamental concepts of control system such as mathematical modeling, time response and Frequency response.
3. To develop concepts of stability and its assessment criteria.

Course Outcomes:

After successful completion of the course student will be able to:

1. Identify various sensors, transducers and their brief performance specification.
2. Understand the principle of working of various transducer used to measure temperature, displacement, level, pressure and their application in industry
3. Determine the models of physical systems in forms suitable for use in the analysis and design of control systems.
4. Obtain the transfer functions for a given Control system.
5. Understand the analysis of systems in time domain and frequency domain.
6. Predict stability of given system using appropriate criteria.

Module No.	Unit No.	Topics	Hrs.
1		**Principle of Measurement, Testing and Measuring instruments**	04
	1.1	Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration.	
	1.2	Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Mega ohm bridge Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge	
2		**Sensors and Transducers**	06
	2.1	Basics of sensors and Transducers-Active and passive transducers, characteristics and selection criteria of transducers	
	2.2	Displacement and pressure- Potentiometers, pressure gauges, linear Variable differential transformers (LVDT) for measurement of pressure and displacement strain gauges	
	2.3	Temperature Transducers- Resistance temperature detectors (RTD). Thermistors and thermocouples, their ranges and applications	
3		**Introduction to control system Analysis**	08
	3.1	Introduction: Open and closed loop systems, example of control systems	
	3.2	Modelling: Modelling, Transfer function model	
	3.3	Block diagram reduction techniques and Signal flow graph	
4		**Response of control system**	04
	4.1	Dynamic Response: Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types	
	4.2	Concept of lag and lead compensator.	
5		**Stability Analysis in Time Domain**	08
	5.1	Concept of stability: Routh and Hurwitz stability criterion	
	5.2	Root locus Analysis: Root locus concept, general rules for constructing root-locus, root locus analysis of control system	
6		**Stability Analysis in frequency domain**	09
	6.1	Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	
	6.2	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot. Frequency response analysis of RC, RL, RLC circuits	
	6.3	Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion, gain and phase margin	
Total			39

Textbooks:

1. A.K. Sawhney, "*Electrical & Electronic Measurement & Instrumentation"* – DRS .India
2. B.C Nakra, K.K. Cahudhary, Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
3. W.D. Cooper, "*Electronic Instrumentation And Measuring Techniques"* –PHI
4. Nagrath, M.Gopal, "*Control System Engineering*", Tata McGrawHill.
5. Rangan C. S., Sarma G. R. and Mani V. S. V., "*Instrumentation Devices And Systems*", Tata McGraw-Hill, 2nd Ed.,2004.
6. K.Ogata, "*Modern Control Engineering*, Pearson Education", IIIrd edition.

Reference Books:

1. Helfrick&Copper, "*Modern Electronic Instrumentation & Measuring Techniques"* –PHI
2. M.M.S. Anand, "*Electronic Instruments and instrumentationTechnology"*.
3. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd.New Delhi, 1998.
4. Benjamin C.Kuo, "*Automatic Control Systems*, Eearson education", VIIthedition
5. Doeblin E.D., Measurement system, Tata Mc Graw Hill., 4th ed, 2003.Madan Gopal, "Control Systems *Principles and Design"*, Tata McGraw hill, 7th edition,1997.
6. Normon, "*Control System Engineering"*, John Wiley & sons, 3rdedition.

NPTEL/ Swayam Course:

1. Course: Control Systems By Prof. C. S. Shankar Ram (IIT Madras); https://swayam.gov.in/nd1_noc20_ee90/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ECL301	Electronic Devices & Circuits Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. Of Test 1 and Test 2				
ECL301	Electronic Devices & Circuits Lab	--	--	--	--	25	25	50

Course Objectives:

1. To make students familiar with equipments and measuring instruments used to perform Electronics Devices and Circuits laboratory work.
2. To provide hands on experience to develop laboratory setup for performing given experimental using various equipments, electronic devices and measuring instruments.
3. To develop an ability among students to gather appropriate data and analyse the same to relate theory with practical.
4. To develop trouble shooting abilities among students.

Course Outcomes:

After successful completion of the course students will be able to:

1. Know various equipments, electronics devices and components, and measuring instruments used to perform laboratory work.
2. Students will be able to explain functionality of various equipments, electronics devices and components and neasu6 instruments used to perform laboratory work.
3. Students will be able connect various equipments, devices, components and measuring devices using bread board as per the circuit diagram for experiment to be performed.
4. Students will able to perform experiment to gather appropriate data.
5. Students will able to analyze data obtained from experiment to relate theory with experiment results.
6. Students will able to prepare laboratory report (Journal) to summarise the outcome each experiment.

Laboratory plan:

Maximum of 10 practicals including minimum 2 to 3 simulations should be conducted.
Suggested list of experiments:

1. To study of pn junction diode characteristics.
2. To study zener as a voltage regulator.
3. To study characteristics of CE configuration.
4. To study BJT biasing circuits.
5. To study BJT as CE amplifier.
6. To study frequency response of CE amplifier.
7. To study EMOSFET biasing circuits.
8. Simulation experiment on study of CS amplifier.
9. Simulation experiment on study frequency response of CS amplifier.
10. Simulation experiment on study of differential amplifier.
11. Simulation experiment on multistage amplifier.

Term Work: At least 10 Experiments including not more than 03 simulations covering entire syllabus must be given during the "Laboratory session batch wise". Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.
Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per **"Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL302	Digital System Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam.			
		Test 1	Test 2	Avg.				
ECL302	Digital System Design Lab	--	--	--	--	25	--	25

Course objectives:

1. To get familiarise with basic building blocks of Digital System Design and verify the operation of various digital ICs.
2. To train students to design and implementation of combinational circuits.
3. To instruct students on how to design and implement sequential circuits.
4. To introduce simulation software like VHDL/Verilog to design basic digital circuits.

Course outcomes:

Learners will be able to …

1. Identify various Digital ICs and basic building blocks of digital system design
2. Design and implement combinational circuits like adder, subtractor, multiplexer, code converters etc.
3. Identify and understand working of various types of flip flops and their inter conversions.
4. Design and implement basic sequential circuits such as counters, registers etc.
5. Acquire basic knowledge of VHDL/Verilog basic programming.

Suggested list of experiments:

1. Simplification of Boolean functions.
2. Design AND, OR, NOT, EXOR, EXNOR gates using Universal gates: NAND and NOR.
3. Implement digital circuits to perform Binary to Gray and Gray to Binary operations.
4. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
5. Design and implement BCD adder using 4-bit Binary Adder IC-7483.
6. Implement logic equations using Multiplexer.
7. Verify encoder and decoder operations.

8. Design and implement Magnitude Comparator.
9. Verify truth table of different types of flip flops.
10. Flip flop conversions JK to D, JK to T and D to TFF.
11. Design asynchronous/synchronous MOD N counter using IC7490.
12. Verify different counter operations.
13. Write VHDL/Verilog simulation code for different logic gates.
14. Write VHDL/Verilog simulation code for combinational and sequential circuits.
15. Write VHDL/Verilog simulation code for 4:1 Multiplexer, 2 to 4 line binary decoder.

Term Work:

At least 08 experiments covering the entire syllabus must be given "**Batch Wise"**. Out of these, **06 hardware experiments**, to be done strictly on breadboard and **at least 02 software experiments** using VHDL/Verilog. Teacher should refer the suggested list of experiments and can design additional experiments to acquire practical design skills. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per **"Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Pract.	Tut.	Total
ECL303	Electronic Instrumentation & Control Systems Lab.	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam			
ECL303	Electronic Instrumentation & Control Systems Lab.	--	--	--	--	25	--	25

Course Objectives:

1. To experimentally verify the principle and characteristics of various transducers and measurement of resistance and inductance.
2. To make students understand the construction and the working principle of various transducers used for Displacement measurement, Temperature measurement and Level measurement.
3. To examine steady-state and frequency response of the Type 0, 1, and 2 systems.
4. To examine steady-state and frequency response of first and second order electrical systems.
5. To inspect stability analysis of system using Root locus, Bode plot, polar plot and Nyquist plot.

Course Outcomes:

After successful completion of the course student will be able to:

1. Plot and validate the performance characteristics of transducers.
2. Validate the characteristics of various temperature, pressure and level transducers.
3. Plot frequency response of first-order electrical system.
4. Plot time response of second-order electrical system and calculate the steady-state error.
5. Validate the effect of damping factor on the response of second order system.
6. Inspect the frequency response specifications of systems by using bode-plot, Polar plot, Nyquist-plot techniques, and comment on the stability of system

List of experiments:

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Designing AC bridge Circuit for capacitance measurement.
3. Study and characteristics of Resistive Temperature Detector (RTD).
4. Study of Linear Variable Differential Transformer (LVDT)
5. To plot the effect of time constant on first-order systems response.
6. To plot the frequency response of first-order System
7. To plot the time response of second-order systems
8. To plot the frequency response of second-order System
9. To Examine Steady State Error for Type 0, 1, 2 System
10. To study the performance of Lead and Lag Compensator
11. To inspect the relative stability of systems by Root-Locus using Simulation Software.
12. To determine the frequency specification from Polar plot of system
13. To inspect the stability of system by Nyquist plot using Simulation software.
14. To inspect the stability of system by Bode plot using Simulation software.
15. Any other experiment based on syllabus which will help students to understand topic/concept.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “Laboratory session batch wise”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time. The grades will be converted to marks as per **“Credit and Grading System”** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL304	Skill Lab: C++ and Java Programming	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks						
		Internal assessment			End Sem. Exam	Term Work	Practical And Oral	Total
		Test 1	Test 2	Avg. Of Test 1 and Test 2				
ECL304	Skill Lab: C++ and Java Programming	--	--	--	--	25	25	50

Note: Before performing practical **'Necessary Theory'** will be taught by concern faculty

Course Pre-requisites:

1. FEL204 - C-Programming

Course Objectives:

1. Describe the principles of Object Oriented Programming (OOP).
2. To understand object-oriented concepts such as data abstraction, encapsulation, inheritance and polymorphism.
3. Utilize the object-oriented paradigm in program design.
4. To lay a foundation for advanced programming.
5. Develop programming insight using OOP constructs.

Course Outcomes:

After successful completion of the course student will be able to:

1. Describe the basic principles of OOP.
2. Design and apply OOP principles for effective programming.
3. Develop programming applications using OOP language.
4. Implement different programming applications using packaging.
5. Analyze the strength of OOP.
6. Percept the Utility and applicability of OOP.

Module No.	Unit No.	Topics	Hrs.
1.0		**C++ Overview**	**08**
	1.1	Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP and C++ as object oriented programming language.	
	1.2	C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.	
2.0		**C++ Control Structures**	**08**
	2.1	**Branching -** If statement, If-else Statement, Decision. **Looping –** while, do-while, for loop **Nested control structure-** Switch statement, Continue statement, Break statement.	
	2.2	**Array-** Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array.	
3.0		**Object-Oriented Programming using C++**	**12**
	3.1	**Operator Overloading-** concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. **Function-** Function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function. **Constructor-** Definition, Types of Constructor, Constructor Overloading, Destructor.	
	3.2	**Inheritance-** Introduction, Types of Inheritance, Inheritance, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Visibility Modes Public, Private, Protected and Friend, Aggregation, Classes Within Classes. Deriving a class from Base Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, **Polymorphism-** concept, relationship among objects in inheritance hierarchy, Runtime & Compile Time Polymorphism, abstract classes, Virtual Base Class.	
4.0		**Introduction to Java**	**06**
	4.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	4.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
5.0		**Inheritance, Polymorphism, Encapsulation using Java**	**10**

	5.1	**Classes and Methods**: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. **String:** String Class and Methods in Java.	
	5.2	**Inheritances:** Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
6.0		**Exception Handling and Applets in Java**	**08**
	6.1	**Exception Handling:** fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Print Writer class. **Threading:** Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread	
	6.2	**Applet:** Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
		Total	**52**

Suggested list of Experiments:

Note: *Before performing practical necessary Theory will be taught by concern faculty*

Sr.No	Write C++ Program to
1	Add Two Numbers
2	Print Number Entered by User
3	Swap Two Numbers
4	Check Whether Number is Even or Odd
5	Find Largest Number Among Three Numbers
6	Create a simple class and object.
7	Create an object of a class and access class attributes
8	Create class methods
9	Create a class to read and add two distance
10	Create a class for student to get and print details of a student.
11	Demonstrate example of friend function with class
12	Implement inheritance.

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40,declare the student as “Pass” else “Fail””
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.
11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'runnable' interface or creating 'Thread Class.
15	Demonstrate Hello World Applet Example

Textbooks:

1. Bjarne Stroustrup, “The C++ Programming language”, Third edition, Pearson Education.
2. Yashwant Kanitkar, “Let Us Java”, 2nd Edition, BPB Publications.
3. D.T. Editorial Services, “Java 8 Programming Black Book”, Dreamtech Press, Edition: 2015
4. Deitel, “C++ How to Program”, 4th Edition, Pearson Education.

Reference Books:

1. Herbert Schidt, “The Complete Reference”, Tata McGraw-Hill Publishing Company Limited, Ninth Edition.
2. Java: How to Program, 8/e, Dietal, PHI.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Languageser Guide”, Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary “Programming in Java”, Oxford University Press, 2010.

Skill-Enhancement:

1. The students should be trained to code in Eclipse (an industry accepted software tool). Also, for a given problem statement, there is need to include external library files (other than JDK files). Moreover, the students need to be trained on Maven (a build tool).
2. Real-life mini-problem statements from software companies (coming in for placement) to be delegated to groups of 3-4 students each and each group to work on the solution for 8-12 hours (last 2 lab sessions).

Software Tools:

1. Raptor-Flowchart Simulation:http://raptor.martincarlisle.com/
2. Eclipse: https://eclipse.org/
3. Netbeans:https://netbeans.org/downloads/
4. CodeBlock:http://www.codeblocks.org/
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Term Work:

At least **12** experiments (**06 experiments** each on **C++** and **JAVA**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.
The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.
Term work assessment must be based on the overall performance of the student with every Experiments are graded from time to time.

The grades will be converted to marks as per "**Choice Based Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam should cover all **12** experiments for examination.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A	--	04[$]	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM301	Mini Project 1A	--	--	--	--	25	25	50

$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: At the end of the course learners will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
  - First shall be for finalisation of problem
  - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - First review is based on readiness of building working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

NOTE: For Electronics & Telecommunication Engineering we recommend following syllabus for Mini-Project 1A, in case it is half-year project.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM301	Mini Project 1A: Analog & Digital Circuit Design based Projects	--	04[$]	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM301	Mini Project 1A: Analog & Digital Circuit Design based Projects	--	--	--	--	25	25	50

$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Course Pre-requisite:

1. FEC105 - BEE

Course Objectives:

1. To make students familiar with the basics of electronic devices and circuits, electrical circuits and digital systems
2. To familiarize the students with the designing and making of Printed circuit boards(PCB)
3. To improve the knowledge of electronics hardware among students

Course outcomes:

After successful completion of the course student will be able to:

1. Create the electronics circuit for particular application/experiment.
2. Design and simulate the circuits by putting together the analog and digital components
3. Learn the technique of soldering and circuit implementation on general purpose printed circuit board (GPP).
4. Realize the PCB design process and gain up-to-date knowledge of PCB design software.
5. Utilize the basic electronic tools and equipment's (like DMM, CRO, DSO etc.)
6. Analysis of hardware fault (Fault detection and correction)

Module No.	Unit No.	Topics	Hrs.
1.0		**Identification and Designing of Circuit**	**08**
	1.1	Identification of particular application with understanding of its detail operation. Study of necessary components and devices required to implement the application.	
	1.2	Designing the circuit for particular application (either analog , digital, electrical , analog and digital, etc)	
2.0		**Software simulation and Implementation on GPP**	**12**
	2.1	Simulation of circuit for particular application using software's to verify the expected results	
	2.2	Implementation of verified circuit on general purpose printed circuit board (GPP). Now Verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
3.0		**PCB design and optimization**	**08**
	3.1	Design the circuit by placing components using PCB design software's.	
	3.2	Reduce the size of PCB by varying the position of components or devices for optimize use of copper clad material	
4.0		**Implementation of PCB**	**08**
	4.1	Transfer the designed PCB on Copper clad either by using dark room or taking printout on glossy paper, etc (use available suitable method).	
	4.2	Perform Etching and then Soldering.	
5.0		**Detection of Hardware faults and Result verification**	**08**
	5.1	Identify the hardware faults in designed circuit and subsequently rectify it	
	5.2	Now again verify the hardware results by using electronic tools and equipment's like millimeter, CRO, DSO etc.	
6.0		**Understanding the Troubleshooting**	**08**
	6.1	Understand the trouble shooting by removing some wired connection.	
	6.2	Understand the trouble shooting of track. Troubleshoot the faculty components or devices	
		Total	**52**

NOTE: During 1st week or within 1-month of the beginning of the semester, following topics related to ADC and DAC should be covered as theoretical concepts.

a. **Performance specifications of ADC, single ramp ADC, ADC using DAC, dual slope ADC, successive approximation ADC.**

b. **Performance specifications of DAC, binary weighted resistor DAC, R/2R ladder DAC, inverted R/2R ladder DAC.**

Reference books:

1. Schultz Mitchel E., *"Grob's Basic Electronics",* McGraw-Hill Education; 10th edition, 25 October , 2006.
2. Charles Platt, *"Make Electronics: Learning by discovery",* O'Reilly; 2nd edition, 18 September , 2015.
3. Forrest M Mims III, *"Getting started in Electronics",* Book Renter, Inc.; 3rd edition , 1 January 2000.

4. R S Khandpur, "*Printed circuit board*", McGraw-Hill Education; 1st edition, 24 February , 2005.
5. Kraig Mitzner, "*Complete PCB Design Using OrCAD Capture and PCB Editor",* Academic Press; 2nd edition , 20 June 2019.

Suggested Software tools:

1. LTspice:https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#
2. Eagle : https://www.autodesk.in/products/eagle/overview
3. OrCAD: https://www.orcad.com/
4. Multisim : https://www.multisim.com/
5. Webbench:http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html
6. Tinkercad : https://www.tinkercad.com/

Online Repository:

1. https://www.electronicsforu.com
2. https://circuitdigest.com
3. https://www.electronicshub.org

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ECC401	Engineering Mathematics-IV	03	-	01*	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Exam Dura-tion (in Hrs.)	Term Work	Pract & Oral	Total
		Internal Assessment			End Sem exam				
		Test1	Test2	Avg. of Test 1 & 2					
ECC401	Engineering Mathematics-IV	20	20	20	80	03	25	-	125

*** Should be conducted batch wise.**

Pre-requisite:

1. FEC101-Engineering Mathematics-I
2. FEC201-Engineering Mathematics-II
3. ECC301-Engineering Mathematics-III & Binomial Distribution.

Course Objectives: The course is aimed:

1. To understand line and contour integrals and expansion of complex valued function in a power series.
2. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
3. To understand probability distributions and expectations.
4. To understand the concepts of vector spaces used in the field of machine learning and engineering problems.
5. To understand the concepts of Quadratic forms and Singular value decomposition.
6. To understand the concepts of Calculus of Variations.

Course Outcomes:

On successful completion of course learner/student will be able to:

1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2. Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3. Apply the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
5. Use the concept of Quadratic forms and Singular value decomposition which are very useful tools in various Engineering applications.
6. Find the extremals of the functional using the concept of Calculus of variation.

Module	Detailed Contents	Hrs.
01	**Module: Complex Integration** 1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 1.2 Taylor's and Laurent's series (without proof). 1.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof). **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations ,Z- Transform.	7
02	**Module: Statistical Techniques** 2.1 Karl Pearson's Coefficient of correlation (r) . 2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) 2.3 Lines of regression. 2.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	6
03	**Module: Probability Distributions** 1.1 Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function. 3.2 Expectation, mean and variance. 3.3 Probability distribution: Poisson & normal distribution. **Self-learning Topics:** Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.	7
04	**Module: Linear Algebra: Vector Spaces:-** 4.1 Vectors in n-dimensional vector space, norm, dot product, The CauchySchwarz inequality (with proof), Unit vector. 4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors. 4.3 Vector spaces over real field, subspaces. **Self-Learning Topics**:- Linear combinations, linear Dependence and Independence, QR decomposition.	6
05	**Module: Linear Algebra: Quadratic Forms** 5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. 5.2 Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite. 5.3 Reduction of Quadratic form to a canonical form using congruent transformations. 5.4 Singular Value Decomposition. **Self-learning Topics:** Orthogonal Transformations**,** Applications of Quadratic forms and SVD in Engineering.	7

06	**Module: Calculus of Variations:** 6.1 Euler- Lagrange equation (Without Proof), When F does not contain y, When F does not contain x, When F contains x, y, y'. 6.2 Isoperimetric problems- Lagrange Method. 6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method. **Self-Learning Topics:-** Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action , Several dependent variables.	6
Total		39

References:

1.Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2.Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
4. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
5 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
7. Beginning Linear Algebra Seymour Lipschutz Schaum's outline series, Mc-Graw Hill Publication
8.Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Term Work (25-Marks):

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Internal Assessment Test (25-Marks):

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Theory Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Question No: 01 will be compulsory and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. Total 04 questions need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC402	Micro-controllers	3	-	--	3	-	--	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of Test 1 and Test 2					
ECC402	Micro-controllers	20	20	20	80	03	-	-	100

Course Pre-requisites:

1. ECC303 - Digital System Design

Course objectives:

1. To develop background knowledge of Computer and its memory System.
2. To understand architecture of 8051 and ARM7 core.
3. To write programs for 8051 microcontrollers.
4. To understand design of Microcontroller Applications.

Course outcomes:

After successful completion of the course student will be able to:

1. Understand Computer and its memory System,
2. Understand the detailed architecture of 8051 and ARM7 Core.
3. Write programs for 8051 microcontrollers.
4. Design an applications using microcontroller.

Module No.	Unit No.	Topics	Hrs
1		**Overview of Microprocessor based System**	5
	1.1	Overview of microcomputer systems and their building blocks, Memory Interfacing, Steps taken by the microprocessor to fetch and executes an instruction from the memory	
	1.2	Concepts of Program counter register, Reset, Stack and stack pointer , Subroutine, Interrupts and Direct Memory Access	
	1.3	Concept of RISC & CISC Architecture	
	1.4	Harvard & Von Neumann Architecture	
2		**The Memory Systems**	4
	2.1	Classification of Memory : Primary and Secondary	
	2.2	Types of Semiconductor memories	
	2.3	Cache Memory	
	2.4	Virtual Memory Concept with Memory Management Unit with Segmentation and Paging (Address Translation Mechanism)	
3		**8051 Microcontroller**	8
	3.1	Comparison between Microprocessor and Microcontroller	
	3.2	Features, architecture and pin configuration	
	3.3	CPU timing and machine cycle	
	3.4	Input / Output ports	
	3.5	Memory organization	
	3.6	Counters and timers	
	3.7	Interrupts	
	3.8	Serial data input and output	
4		**8051 Assembly Language Programming and Interfacing**	9
	4.1	Addressing modes	
	4.2	Instruction set	
	4.3	Need of Assembler & Cross Assemble, Assembler Directives	
	4.4	Programs related to: arithmetic, logical, delay subroutine , input, output, timer, counters, port, serial communication, and interrupts	
	4.5	Interfacing with LEDs, Relay and Keys	
5		**ARM7**	8
	5.1	Introduction & Features of ARM 7	
	5.2	Concept of Cortex-A, Cortex-R and Cortex-M	
	5.3	Architectural inheritance, Pipelining	
	5.4	Programmer's model	
	5.5	Brief introduction to exceptions and interrupts handling	
	5.6	Instruction set: Data processing, Data Transfer, Control flow	
6		**Study 8 bit microcontroller Applications**	5
	6.1	Understanding features of NXP 89v51RD2, Atmega 328P and PIC16F886	
	6.2	Selecting a microcontroller for an application	
	6.3	Study of 89v51 based Clock Using I2C RTC and Seven Segment Display	
	6.4	PIC16F886 Speed Control of DC Motor.	
	6.5	Atmega 328P based remote temperature monitoring with LCD display	
		Total	39

Text Books:

1. Douglas V Hall, SSSP Rao “Microprocessors & Interfacing”, McGraw Hill
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw-Hill
3. Shibu K. V “Introduction to embedded systems” McGraw Hill.
4. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, “The 8051 Microcontroller & Embedded systems”, Pearson Publications, Second Edition 2006.
5. C. Kenneth J. Ayala and D. V. Gadre, “The 8051 Microcontroller & Embedded system using assembly & ‘C’ ”, Cengage Learning, Edition 2010.
6. Steve Furber, “ARM System on chip Architecture”, Pearson,2nd edition.

Reference books:

1. “MCS@51 Microcontroller, Family User’s Manual” Intel
2. “PIC16F882/883/884/886/887 Data Sheet”, Microchip.
3. ATmega328P 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash datasheet, Atmel
4. P89V51RB2/RC2/RD2 8-bit 80C51 5 V low power 16/32/64 kB flash microcontroller, Data Sheet NXP founded by Philips
5. James A. Langbridge, “Professional Embedded Arm Development”, Wrox, John Wiley Brand& Sons Inc., Edition 2014

NPTEL/ Swayam Course:

1. Course: Microprocessors and Microcontrollers By Prof. Santanu Chattopadhyay (IIT Kharagpur); **https://swayam.gov.in/nd1_noc20_ee42/preview**

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC403	Linear Integrated Circuits	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs)	Term Work	Prac. and Oral	Total
		Internal assessment			End Sem. Exam. (ESE)				
		Test1	Test2	Avg. of Test 1 and Test 2					
ECC403	Linear Integrated Circuits	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. FEC105-Basic Electrical Engineering
2. ECC302-Electronic Devices & Circuits

Course Objectives:

1. To understand the concepts, working principles and key applications of linear integrated circuits.
2. To perform analysis of circuits based on linear integrated circuits.
3. To design circuits and systems for particular applications using linear integrated circuits.

Course Outcome:

After successful completion of the course student will be able to:

1. Outline and classify all types of integrated circuits.
2. Understand the fundamentals and areas of applications for the integrated circuits.
3. Develop the ability to design practical circuits that perform the desired operations.
4. Understand the differences between theoretical & practical results in integrated circuits.
5. Identify the appropriate integrated circuit modules for designing engineering application.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Operational Amplifier**	**07**
	1.1	Block diagram of Op-Amp. Ideal and practical characteristics of op-amp.	
	1.2	Configurations of Op-Amp: Open loop and closed loop configurations of Op-amp, Inverting and Non-inverting configuration of Op-amp and buffer.	
	1.3	Summing amplifier, difference amplifiers and Instrumentation amplifier using Op-amp.	
2.0		**Linear Applications of Operational Amplifier**	**08**
	2.1	Voltage to current and current to voltage converter.	
	2.2	Integrator & differentiator (ideal & practical), Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters.	
	2.3	Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.	
3.0		**Non-Linear Applications of Operational Amplifier**	**07**
3.0	**3.1**	Comparators: Inverting comparator, non-inverting comparator, zero crossing detectors, window detector.	
	3.2	Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger.	
	3.3	Waveform Generators: Square wave generator and triangular wave generator. Basics of Precision Rectifiers: Half wave and full wave precision rectifiers. Peak detector.	
4.0		**Timer IC 555 and it's applications**	**07**
	4.1	Functional block diagram and working of IC 555	
	4.2	Design of Astable and Monostable multivibrator using IC 555	
	4.3	Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator.	
5.0		**Voltage Regulators.**	**06**
	5.1	Functional block diagram, working and design of three terminal fixed voltage regulators (78XX, 79XX series).	
	5.2	Functional block diagram, working and design of general purpose IC 723 (HVLC and HVHC).	
	5.3	Introduction and block diagram of switching regulator, Introduction of LM 317.	
6.0		**Special Purpose Integrated Circuits**	**04**
	6.1	Functional block diagram and working of VCO IC 566 and application as frequency modulator.	
	6.2	Functional block diagram and working of PLL IC 565 and application as FSK Demodulator.	
		Total	**39**

Textbooks:

1. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson Prentice Hall, 4th Edition.
2. D. Roy Choudhury and S. B. Jain, “Linear Integrated Circuits”, New Age International Publishers, 4th Edition.

Reference Books:

1. K. R. Botkar, “Integrated Circuits”, Khanna Publishers (2004)
2. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Tata McGraw Hill, 3rd Edition.
3. David A. Bell, “Operation Amplifiers and Linear Integrated Circuits”, Oxford University Press, Indian Edition.
4. R. F. Coughlin and F. F. Driscoll, “Operation Amplifiers and Linear Integrated Circuits”, Prentice Hall, 6th Edition.
5. J. Millman, Christos CHalkias, and Satyabratatajit, Millman’s,“Electronic Devices and Circuits,” McGrawHill, 3rdEdition.

NPTEL/ Swayam Course:

1. Course: ICs MOSFETs Op-Amps & Their Applications By Prof. Hardik Jeetendra Pandya (IISc Bangalore);
   https://swayam.gov.in/nd1_noc20_ee13/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC404	Signals and Systems	03	--	01	03	--	01	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 & Test 2					
ECC404	Signals and Systems	20	20	20	80	03	25	--	125

Course pre-requisite:

1. ECC301 – Engineering Mathematics III

Course objectives:

1. To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.
2. To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course outcomes:

After successful completion of the course student will be able to:

1. Classify and Analyze different types of signals and systems
2. Analyze continuous time LTI signals and systems in transform domain
3. Analyze and realize discrete time LTI signals and systems in transform domain
4. Represent signals using Fourier Series and Analyze the systems using the Fourier Transform.
5. Demonstrate the concepts learnt in Signals and systems Course using the modern engineering tools.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to signals and systems**	**07**
	1.1	**Introduction to Signals:** Definition, Basic Elementary signals - exponential, sine, step, impulse, ramp, rectangular, triangular. Operations on signals. **Classification of Signals:** analog and discrete time signals, even and odd signals, periodic and non-periodic signals , deterministic and non-deterministic signals, energy and power signals.	
	1.2	**Systems and Classification of systems:** System Representation, continuous time and discrete systems, system with and without memory, causal and non-causal system, linear and nonlinear system, time invariant and time variant system, stable system.	
2.0		**Time domain analysis of Continuous Time and Discrete Time systems**	**07**
	2.1	**Linear Time Invariant (LTI) systems:** Representation of systems using differential /difference equation, Impulse, step and exponential response, System Stability and Causality.	
	2.2	Use of convolution integral and convolution sum for analysis of LTI systems, properties of convolution integral/sum, impulse response of interconnected systems.	
	2.3	Correlation and spectral Density: auto-correlation, cross correlation, analogy between correlation and convolution, energy spectral density, power spectral density, relation of ESD and PSD with auto-correlation.	
3.0		**Fourier Analysis of Continuous and Discrete Time Signals and Systems**	**07**
	3.1	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform, Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, Limitations of Fourier Transform.	
4.0		**Laplace Transform and Continuous time LTI systems**	**06**
	4.1	Need of Laplace Transform, Concept of Region of Convergence, Properties of Laplace Transform, Relation between continuous time Fourier Transform and Laplace Transform, unilateral Laplace Transform, inverse Laplace Transform.	
	4.2	**Analysis of continuous time LTI systems using Laplace Transform: C**ausality and stability of systems in *s*-domain, Total response of a system.	
5.0		***z*-Transform and Discrete time LTI systems**	**08**
	5.1	Need of *z*-Transform, *z*-Transform of finite and infinite duration sequences, Concept of Region of Convergence, *z*-Transform	

		properties, Standard *z*-transform pairs, relation between *z*-transform and discrete time Fourier Transform, one sided *z*-Transform. Inverse *z*-Transform: Partial Fraction method only.	
	5.2	**Analysis of discrete time LTI systems using *z*-Transform**: Systems characterized by Linear constant coefficient difference equation, Transfer Function, plotting Poles and Zeros of a transfer function , causality and stability of systems, Total response of a system.	
6.0		**FIR and IIR systems**	**04**
	6.1	Concept of finite impulse response systems and infinite impulse response systems, Linear Phase FIR systems.	
	6.2	**Realization structures of LTI system:** Direct form –I and direct form II, Linear Phase FIR structures.	
Total			**39**

Text books:

1. Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
2. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition 2009.
3. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, Second Edition, 2002.
4. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.

Reference books:

1) Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third edition, 2010
2) Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, Second Edition, 2004.
3) V. Krishnaveni and A. Rajeshwari, Signals and Systems, Wiley-India, First Edition 2012.
4) Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, special Indian Economy edition, 2009.
5) Luis F. Chaparro, Signals and Systems Using MATLAB, Academic Press
6) Rangaraj M. Rangayyan, “Biomedical Signal Analysis- A Case Study Approach”, Wiley 2002.
7) Signals and Systems Laboratory: Virtual Laboratory http://ssl-iitg.vlabs.ac.in/

NPTEL/ Swayam Course:

1. Course: Principles of Signals & Systems By Prof. Aditya K. Jagannatham (IIT Kanpur); https://swayam.gov.in/nd1_noc20_ee15/preview

Teachers and students are encouraged to use *Signals and Systems Laboratory: Virtual Laboratory* (Reference number 8) for demonstration of concepts such as systems and their properties, Fourier analysis etc.

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Term Work (25-Marks):

At least 06 Tutorials covering entire syllabus and 01 course project must be given during the "Class Wise Tutorial".

Students can form team of maximum 4 members and work on course project using any software viz. C, Python, Scilab, Matlab, Octave, etc. The course project should be appropriately selected in order to demonstrate any concept learnt in this course.

03-hours (out of the total 12-hours allotted for the tutorials) can be utilized for the course project completion.

Term work assessment must be based on the overall performance of the student with every tutorial and a course project graded from time to time. The grades will be converted to marks as per "Credit and Grading System" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC405	Principles of Communication Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Exam Duration (in Hrs.)	Term Work	Prac. & Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECC405	Principles of Communication Engineering	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. ECC301 - Engineering Mathematics- III
2. ECC302 - Electronic Devices and Circuits

Course Objectives:

1. To illustrate the fundamentals of basic communication system.
2. To understand various analog modulation and demodulation techniques.
3. To focus on applications of analog modulation and demodulation techniques.
4. To explain the key concepts of analog and digital pulse modulation and demodulation techniques.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand the basic components and types of noises in communication system.
2. Analyze the concepts of amplitude modulation and demodulation.
3. Analyze the concepts of angle modulation and demodulation.
4. Compare the performance of AM and FM receivers.
5. Describe analog and digital pulse modulation techniques.
6. Illustrate the principles of multiplexing and demultiplexing techniques.

Module No.	Unit No.	Topics	Hours
1		**Basics of Communication System**	**05**
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain. Basic concepts of wave propagation.	**03**
	1.2	Types of noise, signal to noise ratio, noise figure, noise temperature and Friss formula.	**02**
2		**Amplitude Modulation and Demodulation**	**12**
	2.1	Basic concepts, need for modulation, waveforms (time domain and frequency domain), modulation index, bandwidth, voltage distribution and power calculations.	**04**
	2.2	DSBFC: Principles, low-level and high-level transmitters, DSB suppressed carrier, Balanced modulators with diode (Ring modulator and FET) and SSB systems.	**04**
	2.3	Amplitude demodulation: Diode detector, practical diode detector, Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television.	**04**
3		**Angle Modulation and Demodulation**	**10**
	3.1	Frequency and Phase modulation (FM and PM): Basic concepts, mathematical analysis, FM wave (time and frequency domain), sensitivity, phase and frequency deviation, modulation index, deviation ratio, bandwidth requirement of angle modulated waves, narrowband FM and wideband FM.	**04**
	3.2	Varactor diode modulator, FET reactance modulator, stabilized AFC, Direct FM transmitter, indirect FM Transmitter, noise triangle, pre- emphasis and de-emphasis	**03**
	3.3	FM demodulation: Balanced slope detector, Foster-Seely discriminator, Ratio detector, FM demodulator using Phase lock loop, amplitude limiting and thresholding, Applications of FM and PM.	**03**
4		**Radio Receivers**	**04**
	4.1	Characteristics of radio receivers, TRF, Super - heterodyne receiver block diagram, tracking and choice of IF, AGC and its types and Communication receiver.	**03**
	4.2	FM receiver block diagram, comparison with AM receiver.	**01**
5		**Analog and Digital Pulse Modulation & Demodulation**	**06**
	5.1	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria, Sampling techniques, aliasing error and aperture effect.	**03**
	5.2	PAM, PWM, PPM generation, detection and applications. Basics of PCM system and differential PCM system. Concepts of Delta modulation (DM) and Adaptive Delta Modulation (ADM).	**03**
6		**Multiplexing & De-multiplexing**	**02**
	6.1	Frequency Division Multiplexing transmitter & receiver block diagram and applications. Time Division Multiplexing transmitter & receiver block diagram and applications.	**02**
		Total	**39**

Textbooks:

1. Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth edition.
2. B.P. Lathi, Zhi Ding "Modern Digital and Analog Communication system", Oxford University Press, Fourth edition.
3. Wayne Tomasi, "Electronics Communication Systems", Pearson education, Fifth edition.

Reference Books:

1. Taub, Schilling and Saha, "Taub's Principles of Communication systems", Tata McGraw Hill, Third edition.
2. P. Sing and S.D. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hill, Third edition.
3. Simon Haykin, Michel Moher, "Introduction to Analog and Digital Communication", Wiley, Second edition.
4. Dennis Roddy and John Coolen, Electronic Communication, Pearson, 4/e, 2011.
5. Louis Frenzel, "Communication Electronics", Tata McGraw Hill, Third Edition.

NPTEL/ Swayam Course:

1. Course: Analog Communication By Prof. Goutam Das (IIT Kharagpur);
https://swayam.gov.in/nd1_noc20_ee69/preview

Internal Assessment (20-Marks):

Internal Assessment (IA) consists of two class tests of 20 marks each. IA-1 is to be conducted on approximately 40% of the syllabus completed and IA-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in IA-I). Duration of each test shall be one hour. Average of the two tests will be considered as IA marks.

End Semester Examination (80-Marks):

Weightage to each of the modules in end-semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of **total 06** questions, each carrying **20 marks**.
2. **Question No: 01** will be **compulsory** and based on entire syllabus wherein 4 to 5 sub-questions will be asked.
3. Remaining questions will be mixed in nature and randomly selected from all the modules.
4. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
5. **Total 04 questions** need to be solved.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL401	Micro-controllers Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL401	Micro-controllers Lab	-	-	-	-	-	25	--	25

Course Objectives:

1. To understand development tools of microcontroller based systems.
2. To learn programming for different microcontroller operation & interface to I/O devices.
3. To develop microcontroller based applications.

Course Outcomes:

After successful completion of the course student will be able to:

1. Understand different development tools required to develop microcontroller based systems.
2. Write assembly language programs for arithmetic and logical operations, code conversion & data transfer operations.
3. Write assembly language programs for general purpose I/O, Timers & Interrupts.
4. Interface & write programs for Input and Output devices
5. Develop microcontroller based Applications.

Suggested Experiment List:

1. Perform Arithmetic and Logical Operations (Using Immediate, Direct and Indirect addressing)
2. Code Conversion
3. Transfer of data bytes between Internal and External Memory
4. Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc
5. Interfacing of Matrix Key board, LED, 7 Segment display, LCD, Stepper Motor, UART

At Least 10 experiment Minimum two from each category of above list must be given during the **Laboratory session batch wise**. Computation/simulation based experiments are also encouraged.

Before starting the experiments there should be one session on Study of development tools like Editor, Assembler-cross Assembler, Compiler-Cross compiler, Linker, Simulator, emulator etc.

Mini project based on 8051 derivatives, PIC, AVR & other 8 bit microcontrollers using Assembly and/or C language. (Readymade of Arduino & raspberry pi are **not recommended here**)

Note: Mini Project can be considered as a part of term-work.

Term Work (25-Marks):

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL402	Linear Integrated Circuits Lab.	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam. Duration (in Hrs)	Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ECL402	Linear Integrated Circuits Lab.	--	--	--	--	--	25	25	50

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand the differences between theoretical, practical and simulated results in integrated circuits.
2. Apply the knowledge to do simple mathematical operations.
3. Apply knowledge of op-amp, timer and voltage regulator ICs to design simple applications.

Laboratory Plan:

Minimum 8 hardware practical (compulsorily based on IC 741, IC 555, IC 723 and remaining on VCO 566 or PLL 565) and 2 simulations should be conducted. At least one experiment from each Module of syllabus.

Suggested list of experiments:

1. Design inverting, non-inverting amplifier and buffer using IC 741.
2. Design summing and difference amplifier using op-amp.
3. Design voltage to current converter with grounded load.
4. Design and analyze Integrator
5. Design and analyze Differentiator
6. Design Schmitt trigger using Op-amp.
7. Design Wein bridge and RC phase shift Oscillator.
8. Design and analyze second order High pass and Low pass filter
9. Design and analyze Band pass and Band reject filter.
10. Design Astable multivibrator using IC 555 for fixed frequency and variable duty cycle.
11. Design Monostable Multivibrator using IC 555.
12. Design Low voltage Low current voltage regulator using IC 723.
13. Design High voltage High current voltage regulator using IC 723.
14. Design Frequency Modulator using IC 566
15. Design FSK Demodulator using IC 565
16. Design Instrumentation amplifier using 3 Op-Amp.
17. Design Precision rectifier
18. Design Square & Triangular wave generator

Term Work (25-Marks):

At least 10 Experiments including 02 simulations covering entire syllabus must be given during the “Laboratory session batch wise”. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects are graded from time to time.

The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL403	Principles of Communication Engineering Lab.	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical & Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ECL403	Principles of Communication Engineering Lab.	--	--	--	--	--	25	25	50

Course Pre-requisites:

1. Usage of basic Electronic instruments and components.
2. Fundamentals of Electronic Devices and circuits

Course Objectives:

1. To give an understanding of Time and Frequency domain representation of signals.
2. To demonstrate continuous wave modulation and demodulation.
3. To demonstrate analog and digital pulse communication.
4. Able to use simulation software to build communication circuits.

Course Outcomes:

After successful performance of the practicals student will be able to:

1. Analyze analog modulation techniques.
2. Analyze the waveforms of Radio receivers.
3. Implement analog pulse modulation and demodulation circuits.
4. Demonstrate digital pulse modulation and demodulation techniques.
5. Verify the concepts of TDM and FDM.

Suggested list of Experiments:

Sr. No	Title
1	Generation of AM modulation and demodulation.
2	Analyze waveforms at various stages of SSB system.
3	Generation of FM modulation and demodulation.
4	Analyze the output waveforms of each block of AM transmitter /receiver
5	Analyze the output waveforms of each block of FM transmitter /receiver
6	Design and implement Pre-emphasis and De-emphasis circuit.
7	Verification of sampling theorem.
8	Generation of PAM modulation and demodulation.
9	Generation of PWM and PPM modulation and demodulation.
10	Demonstrate Digital pulse transmission technique (PCM)
11	Demonstrate Digital pulse transmission technique (DM,ADM)
12	Observation of TDM multiplexing and de-multiplexing signals.
13	Observation of FDM multiplexing and de-multiplexing signals.

Term Work (25-Marks):

At least **10** experiments (**07 hardware experiments and at least 03 software experiments**) covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and application oriented. Signal should be analyzed in time and frequency domain.

Term work assessment must be based on the overall performance of the student with every Experiments are graded from time to time.

The grades will be converted to marks as per "**Credit and Grading System**" manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encouraged to share their experiments codes on online repository. Practical exam slip should cover all 10 experiments for examination.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECL404	Skill Lab: Python Programming	-	04	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of Test 1 and Test 2				
ECL404	Skill Lab: Python Programming	-	-	-	-	25	25	50

NOTE: Necessary theory part should be taught by the teacher at the beginning of the laboratory session.

Course pre-requisite:

1. ECL304 – Skill Lab: C++ and Java Programming.

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore file handling in Python
3. Infer the Object-oriented Programming concepts in Python
4. Formulate GUI Programming and Databases operations in Python
5. Develop applications using variety of libraries and functions

Course Outcomes:

After successful completion of the course student will be able to:

1. Describe syntax and semantics in Python
2. Illustrate different file handling operations
3. Interpret object oriented programming in Python
4. Design GUI Applications in Python
5. Express proficiency in the handling Python libraries for data science
6. Develop machine learning applications using Python

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Python**	6
	1.1	Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input Statements in python	
	1.2	Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures.	
	1.3	Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements	
2.0		**Functions and File I/O Handling**	8
	2.1	Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code.	
	2.2	File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, *with* keywords, Moving within a file, Manipulating files and directories, OS and SYS modules.	
3.0		**Object Oriented Programming**	9
	3.1	Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes.	
	3.2	Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Exception Handling, Link list, Stack, Queues.	
4.0		**Graphical User Interface and Image processing**	9
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.	
	4.2	Database: Sqilite database connection, Create, Append, update, delete records from database using GUI.	
	4.3	Basic Image Processing using OpenCV library, simple image manipulation using image module.	
5.0		**Numpy, Pandas, Matplotlib, Seaborn, Scipy**	10
	5.1	Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy.	
	5.2	Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation.	
	5.3	Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn.	
	5.4	Introduction to Scipy, Scipy Sub packages – Integration and Optimization, Eigen values and Eigen Vectors, Statistic, Weave and IO.	
6.0		**Python Applications**	10
	6.1	GUI based applications	
	6.2	Applications in Image Processing, Networking	
	6.3	Machine Learning, Linear Regression, Logistic Regression	
	6.4	Classification using K nearest neighbor,	
	6.5	Support Vector Machines	
		Total	**52**

Text Books:

1. Yashavant Kanetkar, “Let us Python: Python is Future, Embrace it fast”, BPB Publications; 1 edition (8 July 2019).
2. Dusty Phillips, “Python 3 object-oriented Programming”, Second Edition PACKT Publisher August 2015.
3. John Grayson, “Python and Tkinter Programming”, Manning Publications (1 March 1999).
4. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
6. Introduction to computing and problem solving using python , E Balagurusamy, McGraw Hill Education.
7. Zed A. Shaw, “Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code”, Addison Wesley; 3 edition (1 October 2013).

Reference Books:

1. Eric Matthes, “Python Crash Course A hands-on, Project Based Introduction to programming” No Starch Press; 1 edition (8 December 2015).
2. Paul Barry, “Head First Python” O′Reilly; 2 edition (16 December 2016)
3. Andreas C. Mueller, “Introduction to Machine Learning with Python”, O′Reilly; 1 edition (7 October 2016)
4. David Beazley, Brian K. Jones, “Python Cookbook: Recipes for Mastering Python 3”, O'Reilly Media; 3 edition (10 May 2013).
5. Bhaskar Chaudhary, “Tkinter GUI Application Development Blueprints: Master GUI programming in Tkinter as you design, implement, and deliver 10 real world application”, Packt Publishing (November 30, 2015)

Software Tools:

1. Python IDE: https://www.python.org/downloads/
2. Anaconda Environment: https://www.anaconda.com/distribution/

Online Repository:

1. Github
2. Python 3 Documentation: https://docs.python.org/3/
3. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
4. http://spoken-tutorial.org
5. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
6. Numpy Documentation: https://numpy.org/doc/
7. Pandas Documentation: https://pandas.pydata.org/docs/
8. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
9. Scipy Documentation : https://www.scipy.org/docs.html
10. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
11. https://nptel.ac.in/courses/106/106/106106182/

The following list of experiments and course project is for illustration purpose. Faculty members are required to introduce their own innovative list of experiments based on above curriculum.

Sr. No.	Problem Statement	Module No.
1.	1. Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc. 2. Write Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc) 3. Write Python program to implement control structures.	Module 1

	4. Assume a suitable value for distance between two cities (in km). Write a program to convert and print this distance in meters, feet, inches and centimetre. 5. Write a program to carry out the following operations on the given set s = {10, 2, -3, 4, 5, 88} a. Number of items in sets s b. Maximum element in sets s c. Minimum element in sets s d. Sum of all elements in sets s e. Obtain a new sorted set from s, set s remaining unchanged f. Report whether 100 is an element of sets s g. Report whether -3 is not an element of sets s.	
2.	1. Write python program to understand different File handling operations 2. Create 3 lists – a list of names, a list of ages and a list of salaries. Generate and print a list of tuples containing name, age and salary from the 3lists. From this list generate 3 tuples – one containing all names, another containing all ages and third containing all salaries.	Module 2
3.	1. Write Python program to implement classes, object, Static method and inner class 2. If any integer is given as in input through the keyboard, write a program to find whether it is odd or even number. 3. If ages of Ram, Shyam, and Ajay are given as an input through the keyboard, write a program to determine the youngest of the three. 4. Write a program that prints square root and cube root of numbers from 1 to 10, up to 4 decimal places. Ensure that the output is displayed in separate lines, with number center-justified and square and cube roots right-justified. 5. Write a program to find the factorial value of any number entered through the keyboard. 6. Write a program that defines a function count_lower_upper( ) that accepts a string and calculates the number of uppercase and lowercase alphabets in it. It should return these values as a dictionary. Call this function for some sample strings. 7. A 5-digit positive integer is entered through the keyboard, write a recursive function to calculate sum of digits of 5-digit number.	Module 3
4.	1. Write Python program to create, append, update, delete records from database using GUI. 2. Write Python program to obtain histogram of any image 3. Write Python Program to split color image in R,G,B and obtain individual histograms. 4.Write Python program for histogram equalization 5 Write Python Program for edge detection 6. Write Python Program for image segmentation 7. Write Python program to implement GUI Canvas application using Tkinter 8. Write Python program to implement GUI Frame application using Tkinter	Module 4
5.	1. Write Python program to study define, edit arrays and perform arithmetic operations. 2. Write python program to study selection, indexing, merging, joining, concatenation in data frames 3. Evaluate the dataset containing the GDPs of different countries to: a. Find and print the name of the country with the highest GDP b. Find and print the name of the country with the lowest GDP c. Print text and input values iteratively	Module 5

	d. Print the entire list of the countries with their GDPs e. Print the highest GDP value, lowest GDP value, mean GDP value, standardized GDP value, and the sum of all the GDPs 4. Analyze the Federal Aviation Authority (FAA) dataset using Pandas to do the following: a. a. View: aircraft make name, state name, aircraft model name, text information, flight phase, event description type, b. fatal flag c. b. Clean the dataset and replace the fatal flag NaN with "No". d. c. Find the aircraft types and their occurrences in the dataset e. d. Remove all the observations where aircraft names are not available f. Display the observations where fatal flag is "Yes" 5. Analyze the "auto mpg data" and draw a pair plot using seaborn library for mpg, weight, and origin. (a) Origin: This dataset was taken from the StatLib library maintained at Carnegie Mellon University. • Number of Instances: 398 • Number of Attributes: 9 including the class attribute • Attribute Information: • mpg: continuous • cylinders: multi-valued discrete • displacement: continuous • horsepower: continuous • weight: continuous • acceleration: continuous • model year: multi-valued discrete • origin: multi-valued discrete • car name: string (unique for each instance) 5. Write python program to use SciPy to solve a linear algebra problem. 6. There is a test with 30 questions worth 150 marks. The test has two types of questions: 1. True or false – carries 4 marks each 2. Multiple-choice – carries 9 marks each. Find the number of true or false and multiple-choice questions.	
6.	1. Write python program to study linear regression 2. Write python program to study multiple linear regression 3. Write python program to study logistic regression 4. Write python program to study Support Vector Machine 5. Write python program to study decision tree algorithm 6. Write python program to study two-way communication between client and server. 7. Write Python Program to study image morphological operations.	Module 6

Suggested list of course projects:

- Speed typing Test using Python
- Music player in Python
- Calculator app using tkinter
- Train announcement system using python
- Dice rolling simulator
- Expense tracker
- Contact book using python
- Develop classification model using freely available datasets
- Develop python application for sentiment analysis

Note:

1. Use of free cloud service such as Google Colab to run python scripts is encouraged.

2. Necessary theory part should be taught by the teacher at the beginning of the laboratory session.

Term Work (25-Marks):

At least **12 experiments and 01 course project** should be performed. Term work assessment must be based on the overall performance of the student with every experiment and project graded from time-to-time. The grades will be converted to marks as per "**Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM401	Mini Project 1B	--	04[$]	--	--	2	--	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. Of Test1 and Test2				
ECM401	Mini Project 1B	--	--	--	--	25	25	50

$ Indicates work load of a learner (Not Faculty) for Mini Project 1A. Faculty Load: 1 hour per week per four groups.

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: At the end of the course learners will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
  - First shall be for finalisation of problem
  - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - First review is based on readiness of building working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

NOTE: For Electronics & Telecommunication Engineering we recommend following syllabus for Mini-Project 1B, in case it is half-year project.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECM401	Mini-Project 1B: Arduino & Raspberry Pi based Projects	-	04$	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. Of Test 1 and Test 2				
ECM401	Mini-Project 1B: Arduino & Raspberry Pi based Projects	-	-	-	-	25	25	50

$ indicates work load of Learner (Not Faculty), for Mini Project 1B. Faculty Load: 1 hour per week per four groups.

Course pre-requisite:

1. ECM301 – Mini-Project 1A
2. ECL304 – C++ and Java Programming
3. ECC302 – Electronic Devices and Circuit

Course Objectives:

1. To make students familiar with the basics of Electronics, Microcontroller, Arduino board, Raspberry Pi, Arduino IDE (Integrated Development Environment) and Python programming.
2. To familiarize the students with the programming and interfacing of different devices with Arduino and Raspberry Pi Board.
3. To increase students critical thinking ability and provide solutions to some real time problems.

Course Outcomes:

After successful completion of the course student will be able to

1. Write basic codes for the Arduino board using the IDE for utilizing the onboard resources.
2. Apply the knowledge of interfacing different devices to the Arduino board to accomplish a given task.
3. Design Arduino based projects for a given problem.
4. Write code using python language using IDE for utilizing the onboard resources.
5. Apply the knowledge of interfacing different devices to raspberry Pi board to accomplish a given task.
6. Design Raspberry Pi based projects for a given problem.

Experiment No.	Unit No.	Section A: Arduino Board	Hrs.
EX.1.0		Introduction to Arduino Board	02
	1.1	Introduction to Arduino Uno board and integrated development environment (IDE	
	1	Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.	
EX.2.0		GPIO (along with Analog pin) Programming	04
	2.1	Introduction to programming GPIO, Analog and PWM PINS.	
	1	Interface any Digital Sensors to the Arduino board and display sensor values on serial Monitor.	
	2	Interface any Analog sensor to the Arduino board and display sensor values on serial Monitor.	
	3.	Generate varying duty cycle PWM using Arduino.	
EX.3.0		Controlling output devices/Displaying	04
	3.1	Introduction to different sensor (Analog and Digital), Relays, Motors and display.	
	1	Interface an Analog Sensors to the Arduino board and display sensor values on LCD/TFT/Seven segment Display.	
	2	Interface a temperature sensor to Arduino and switch on a relay to operate a fan if temperature exceeds given threshold. Also display the temperature on any of the display device	
EX.4.0		Interfacing Communication Devices and Cloud Networking	04
	4.1	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.	
	1	Interface Wi-Fi /Bluetooth/GSM/Zigbee/RF module to Arduino and program it to transfer sensor data wirelessly between two devices. Any two techniques from the above-mentioned modules needs to be interfaced.	
5.0		Sample Projects	10
	1.	Waste Management System	
	2.	Smart City Solutions	
	3.	Energy Monitoring Systems	
	4.	Smart Classrooms and learning Solutions	
	5.	Home security systems	
	6.	Smart Agriculture solutions	
	7.	Healthcare solutions.	
	8.	Industrial Applications	
	9.	IoT Applications	
	10.	Robotics	
		Section 'A' Total Hrs.	24

Experiment No.	Unit No.	Section B: Raspberry Pi	Hrs.
EX.1.0		Introduction to Raspberry PI	02
	1.1	What is Raspberry PI? Downloading and Installation of NOOBS, First Power-Up & Having a Look around, Introduction to the Shell and Staying updated.	
	1	Familiarization with Raspberry PI and perform necessary software installation. Apparatus Requirement: Hardware: Raspberry PI Board, Memory of 16GB, Power adapter, Memory Writer. Software: NOOBS, Raspbian OS, Win32 disk Imager, SD-Formatter software.	

EX.2.0		**Interfacing with Input / Output Devices using Python**	**04**
	2.1	**Introduction to Python, Connecting to the outside World with GPIO.**	
	1	**To Interface LED/Buzzer with Raspberry PI and write a program to turn ON LED for 1 sec after every 2 sec.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, LED, Buzzer.	
	2	**To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI and write a program to turn ON LED when Push button is pressed or at sensor detection.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, Push Button Switch, Digital Sensor (IR/LDR).	
	3.	**To interface analog sensor using MCP 3008 analog to digital converter chip.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, analog sensor, MCP 3008 chip.	
EX.3.0		**Interfacing Temperature Sensor, Motors, Display Devices.**	**04**
	3.1	**Introduction to Temperature sensor (Analog and Digital), Relays, Motors (DC, Stepper) and Driver circuits.**	
	1	**To interface DHT11 sensor with Raspberry PI and write a program to print temperature and humidity readings.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, DTH11 Sensor.	
	2	**To interface motor using relay with Raspberry PI and write a program to turn ON motor when push button is pressed.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, Relays, Motor Driver, Motors.	
	3	**To interface OLED with Raspberry PI and write a program to print temperature and humidity readings on it.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, OLED display device.	
EX.4.0		**Interfacing Communication Devices and Cloud Networking**	**04**
	4.1	**Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.**	
	1	**To interface Bluetooth/Zigbee/RFID/WiFI with Raspberry PI and write a program to send sensor data to smartphone using Bluetooth/Zigbee/RFID/WIFI. (Any one can be used for performing)** Apparatus Requirement: Raspberry PI with inbuilt Python Package, Bluetooth/Zigbee/RFID/WIFI.	
	2	**Introduction to Cloud computing, different types cloud networks and interconnection using Raspberry PI**	
	3	**Write a program on Raspberry PI to upload temperature and humidity data from thingspeak cloud.** Apparatus Requirement: Raspberry PI with inbuilt Python Package, Cloud networks such as thingspeak (open source), AWS, Azure, etc. anyone can be used for understanding purpose and building projects.	
EX.5.0		**Understanding of Communication Protocols**	**04**
	5.1	**Introduction to MQTT, IFTTT protocols and configuration steps.**	
	1	**Write a program on Raspberry PI to publish temperature data to MQTT broker**	
	2	**Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it.**	
	3	**Configuration of Webserver using Raspberry PI.**	
6.0		**Sample Projects**	**10**
	1.	**MQTT Based Raspberry Pi Home Automation: Controlling Raspberry Pi GPIO using MQTT Cloud**	
	2.	**License Plate Recognition using Raspberry Pi and OpenCV**	
	3.	**Real Time Face Recognition with Raspberry Pi and OpenCV**	
	4.	**Smart Garage Door Opener using Raspberry Pi**	

	5.	Remote Controlled Car Using Raspberry Pi and Bluetooth	
	6.	Fingerprint Sensor based door locking system using Raspberry Pi	
	7.	Raspberry Pi Ball Tracking Robot using Processing	
	8.	Web Controlled Home Automation using Raspberry Pi	
	9.	Line Follower Robot using Raspberry Pi	
	10.	Raspberry Pi based Smart Phone Controlled Home Automation	
	11.	Web Controlled Raspberry Pi Surveillance Robotic Car	
	12.	Raspberry Pi Based Weight Sensing Automatic Gate	
	13.	Raspberry Pi Emergency Light with Darkness and AC Power Line Off Detector	
	14.	Detecting Colors using Raspberry Pi and Color Sensor TCS3200	
	15.	Measure Distance using Raspberry Pi and HCSR04 Ultrasonic Sensor	
	16.	Call and Text using Raspberry Pi and GSM Module	
	17.	Raspberry Pi Home Security System with Email Alert	
	18.	Raspberry Pi Based Obstacle Avoiding Robot using Ultrasonic Sensor	
	19.	Web Controlled Notice Board using Raspberry Pi	
	20.	RF Remote Controlled LEDs Using Raspberry Pi	
	21.	RFID and Raspberry Pi Based Attendance System	
	22.	Raspberry Pi Interactive Led-Mirror	
	23.	Garage Door monitor using Raspberry Pi	
	24.	Raspberry Pi Digital Code Lock on Breadboard	
	25.	Electronic Voting Machine using Raspberry Pi	
		Section 'B' Total Hrs.	**28**
		Total A + B	**52**

Reference Books:

1. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017)
2. Simon Monk, "Raspberry PI Cookbook Software and Hardware Problems and Solutions" O'Reilly 2nd Edition
3. Simon Monk, Programming the Raspberry Pi, 2nd Edition: Getting Started with Python" The McGraw Hill
4. "DK Workbooks: Raspberry Pi Project Workbook", DK Children; Workbook edition (March 7, 2017)
5. Donald Norris, "Raspberry Pi Electronic Projects for Evil Genius", McGraw-Hill Education TAB; 1 edition (May 20, 2016)

Software Tools:

1. Raspbian OS: https://www.raspberrypi.org/downloads/
2. Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
3. SD Card Formatter: https://www.sdcard.org/downloads/formatter/
4. Arduino IDE: https://www.arduino.cc/en/main/software

Online Repository:

1. GitHub
2. NPTEL Videos on Raspberry Pi and Arduino Programming
3. https://www.electronicsforu.com/raspberry-pi-projects
4. https://circuitdigest.com/simple-raspberry-pi-projects-for-beginners
5. https://www.electronicshub.org/raspberry-pi-projects/

6. Spoken Tutorial Project-IIT Bombay: https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English
7. Teachers are recommended to use a free online simulation platform “Tinkercad” for the simulation of Arduino based circuits before the students implement it in the hardware: https://www.tinkercad.com/

AC- 5.05.2018
Item No. 4.53

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics and Telecommunication Engineering

Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

Dean, Faculty of Science and Technology

Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development. Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, semester-based credit and grading system is also introduced to ensure quality of engineering education. Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scales to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc. Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017- 18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Dean (I/c) Faculty of Science and Technology,
Member - Academic Council,
University of Mumbai, Mumbai

Chairman's Preamble:

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

Objectives:

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.

2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.

3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.

4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

Dr. Uttam D. Kolekar

Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering

Program Structure for
B.E. Electronics & Telecommunication Engineering (Rev. 2016)
University of Mumbai (With Effect from 2017-2018)
Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC501	Microprocessor & Peripherals Interfacing	4	-	-	4	-	4
ECC502	Digital Communication	4	-	-	4	-	4
ECC503	Electromagnetic Engineering	4	-	1@	4	1	5
ECC504	Discrete Time Signal Processing	4	-	-	4	-	4
ECCDLO 501X	Department Level Optional Course I	4	-	-	4	-	4
ECL501	Microprocessor & Peripherals Interfacing Lab	-	2	-	-	1	1
ECL502	Digital Communication Lab	-	2	-	-	1	1
ECL503	Business Communication & Ethics Lab	-	2+2*	-	-	2	2
ECL504	Open Source Technology for Communication Lab	-	2	-	-	1	1
ECLDLO 501X	Department Level Optional Lab I	-	-	2#	-	1	1
Total		**20**	**10**	**3**	**20**	**7**	**27**

@ 1 hour to be taken as tutorial classwise #2 hours to be taken as either lab or tutorial based on subject requirement
*2 hours to be taken as tutorial batchwise

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral/ Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC501	Microprocessor & Peripherals Interfacing	20	20	20	80	03	--	--	100
ECC502	Digital Communication	20	20	20	80	03	--	--	100
ECC503	Electromagnetic Engineering	20	20	20	80	03	25	--	125
ECC504	Discrete Time Signal Processing	20	20	20	80	03	--	--	100
ECCDLO 501X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ECL501	Microprocessor & Peripherals Interfacing Lab	--	--	--	--	--	25	25	50
ECL502	Digital Communication Lab	--	--	--	--	--	25	25	50
ECL503	Business Communication & Ethics Lab	--	--	--	--	--	50	--	50
ECL504	Open Source Technology for Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 501X	Department Level Optional Lab I	--	--	--	--	--	25	--	25
Total				**100**	**400**		**175**	**75**	**750**

Course Code	Department Level Optional Course I
ECCDLO 5011	Microelectronics
ECCDLO 5012	TV & Video Engineering
ECCDLO 5013	Finite Automata Theory
ECCDLO 5014	Data Compression and Encryption

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC601	Microcontrollers & Applications	4	-	--	4	--	4
ECC602	Computer Communication Networks	4	-	-	4	-	4
ECC603	Antenna & Radio Wave Propagation	4	-	-	4	-	4
ECC604	Image Processing and Machine Vision	4	-	--	4	--	4
ECCDLO 602X	Department Level Optional Course II	4	-	-	4	-	4
ECL601	Microcontroller & Applications Lab	-	2	-	-	1	1
ECL602	Computer Communication Network Lab	-	2	-	-	1	1
ECL603	Antenna & Radio Wave Propagation Lab	-	2	-	-	1	1
ECL604	Image Processing and Machine Vision Lab	-	2	-	-	1	1
ECLDLO 602X	Department Level Optional Lab II	-	2	-	-	1	1
Total		**20**	**10**	**-**	**20**	**5**	**25**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC601	Microcontroller& Applications	20	20	20	80	03	--	--	100
ECC602	Computer Communication Network	20	20	20	80	03	--	--	100
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	03	--	--	100
ECC604	Image Processing and Machine Vision Lab	20	20	20	80	03	--	--	100
ECCDLO 602X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ECL601	Microcontroller & Applications Lab	--	--	--	--	--	25	25	50
ECL602	Computer Communication Network Lab	--	--	--	--	--	25	25	50
ECL603	Antenna & Radio Wave Propagation Lab	--	--	--	--	--	25	25	50
ECL604	Image Processing and Machine Vision Lab	--	--	--	--	--	25	25	50
ECLDLO 602X	Department Level Optional Lab II	--	--	--	--	--	25	--	25
Total				**100**	**400**		**125**	**100**	**725**

Course Code	Department Level Optional Course II
ECCDLO 6021	Digital VLSI Design
ECCDLO 6022	Radar Engineering
ECCDLO 6023	Database Management System
ECCDLO 6024	Audio Processing

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC701	Microwave Engineering	4	-	-	4	-	4
ECC702	Mobile Communication System	4	-	-	4	-	4
ECC703	Optical Communication	4	-	--	4	-	4
ECCDLO 703X	Department Level Optional Course III	4	-	-	4	-	4
ILO701X	Institute Level Optional Course I	3	-	-	3	-	3
ECL701	Microwave Engineering Lab	-	2	-	-	1	1
ECL702	Mobile Communication System Lab	-	2	-	-	1	1
ECL703	Optical Communication Lab	-	2	-	-	1	1
ECLDLO 703X	Department Level Optional Lab III	-	2	-	-	1	1
ECL704	Project-I	-	6	-	-	3	3
Total		**19**	**14**	**-**	**19**	**7**	**26**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC701	Microwave Engineering	20	20	20	80	03	--	--	100
ECC702	Mobile Communication System	20	20	20	80	03	--	--	100
ECC703	Optical Communication	20	20	20	80	03	--	--	100
ECCDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100
ILO701X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
ECL701	Microwave Engineering Lab	--	--	--	--	--	25	25	50
ECL702	Mobile Communication System Lab	--	--	--	--	--	25	25	50
ECL703	Optical Communication Lab	--	--	--	--	--	25	25	50
ECLDLO 703X	Department Level Optional Lab III	--	--	--	--	--	25	25	50
ECL704	Project-I	--	--	--	--	--	50	50	100
Total				**100**	**400**		**150**	**150**	**800**

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I[#]
ECCDLO7031	Neural Networks and Fuzzy Logic	ILO7011	Product Lifecycle Management
ECCDLO7032	Big Data Analytics	ILO7012	Reliability Engineering
ECCDLO7033	Internet Communication Engineering	ILO7013	Management Information System
ECCDLO7034	CMOS Mixed Signal VLSI	ILO7014	Design of Experiments
ECCDLO7035	Embedded System	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

 # Common with all branches

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pracs	Tut	Theory	TW/ Pracs	Total
ECC801	RF Design	4	-	--	4	--	4
ECC802	Wireless Networks	4	-	-	4	-	4
ECCDLO 804X	Department Level Optional Course IV	4	-	-	4	-	4
ILO802X	Institute Level Optional Course II	3	-	-	3	-	3
ECL801	RF Design Lab	-	2	-	-	1	1
ECL802	Wireless Networks Lab	-	2	-	-	1	1
ECLDLO 804X	Department Level Optional Lab IV	-	2	-	-	1	1
ECL803	Project-II	-	12	-	-	6	6
Total		**15**	**18**	**-**	**15**	**9**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral & Prac	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
ECC801	RF Design	20	20	20	80	03	--	--	100
ECC802	Wireless Networks	20	20	20	80	03	--	--	100
ECCDLO 804X	Department Level Optional Course IV	20	20	20	80	03	--	--	100
ILO802X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
ECL801	RF Design Lab	--	--	--	--	--	25	25	50
ECL802	Wireless Networks Lab	--	--	--	--	--	25	25	50
ECLDLO 804X	Department Level Optional Lab IV	--	--	--	--	--	25	25	50
ECL803	Project-II	--	--	--	--	--	100	50	150
Total				**80**	**320**		**175**	**125**	**700**

Course Code	Department Level Elective Course IV	Course Code	Institute Level Elective Course II[#]
ECCDLO8041	Optical Networks	ILO8021	Project Management
ECCDLO8042	Advanced Digital Signal Processing	ILO8022	Finance Management
ECCDLO8043	Satellite Communication	ILO8023	Entrepreneurship Development and Management
ECCDLO8044	Network management in Telecommunication	ILO8024	Human Resource Management
		ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

 # Common with all branches

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC501	Microprocessors & Peripherals	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC501	Microprocessors & Peripherals	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

- To understand the basic concepts of microcomputer systems.
- To develop background knowledge and core expertise in 8086 microprocessor and co-processor 8087.
- To write assembly language programs for 8086 microprocessor
- To understand peripheral devices and their interfacing to 8086 and to study the design aspects of basic microprocessor based system.

Course outcomes:

After successful completion of the course student will be able to

- Understand the basic concepts of microcomputer systems.
- Understand the architecture and software aspects of microprocessor 8086.
- Write Assembly language program in 8086.
- Know the Co-processor configurations.
- Interface peripherals for 8086.
- Design elementary aspect of microprocessor based system.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Microcomputer System**	**06**
	1.1	Block diagram of microprocessor based system: CPU, I/O Devices, Clock, Memory, Concept of Address, Data and Control Bus and Tristate logic.	
	1.2	Need of Assembly Language and its Comparison with higher level languages	
	1.3	Need of Assembler and Compiler and their comparison.	
2.0		**Architecture of 8086 Microprocessor**	**06**
	2.2	8086 Architecture and organization, pin configuration.	
	2.3	Minimum and Maximum modes of 8086.	
	2.4	Read and Write bus cycle of 8086.	
3.0		**Instruction set and programming of 8086**	**10**
	3.1	8086 Addressing modes.	
	3.2	8086 Instruction encoding formats and instruction set.	
	3.3	Assembler directives.	
	3.4	8086 programming and debugging of assembly language program. Programs related to: arithmetic, logical, delay, string manipulation, stack and subroutines, input, output, timer/counters.	
	3.5	Elementary DOS Programming: Introduction to int-21h services.	
4.0		**Peripherals interfacing with 8086 and applications.**	**10**
	4.1	8086-Interrupt structure.	
	4.2	Programmable peripheral Interface 8255.	
	4.3	Programmable interval Timer 8254.	
	4.4	Elementary features of 8259A and 8257 and interface.	
	4.5	Interfacing 8255, 8254 with 8086 and their applications	
5.0		**ADC, DAC interfacing with 8086 and its application**	**08**
	5.1	Analog to Digital Converter (ADC) 0809	
	5.2	Digital to Analog Converter (DAC) 0808	
	5.3	Interfacing ADC 0809, DAC 0808 with 8086 and their applications.	
	5.4	8086 based data Acquisition system.	
6.0		**8086 Microprocessor interfacing**	**08**
	6.1	8087 Math co-processor, its data types and interfacing with 8086.	
	6.2	Memory interfacing with 8086 microprocessor	
		Total	**48**

Text Books:

1. John Uffenbeck: "8086/8088 family: "Design, Programming and Interfacing", Prentice Hall, 2nd Edition
2. B. B. Brey: "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor", Pearson Pub, 8th Edition
3. Hall D.V: "Microprocessor and Interfacing Programming and Hardware", Tata McGraw Hill, 2nd Edition.
4. Yu-Cheng Liu/Glenn A. Gibson: "Microcomputer Systems: The 8086/8088 Family Architecture, Programming and Design", Phi Learning.

Reference Books:

1. Peter Abel: "IBM PC ASSEMBLY LANGUAGE & PROGRAMMING", Phi Learning.
2. A. K. Ray and K. M. Burchandi: "Advanced Microprocessor and Peripherals, Architecture Programming and Interfacing", Tata McGrawHill, 3rd Edition
3. Don Anderson, Tom Shanley: "Pentium Processor System Architecture", MindShare Inc., 2nd Edition
4. National Semiconductor: Data Acquisition Linear Devices Data Book
5. Intel Peripheral Devices: Data Book.
6. The Intel 8086 family user manual.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC502	Digital Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC502	Digital Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication

Course objectives:

- To identify the signals and functions of its different components,
- To learn about theoretical aspects of digital communication system and Draw signal space diagrams, compute spectra of modulated signals,
- To learn about error detection and correction to produce optimum receiver.

Course outcomes:

After successful completion of the course student will be able to

- Understand random variables and random processes of signal,
- Apply the concepts of Information Theory in source coding,
- Evaluate different methods to eliminate Inter-symbol interference,
- Compare different band-pass modulation techniques,
- Evaluate performance of different error control codes.

Module No.	Unit No.	Topics	Hrs.
1.0		**Probability Theory & Random Variables**	**08**
	1.1	Information, Probability, Conditional Probability of independent events, Relation between probability and probability Density , Raleigh Probability Density , CDF, PDF.	
	1.2	Random Variables, Variance of a Random Variable, correlation between Random Variables, Statistical Averages(Means),Mean and Variance of sum of Random variables, Linear mean square Estimation, Central limit theorem, Error function and Complementary error function Discrete and Continuous Variable, Gaussian PDF, Threshold Detection, Statistical Average, Chebyshev In-Equality, Auto-correction.	
	1.3	Random Processes	
2.0		**Information Theory and Source Coding**	**06**
	2.1	Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and it's properties	
	2.2	Mini Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding, Huffman Source Coding	
	2.3	Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem	
3.0		**Error Control Systems**	**12**
	3.1	Types of error control, error control codes, linear block codes, systematic linear block codes, generator matrix, parity check matrix, syndrome testing ,error correction, and decoder implementation	
	3.2	**Systematic and Non-systematic Cyclic codes**: encoding with shift register and error detection and correction	
	3.3	**Convolution Codes**: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods.	
4.0		**Bandpass Modulation & Demodulation**	**10**
	4.1	Band-pass digital transmitter and receiver model, digital modulation schemes	
	4.2	Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying QPSK), M- ary PSK Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK)	

5.0		**Baseband Modulation & Transmission**	**04**
	5.1	Discrete PAM signals and it's power spectra	
	5.2	Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern	
6.0		**Optimum Reception of Digital Signal**	**08**
	6.1	Baseband receiver	
	6.2	Probability of Error	
	6.3	Optimum Receiver and Filter	
	6.4	Matched Filter and its probability of error	
	6.5	Coherent Reception	
	Total		**48**

Text Books:

1. H. Taub, D. Schlling, and G. Saha, "Principles of Communication Systems," Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
2. Lathi B P, and Ding Z., "Modern Digital and Analog Communication Systems," Oxford University Press, Fourth Edition, 2009.
3. Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.

Reference Books:

1. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. T L Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3. P Ramakrishna Rao, "Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2011.
4. M F Mesiya, "Contempory Communication systems", Mc-Graw Hill, Singapore, First Edition, 2013.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC503	Electromagnetic Engineering	04	--	@1	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC503	Electromagnetic Engineering	20	20	20	80	25	--	--	125

@ 1 hour to be taken as tutorial class wise

Course prerequisite:

- Vector Algebra and vector Calculus
- Various Co-ordinate system
- Two port network

Course objectives:

- To learn electromagnetics, including static and dynamic electromagnetic fields and waves within and at the boundaries of media.
- To learn mathematical skills, including Vectors and phasors and Partial differential equations.
- To learn Electromagnetic radiation and propagation in space and within transmission lines

Course outcomes:

After successful completion of the course student will be able to explain and evaluate EM fields and key physical parameters for:

- Fields and energies in simple planar, cylindrical, and spherical geometries, Fields within conducting and anisotropic media
- Electric and magnetic forces on charges, wires, and media Sinusoids and transients on TEM lines with mismatched impedances and tuning

Module No.	Unit No.	Topics	Hrs.
1.0		**Electrostatics**	**07**
	1.1	Coulomb's Law & Electric Field Intensity, Electric Field due to point charge, line charge and surface charge distributions	
	1.2	Electric Flux Density, Gauss's Law and its Application to differential volume element, divergence, divergence theorem.	
	1.3	Electric potential, Relationship between Electric field & potential , Potential Gradient., electric dipole	
2.0		**Electric Fields in Material Space**	**06**
	2.1	Energy density in electrostatic field, Current and current Density, continuity equation, Polarization in dielectrics	
	2.2	Capacitance, capacitance of parallel plate; spherical; cylindrical capacitors with multiple di-electrics, Boundary conditions	
	2.3	Poisson's and Laplace's equation, General procedures for solving Poisson's and Laplace's equations.	
3.0		**Steady Magnetic Field**	**07**
	3.1	Biot-Savart's Law, Ampere's Circuital Law and its Applications, magnetic flux density, Magnetic Scalar and vectors potentials, Derivations of Biot-Savart's law and Ampere's law based on Magnetic Potential	
	3.2	Forces due to magnetic field, magnetic dipole, Classification of Magnetic Materials, Magnetic boundary conditions.	
4.0		**Maxwell's Equation and Electromagnetic Wave Propagation**	**12**
	4.1	Faraday's law, Displacement current, Maxwell's equations in point form and integral form, Boundary conditions for time varying field , magnetic vector potential, Time harmonic field, Introduction to the concept of Uniform Plane Wave and Helmholtz equation.	
	4.2	Wave Propagation in Free Space, Lossy and Lossless Dielectrics and in Good Conductors. Reflection of Plane Wave, Poynting Vector, Wave Power, Skin Effect, Wave Polarization and Standing Wave Ratio	
5.0		**Transmission Lines**	**10**
	5.1	Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio, Power, Transients on transmission lines.	
	5.2	Smith Chart, Applications of Smith Chart in finding VSWR ,and reflection coefficient, admittance calculations, impedance calculations over length of line.	

6.0		**Applications of Electromagnetics**	**06**
	6.1	Electrostatic discharge, Materials with high dielectric constant, Graphene, Inkjet printer, RF mems, Multidielectric systems, magnetic levitation, Memristor, Optical nanocircuits, Metamaterials, Microstrip lines and characterization of Data cables, RFID	
		Total	**48**

Text Books:

1. Engineering Electromagnetics, William H Hayt and John A Buck - Tata McGraw-Hill Publishing Company Limited, Seventh Edition
2. Principles of Electromagnetics, Matthew N. O.Sadiku ,S.V.Kulkarni- Oxford university press, Sixth edition

Reference Books:

1. Electromagnetics with applications by J.D.Krauss and Daniel Fleisch fifth edition
2. Electromagnetic Field Theory Fundamentals, Bhag Singh Guru, Hüseyin R. Hiziroglu Cambridge University Press, Second Edition.
3. Electromagnetics, Joseph Edminister, , Mahmood Nahvi, Schaum Outline Series, Fourth edition.
4. R. K. Shevgaonkar, "Electromagnetic Waves" Tata McGraw Hil

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC504	Discrete Time Signal Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC504	Discrete Time Signal Processing	20	20	20	80	--	--	--	100

Course prerequisite:

- Signals & Systems

Course objectives:

- To develop a thorough understanding of DFT and FFT and their applications.
- To teach the design techniques and performance analysis of digital filters
- To introduce the students to digital signal processors and its applications.

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts of discrete-time Fourier transform and fast Fourier transform.
- Apply the knowledge of design of IIR digital filters to meet arbitrary specifications.
- Apply the knowledge of design of FIR digital filters to meet arbitrary specifications.
- Analyze the effect of hardware limitations on performance of digital filters.
- Apply the knowledge of DSP processors for various applications.

Module No.	Unit No.	Topics	Hrs.
1.0		**Discrete Fourier Transform & Fast Fourier Transform**	**10**
	1.1	Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT	
	1.2	Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and introduction to composite FFT.	
2.0		**IIR Digital Filters**	**10**
	2.1	Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop and All Pass), Analog filter approximations: Butterworth, Chebyshev I, Elliptic.	
	2.2	Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with examples.	
	2.3	Analog and digital frequency transformations with design examples.	
3.0		**FIR Digital Filters**	**10**
	3.1	Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters. Frequency response, location of the zeros of linear phase FIR filters.	
	3.2	Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann, Kaiser), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.	
4.0		**Finite Word Length effects in Digital Filters**	**06**
	4.1	Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Co-efficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling.	
	4.2	Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters.	
5.0		**DSP Processors**	**06**
	5.1	Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC), Special Instructions, Replication, On-chip memory, Extended Parallelism.	

	5.2	General purpose digital signal processors, Selecting digital signal processors, Special purpose DSP hardware, Architecture of TMS320CX fixed and floating DSP processors.	
6.0		**Applications of Digital Signal Processing**	**06**
	6.1	Application of DSP for ECG signals analysis.	
	6.2	Application of DSP for Dual Tone Multi Frequency signal detection.	
	6.3	Application of DSP for Radar Signal Processing.	
		Total	**48**

Text Books:

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing"*, A Practical Approach by, Pearson Education
2. Tarun Kumar Rawat, " *Digital Signal Processing"*, Oxford University Press, 2015

Reference Books:

1. Proakis J., Manolakis D., "*Digital Signal Processing*", 4th Edition, Pearson Education.
2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited.
3. Oppenheim A., Schafer R., Buck J., "*Discrete Time Signal Processing*", 2nd Edition, Pearson Education.
4. B. Venkata Ramani and M. Bhaskar, "*Digital Signal Processors, Architecture, Programming and Applications*", Tata McGraw Hill, 2004.
5. L. R. Rabiner and B. Gold, "*Theory and Applications of Digital Signal Processi*ng", Prentice-Hall of India, 2006.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5011	Microelectronics	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5011	Microelectronics	20	20	20	80	--	--	--	100

Course prerequisite:

- Electronics Devices and Circuits- I
- Electronics Devices and Circuits- II

Course objectives:

- To understand integrated circuit biasing using MOSFET.
- To analyze single stage active load MOS amplifier.
- To analyze active load differential amplifier
- To understand implementation of passive components in ICs.

Course outcomes:

After successful completion of the course student will be able to

- Analyze various constant current source circuit using MOS
- Design and implement active load MOS amplifier.
- Design and implement active load differential amplifier

Module No.	Unit No.	Topics	Hrs.
1.0		**Basics of MOSFETs**	**08**
	1.1	Introduction to various fabrication process(in brief) Fabrication of NMOS and PMOS transistors along with mask layout diagram, Multi finger transistor, Scaling of MOSFET, Various Short channel effects in MOSFET, Second order effects in MOSFET, MOS as controlled resistor, MOS device capacitances	
2.0		**Integrated Circuit Biasing & Active Loads using MOSFET**	**08**
	2.1	Current Mirror, cascade current source, Wilson current source, bias independent current source using MOSFET,DC analysis and small signal analysis of MOS active load, DC analysis and small signal analysis of MOS advanced active load	
3.0		**Single Stage MOS Active Load amplifiers**	**08**
	3.1	CS amplifier with current source load, CS amplifier with diode connected load, CS amplifier with current source load, Common gate circuit, Cascode amplifier, Double Cascoding, Folded Cascode.	
4.0		**Active Load MOSFET Differential Amplifier**	**10**
	4.1	Basic MOS Differential Amplifier, DC transfer characteristics, small signal equivalent analysis, MOS differential amplifier with active load, MOS differential amplifier with cascode active load,	
5.0		**Passive Device Fabrication in IC**	**07**
	5.1	Fabrication of inductors, fabrication of transformers, fabrication of varactors, and fixed value capacitors.	
6.0		**Power Amplifiers**	**07**
	6.1	Class A, class B, Class C, Class D, Class E, Class F using MOSFET	
		Total	**48**

Text Books:

1. A. Sedra, K. Smith, adapted by A. Chanorkar "Microelectronic Circuits-Theory and Application *Advanced engineering mathematics*", Oxford Higher Education, 7th Edition
2. D. Neamen, "Electronic Circuits Analysis and Design", McGraw Hill Education, 3rd Edition
3. B. Razavi, "Design of Analog Integrated Circuits", McGraw Hill Education, Indian Edition

Reference Books:

1. B. Razavi,"R F Microelectronics", Pearson Publication, 2nd Edition

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
3. Question paper will comprise of 6 questions, each carrying 20 marks.
4. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5012	TV & Video Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5012	TV & Video Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand basic concepts of TV system .
- To understand compression techniques
- To introduce to advanced systems and dvb standards

Course outcomes:

After successful completion of the course student will be able to

- Understand overview of TV system.
- Understand details of compression technique.
- Know about different dvb standards.
- Understand advanced digital systems

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of TV system**	**10**
	1.1	Interlaced scanning, Composite video signal, VSB(Vestigial sideband transmission), Channel bandwidth, Study of transmitter and receiver block diagram of monochrome Television	
	1.2	Camera Tubes: Vidicon, Image Orthicon	
2.0		**Colour Television**	**10**
	2.1	Colour Fundamentals, Chromaticity diagram, Frequency interleaving, compatibility considerations	
	2.2	NTSC system characteristics, Encoder and Decoder block diagram, PAL system characteristics, Encoder and Decoder block diagram, Comparison of NTSC and PAL systems	
3.0		**Digital Video**	**08**
	3.1	Basics of digital video	
	3.2	Chroma subsampling:4:4:4,4:2:2,4:2:0,4:1:1 digital video formats	
	3.3	Video compression standards:MPEG2:DCT coding, codec structure. Introduction to H.264/MPEG-4 AVC, Introduction to H.265	
	3.4	Set-Top Box	
4.0		**Digital Video Broadcasting**	**06**
	4.1	Introduction to DVB-T,DVB-T2,DVB-H,DVB-S,DVB-C	
	4.2	Satellite Television	
5.0		**Advanced Digital TV Systems**	**10**
	5.1	MAC MACd2	
	5.2	HDTV,SUHDTV	
	5.3	Smart TV and its functions	
	5.4	Introduction to IPTV	
	5.5	Application of TV system as CCTV	
6.0		**Displays & Streaming Media Device**	**04**
	6.1	LCD,LED	
	6.2	Chromcast	
		Total	**48**

Text Books:

1. Monochrome and colour Television by R.R.Gulathi
2. Television and video engineering by A.M. Dhake

Reference Books:

1. Digital Television (Practical guide for Engineers) by Fischer

Websites:

1. https://www.dvb.org/resources/public/factsheets
2. https://en.wikipedia.org/wiki/Digital_Video_broadcasting

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5013	Finite Automata Theory	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5013	Finite Automata Theory	20	20	20	80	--	--	--	100

Course prerequisite:

- Digital System Design

Course objectives:

This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit. The main objectives are:

- To understand learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To design combinational logic circuits and its optimization and fault detection.
- To study Mealy and Moore synchronous and asynchronous sequential circuits design and their applications.

Course outcomes:

After successful completion of the course student will be able to

- Manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
- Design and analyze small combinational circuits and to use standard combinational functions/ building blocks to build larger more complex circuits.
- Design and analyze small sequential circuits and devices and to use standard sequential functions/ building blocks to build larger more complex circuits.
- Design finite state machine understand the fundamentals and areas of applications for the integrated circuits.
- Perform symmetric and cascade threshold function and element

Module No.	Unit No.	Topics	Hrs.
1.0		**Combinational Logic**	**09**
	1.1	Notations of sets, Relations and Lattices, Venn diagram	
	1.2	Switching Algebra and functions, Boolean algebras and functions, Minimization of Boolean functions using map method and Tabulation Method, Prime implicant chart, Reduction of the chart, Branching method	
	1.3	Design of combinational Logic circuits, Contact networks, Functional decomposition and symmetric functions. Identification of symmetric functions	
2.0		**Threshold Logic & Synthesis of Threshold Networks**	**06**
	2.1	Threshold Logic, Threshold elements, Capabilities and limitations of threshold logic, elementary properties, Linear separability, Unate functions, Synthesis of threshold functions, Cascading of threshold elements.	
3.0		**Testing of Combinational Circuits**	**09**
	3.1	Reliable Design and fault Diagnosis, Fault Detection in combinational circuits, Fault location experiments, Fault Detection by Boolean Differences and path sensitization, Synthesis for testability, Multiple fault detection using map method, failure-Tolerant Design.	
4.0		**Sequential Circuits**	**12**
	4.1	Synchronous sequential circuits and iterative networks: Memory elements and their excitation functions; Synthesis of synchronous sequential circuits, Capabilities and limitations, State equivalence and Minimization, Minimization of completely specified and Incompletely specified sequential machines, Partition technique, Merger methods	
	4.2	Asynchronous sequential circuits: Hazards, Synthesis, State assignment and minimization	
	4.3	Finite state Machines – Mealy and Moore synchronous and asynchronous sequential circuits Design,	
5.0		**Structure and testing of Sequential Circuits**	**08**
	5.1	Structure of sequential Machines, Lattice of closed partitions, State Assignment using partitions, Reduction of output dependency, Input Independence and Autonomous clock.	
	5.2	Homing sequence, synchronizing sequence, Distinguishing sequence, Checking experiments, Machine identification, Recent Trends/Developments	

6.0		**Algorithmic State Machine**	**04**
	6.1	Introduction and components of ASM charts, Representation of sequential circuits using ASM charts, Example using ASM chart: 2 bit counter, binary multiplier, Weighing machine etc.	
		Total	**48**

Text Books:

1. Zvi Kohavi and Niraj K. Jha. "*Switching and Finite Automata Theory*", 3 Editions, Cambridge University Press.
2. Zvi Kohavi, *"Switching Theory and Finite Automata",* 2nd edition, Tata McGraw Hill
3. R. P. Jain, "*Switching Theory and Logic Design*", Tata McGraw Hill Education, 2003.
4. Lee Samuel C.," *Modern Switching Theory and Digital Design*", Prentice Hall PTR

Reference Books:

1. Morris Mano, "*Digital Logic and Computer Design*", Pearson Education
2. Samuel Lee, "*Digital Circuits and Logic design*", Prentice Hall.
3. William I. Fletcher, "*An Engineering Approach to Digital Design*", Prentice Hall.
4. John F. Wakerly, "*Digital Design ‐ Principles and Practices*", Pearson Education
5. A. Anand Kumar, *"Switching Theory and Logic Design",* PHI Learning private limited, 2014

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 5014	Data Compression & Encryption	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 5014	Data Compression & Encryption	20	20	20	80	--	--	--	100

Course objectives:
To teach the students

- Lossless and Lossy compression techniques for different types of data.
- Data Encryption Techniques.
- Network and Web Security.

Course outcomes:
After successful completion of the course student will be able to

- Implement text, audio and video compression techniques.
- Understand Symmetric and Asymmetric Key Cryptography schemes.
- Understand network security.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Data Compression**	**12**
	1.1	Data Compression : Modelling and Coding, Statstical Modelling, Dictionary Schemes, LZ, Lossy Compression	
	1.2	Shannon – Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding	
	1.3	Difficulties in Huffman Coding, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window Compression: LZ-77, LZ-78, LZW	
2.0		**Image Compression**	**06**
	2.1	DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards	
3.0		**Video and Audio Compression**	**08**
	3.1	Analog Video, Digital Video, MPEG – 2, H – 261 Encoder and Decoder	
	3.2	Sound, Digital Audio, μ-Law and A-Law Companding, MPEG – 1 Audio Layer (MP3 Audio Format)	
4.0		**Data Security**	**06**
	4.1	Security Goals, Cryptographic Attacks, Techniques	
	4.2	Symmetric Key: Substitution Cipher, Transposition Cipher , Stream and Block Cipher	
	4.3	DES, AES	
5.0		**Number Theory and Asymmetric Key Cryptography**	**08**
	5.1	Prime Numbers, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Discreet Logarithms	
	5.2	Principles of Public Key Crypto System, RSA	
	5.3	Key Management, Deffie-Hellman Key Exchange	
	5.4	Message Integrity, Message Authentication and Hash Functions, SHA, H MAC, Digital Signature Standards	
6.0		**Network Security**	**08**
	6.1	Email, PGP, S/MIME, Intrusion Detection System	
	6.2	Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions	
	6.3	Kerberos, X.509 Authentication Service, Public Key Infrastructure	
		Total	**48**

Text Books:

1. Mark Nelson, Jean-Loup Gailly,"The Data Compression Book", 2nd edition, BPB Publications
2. Khalid Sayood, "Introduction to Data Compression", 2nd Edition Morgan Kaufmann.
3. William Stallings, "Cryptography and Network Security Principles and Practices 5th Edition", Pearson Education.
4. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill.

Reference Books:

1. David Salomon, "Data Compression: The Complete Reference", Springer.
2. Matt Bishop, "Computer Security Art and Science", Addison-Wesley.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL501	Microprocessors & Peripherals Interfacing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL501	Microprocessors & Peripherals Interfacing Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

Experiments can be conducted on Assembler, Emulator or Hardware kits, in Assembly language.

- To write an assembly language program to perform 8-bit addition using multiple addressing modes, viz., direct, indirect, register, etc. addressing mode.
- To write an assembly language program to perform 16-bit Logical operations, viz., AND, OR, XOR, NAND, etc.
- To write an assembly language program to perform 32-bit Subtraction
- To write an assembly language program to generate 10 msec delay using software (register) and 8254
- To write an assembly language program to move 10 memory locations using String Instruction
- To write an assembly language subroutine (program) that takes a number as input and returns the square of it
- To write an assembly language program for interfaced 7 segment display or keypad or both, through 8255
- To write an assembly language program to read and save value from ADC
- To write an assembly language program to generate square / triangular / ramp waveforms using DAC
- To write an assembly language program for performing floating point division using 8087
- To write an assembly language program to use INT 21h DOS Functions, viz. read character, write character, get system date, etc

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL502	Digital Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL502	Digital Communication Laboratory	--	--	--	--	25	25	--	50

Experiments should be performed on Bread-board or on experimentation kits.

Suggested Experiment List

- To understand sampling theorem and reconstruction
- To understand Various line codes
- To observe the performance of Return to Zero (RZ) types of line code
- To observe the performance of Non- Return to Zero (NRZ) types of line code
- Modulation and Demodulation of Binary Amplitude Shift Keying
- Modulation and Demodulation of Binary Frequency Shift Keying
- Modulation and Demodulation of Binary Phase Shift Keying
- Modulation and Demodulation of Quadrature Phase Shift Keying
- To observe the effect of signal Distortion using EYE-Diagram
- To Study and perform Linear Block codes
- To Study and perform cyclic codes

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will

be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL503	Business Communication & Ethics Laboratory	2 (classwise)	2 (batch wise)	--	--	2	--	2

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL503	Business Communication & Ethics Laboratory	--	--	--	--	50	--	--	50

Course objectives:
To teach the students

- To inculcate professional and ethical attitude.
- To enhance effective communication and interpersonal skills.
- To build multidisciplinary approach towards all life tasks.

Course outcomes:
After successful completion of the course student will be able to

- Design a technical document using precise language, suitable vocabulary and apt style.
- Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
- Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
- Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
- Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module No.	Unit No.	Topics	Hrs.
1.0		**Report Writing**	**05**
	1.1	Objectives of Report Writing	
	1.2	Language and Style in a report	
	1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
2.0		**Technical Writing**	**03**
	2.1	Technical Paper Writing (IEEE Format)	
	2.2	Proposal Writing	
3.0		**Introduction to Interpersonal Skills**	**09**
	3.1	Emotional Intelligence	
	3.2	Leadership and Motivation	
	3.3	Team Building	
	3.4	Assertiveness	
	3.5	Conflict Resolution and Negotiation Skills	
	3.6	Time Management	
	3.7	Decision Making	
4.0		**Meetings & Documentations**	**02**
	4.1	Strategies for conducting effective meetings	
	4.2	Notice, Agenda and Minutes of a meeting	
	4.3	Business meeting etiquettes	
5.0		**Introduction to Corporate Ethics**	**02**
	5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
	5.2	Introduction to Intellectual Property Rights	
	5.3	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
6.0		**Employment Skills**	**07**
	6.1	Group Discussion	
	6.2	Resume Writing	
	6.3	Interview Skills	
	6.4	Presentation Skills	
	6.5	Statement of Purpose	
		Total	**28**

References

1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, *"Personal Development for Life and Work",* Thomson Learning, 12th edition
5. Heta Murphy, *"Effective Business Communication",* Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing",* Tata McGraw-Hill Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development",* Tata McGraw Hill.
8. Lehman, Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
10. Dr. Alex, K., "Soft Skills", S Chand and Company
11. Subramaniam, R., "Professional Ethics" Oxford University Press.
12. Robbins Stephens P., "Organizational Behavior", Pearson Education
13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

List of Assignments:

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work:

Term work will consist of all assignments from the list. The distribution of marks for term

Work willl be as follows:

Book Report……..(10) Marks

Assignments …… (10) Marks

Project Report Presentation…….. (15) Marks

Group Discussion.…… (10) Marks

Attendance …… (05) Marks

TOTAL: ……(50) Marks

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL504	Open Source technology for Communication Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL504	Open Source technology for Communication Lab	--	--	--	--	25	25	--	50

Prerequisites:

- Principals of Communication Engineering
- Digital System Design
- Signals and Systems
- Electronics Circuits and Devices

Course objectives:

- Introduction to open source tools for communication lab.
- To simulate and analyze the various parameters of communication systems.
- To understand and implement the communication system/sub system.

Course outcomes:

After successful completion of the course student will be able to

- Learn open source programming tools for communication technology.
- Simulate and analyze the performance of communication system.
- Implement the communication system/subsystem.

Sample List of Experiments:

Note: These are few examples of experiments; teachers may prepare their own list.

Sr. No	Title	Resource
1	Installation of a. Python, NumPy and commPy or b. Octave or c. Scilab or d. Xilinx using HDL Or e. LT SPICE Or f. SEQUEL Note: Any one tool or a combination of tools .	See the E-resource Links
2	Write a program to represent analog signal to digital signal (A to D conversion)	http://www.scilab.in/files/textbooks/ProfSenthikumar/DC.pdf
3	Write a program to generate basic functions a. Unit Impulse Signal b. Unit Step Signal c. Generate Ramp Signal d. Exponential Sequence e. Generate Sine Sequence f. Cos Sequence	See the E-resource Links
4	Write a program to perform convolution and correlation on the given signal.	See the E-resource Links
5	Plot the ASK, FSK and PSk Waveforms using scilab/python	See the E-resource Links
6	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
7	Write a program to read a speech signal and plot it and play it.	See the E-resource Links

8	Write a program to apply Low/High Pass Filter on the given signal.	See the E-resource Links
9	Write a code to design Butterworth/Chebyshev filter using Scilab/Octave/Python.	See the E-resource Links
10	Write a program to calculate Hamming distance using Scilab/python.	See the E-resource Links
11	Encoding and decoding of convolutional codes	1.https://github.com/veeresht/CommPy/blob/master/commpy/examples/conv_encode_decode.py 2.https://media.readthedocs.org/pdf/commpy/latest/commpy.pdf
12	Design and programming of of 1-bit Full adder and testing using Testbench.	See the E-resource Links
13	Design and programming of 4-bit adder using Full adder and testing using Testbench	See the E-resource Links
14	Design and programming of 8:1 Mux and testing using Testbench	See the E-resource Links
15	Design and programming of 3:8 Decoder and testing using Testbench	See the E-resource Links
16	Design and programming of D Latch and D Flip Flop and testing using Testbench	See the E-resource Links
17	Design and programming of T FF and testing using Testbench	See the E-resource Links
18	Design and programming of Counter and testing using Testbench	See the E-resource Links
19	Design and programming of RAM and testing using Testbench	See the E-resource Links

20	Design and Programming of FSM and testing using Testbench	See the E-resource Links
21	Design and Simulation of Basic diode Circuits like Clipper, Clapper, Voltage Doubler using Sequel or LT Spice	See the E-resource Links
22	Design and simulation of single stage and Multistage BJT amplifier using Sequel or LT SPICE	See the E-resource Links
23	Design and simulation of Differential amplifier and current mirror circuit using Sequel or LT SPICE	See the E-resource Links
24	Design and Simulation of Basic Op-circuits like Inverting amplifier , Non-Inverting amplifier, Difference amplifier, I to V convertor, V to I Convertor etc using Sequel ot LT SPICE.	See the E-resource Links
25	Design and Simulation of oscillators and Filters using Op-amp using LT SPICE or Sequel.	See the E-resource Links
26	Simulation of non-linear applications of Op-amp like Schmitt Trigger, Window Detector, Precision Rectifier, Square Wave Generator etc using LT SPICE or Sequel.	See the E-resource Links

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Implementing liner block code of (7,4).
2. Implementing FSK TX and RX.
3. Implementing Nyquist criteria with noisy environment.

Suggested List of Mini Projects on Xilinx using HDL Programming

4. 16 bit Multiplier
5. 32 Bit CLA adder
6. Shift and Add Multiplier
7. GCD Calculator
8. 3-bit FIR Filter design
9. 4 Bit ALU
10. 4-bit Comparator

11. 2’s Complement adder

Suggested List of Mini Projects using LT SPICE or SEQUEl

12. Audio Equalizer using Op-amp.
13. Strain Guage amplifier Circuit.
14. Synchronous DC-DC Buck Convertor.
15. RTD based 4 to 20mA transmitter circuit.

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

E-Resources:

1. Spoken Tutorial : http://spoken-tutorial.org/
2. Scilab: http://www.scilab.org/
3. Octave: https://www.gnu.org/software/octave/
4. Python: https://www.python.org/
5. Xilinx using HDL: **https://www.xilinx.com/products/design-tools/ise-design-suite/ise-webpack.html**
6. LT SPICE : http://www.linear.com/designtools/software/
7. SEQUEL**:** https://www.ee.iitb.ac.in/~sequel/

Note: Mini Project can be considered as a part of termwork (Topic based on syllabus)

Term Work:

At least 08 Experiments covering entire syllabus must be given during the “**Laboratory session batch wise”**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.
Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per “**Choice Based Credit and Grading System”** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.
The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5011	Microelectronics Laboratory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5011	Microelectronics Laboratory	--	--	--	--	25	--	--	25

Term Work:

At least 08 tutorials covering entire syllabus must be given during the "**Tutorial session batch wise"**

Term work assessment must be based on the overall performance of the student with every tutorial graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5012	TV & Video Laboratory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5012	TV & Video Laboratory	--	--	--	--	25	--	--	25

Suggested List of Experiments

- To study CVS
- Measurement of horizontal and vertical scanning frequency
- To study sound section of TV receiver
- To study receiver sections by using fault simulation switches
- To study DTH receiver
- To study HDTV
- To study set top box trainer
- To study LCD display
- To study LED display

Term Work:

At least 8 Practicals/ Tutorials covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5013	Finite Automata Theory	--	--	02	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5013	Finite Automata Theory	--	--	--	--	25	--	--	25

List of Mini Projects:

1. Combinational circuits
2. Synchronous sequential circuits (Finite state machine)
3. Asynchronous sequential circuits (Finite state machine)
4. Algorithmic state machine

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 8 Tutorials covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 5014	Data Compression & Encryption	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 5014	Data Compression & Encryption	--	--	--	--	25	--	--	25

Suggested Practical List:

- Huffman Code.
- Adaptive Huffman Code.
- Arithmetic Code.
- LZW Compression and Decompression.
- Companding Implementation.
- Implementation of DCT.
- RSA and MD5 Algorithm.
- Packet Analyzer.
- PGP (Pretty Good Privacy).
- Vulnerability Scanner.
- Intrusion Detection System.
- Firewall.
- SSL

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC601	Microcontrollers & Applications	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC601	Microcontrollers & Applications	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge and core expertise in microcontrollers.
- To understand peripheral devices and their interfacing to microcontrollers.
- To write programs for microcontrollers and their applications in Assembly and Embedded C Language.

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed architecture of 8051 and ARM7 microcontroller.
- Study the in-depth working of the microcontrollers and their Instruction set.
- Interface various peripheral devices to the microcontrollers.
- Write Assembly language and Embedded C program for microcontrollers.

Module No.	Unit No.	Topics	Hrs.
1.0		**8051 Microcontroller**	**12**
	1.1	Comparison between Microprocessor and Microcontroller	
	1.2	Features, architecture and pin configurations	
	1.3	CPU timing and machine cycle	
	1.4	Input / Output ports	
	1.5	Memory organization	
	1.6	Counters and timers	
	1.7	Interrupts	
	1.8	Serial data input and output	
2.0		**8051 Programming**	**08**
	2.1	Instruction set	
	2.2	Addressing mode	
	2.3	Assembler Directives	
	2.4	**Programs related to**: arithmetic, logical, delay, input, output, timer, counters, port, serial communication, and interrupts	
3.0		**8051 Interfacing and Applications**	**06**
	3.1	Interfacing of Display: LED, LCD and Seven Segment display	
	3.2	Stepper Motor and Relay	
	3.3	UART	
4.0		**ARM7: A 32 bit Microcontroller**	**08**
	4.1	The RISC and the CISC design philosophy	
	4.2	Concept of Cortex-A, the Cortex-R and the Cortex-M	
	4.3	Features of ARM Microcontroller	
	4.4	Pipeline Architecture	
	4.5	Registers	
	4.6	Exceptions, Interrupt and Vector Table	
	4.7	Memory Management	
5.0		**ARM7 Programming**	**08**
	5.1	Data Processing Instructions	
	5.2	Conditional and Branching Instructions	
	5.3	ARM-THUMB Interworking	
	5.4	Single-Register Load-Store Instructions	
	5.5	Stack Instructions	
	5.6	Software Interrupt Instructions	
6.0		**ARM Programming with Embedded C**	**06**
	6.1	General Purpose Input Output	
	6.2	Timer Mode	
	6.3	Pulse –Width Modulator Configuration	
		Total	**48**

Text Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "*The 8051 Microcontroller & Embedded systems*", Pearson Publications, Second Edition 2006.
2. C. Kenneth J. Ayala and D. V. Gadre, "*The 8051 Microcontroller & Embedded system using assembly & 'C*' ", Cengage Learning, Edition 2010.
3. Satish Shah, "*The 8051 Microcontrollers",* Oxford publication first edition 2010.
4. Andrew Sloss, Dominic Symes, and Chris Wright, "*ARM System Developer's Guide*" Morgan Kaufmann Publishers, First Edition 2004.
5. Lyla Das, "*Embedded Systems: An Integrated Approach*", Pearson Publication, First Edition 2013
6. James A. Langbridge, "*Professional Embedded Arm Development*", Wrox, John Wiley Brand& Sons Inc., Edition 2014

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC602	Computer Communication Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC602	Computer Communication Networks	20	20	20	80	--	--	--	100

Course Pre requisite:

- Analog Communication

Course objectives:

- To introduce analysis and design of computer and communication networks.
- To design and configure a network for an organization. To implement client-server socket programs.
- To analyse the traffic flow and the contents of protocol frames.

Course outcomes:

After successful completion of the course student will be able to

- Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
- Perform basic configurations on routers and Ethernet switches.
- Demonstrate knowledge of programming for network communications.
- Learn to simulate computer networks and analyse the simulation results.
- Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model.
- Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Network Applications	
	1.2	Network Hardware	
	1.3	Network Software	
	1.4	Reference Models, overview of TCP/IP, layer Functions, services, sockets and ports, Encapsulation.	
2.0		**Introduction to Physical layer Services and System**	**08**
	2.1	Introduction to physical media, Coax, RJ 45 , fiber, twisted pair, DSL, HFC, WiMax, cellular, satellite, and telephone networks, bit transmission, frequency division multiplexing. time division multiplexing.	
3.0		**The Data Link Layer**	**08**
	3.1	Data link Layer Design Issues	
	3.2	Error Detection and Correction	
		Elementary Data Link Protocols, Sliding Window Protocols	
		Example Data Link Protocols: HDLC: High-Level Data Link Control, The Data Link Layer in The Internet.	
4.0		**The Medium Access Sub- Layer**	**06**
	4.1	Channel Allocation Problem.	
	4.2	Multiple Access Protocols.	
5.0		**The Network Layer**	**10**
	5.1	Network Layer Design Issues.	
	5.2	Routing Algorithms.	
	5.3	Congestion Control Algorithms, Quality of Service.	
	5.4	Internetworking.	
	5.5	The Network Layer In The Internet: The IP Protocol, IPv4 header, IP Addressesing, Subnetting.	
	5.6	Internet Control Protocols, The Interior Gateway Routing Protocol: OSPF, The Exterior Gateway Routing Protocol: BGP.	
6.0		**The Transport Layer**	**10**
	6.1	The Transport Service.	
	6.2	Elements of Transport Protocols.	
	6.3	The Internet Transport Protocol: UDP	
	6.4	The Internet Transport Protocol: TCP:-Introduction to TCP, The TCP Service Model, The TCP Protocol.	
	6.5	The TCP Segment Header.	
	6.6	TCP Connection Establishment, TCP Connection Release.	
	6.7	Modeling TCP Connection Management.	
	6.8	TCP Transmission Policy.	
	6.9	TCP Congestion Control.	
	6.10	TCP Timer Management, Transactional TCP.	

		Total	**48**

Text Books:

1. A. S. Tanenbaum,"Computer Networks", 4th edition, Prentice Hall
2. B. F. Ferouzan,"Data and Computer Communication", Tata McGraw Hill.

Reference Books:

1. Peterson & Davie, "Computer Networks", 2nd Edition, Morgan Kaufmann.
2. Kurose, Ross, "Computer Networking", Addison Wesley
3. S. Keshav, "An Engg, Approach To Computer Networking", Addison Wesley.
4. W. Richard Stevens, "TCP/IP Volume1, 2, 3", Addison Wesley.
5. D. E. Comer, "Computer Networks And Internets", Prentice Hall.
6. B. F. Ferouzan , "TCP/IP Protocol Suite", Tata McGraw Hill.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC603	Antenna & Radio Wave Propagation	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC603	Antenna & Radio Wave Propagation	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Field
- Two port network
- Transmission Line

Course objectives:

- To learn fundamental parameters of Antenna
- To learn about linear wire antenna elements and Antenna arrays
- To learn about Special types of Antennas
- To learn about Antenna measurements and radio wave propagation

Course outcomes:

After successful completion of the course student will be able to

- Define Basic antenna parameters like radiation pattern, directivity and gain.
- Derive the field equations for the basic radiating elements like linear wire antenna and loop antenna.
- Design of uniform linear and planar antenna arrays using isotropic and directional Sources.
- Implement special types of Antennas like microstrip antennas and reflectors.

Module No.	Unit No.	Topics	Hrs.
1.0		**Antenna Fundamentals**	**08**
	1.1	Introduction, Radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, Beamwidth, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, Antenna radiation efficiency, FRIIS transmission equation	
	1.2	Basic concepts of Maxwell's equation, vector potential, wave equation, near field and far field radiation, dual equations for electric and magnetic current sources.	
2.0		**Wire Elements: Dipoles, Monopoles, Loops and Helical**	**12**
	2.1	Infinitesimal dipole, radiation fields, radiation resistance, radiation sphere, near field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, Monopole antenna, Folded dipole. Design of dipole and monopole antenna	
	2.2	Loop Antenna: Small circular loop, comparison of small loop with short dipole, Ferrite loop, radiation patterns its parameters and their application.	
	2.3	Helical Antennas: Input impedance matching, Axial mode and normal mode propagation, Circular polarization using Helical Antenna	
3.0		**Arrays**	**12**
	3.1	Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, Phase scanning arrays, broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array.	
	3.2	Introduction to planner and circular arrays	
	3.3	Design of Yagi antenna and Log Periodic antenna	
4.0		**Aperture Antennas**	**06**
	4.1	Horn Antennas :E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn	
	4.2	Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector, Design considerations	
5.0		**Patch Antenna**	**04**
	5.1	Microstrip antenna (MSA): Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs	

6.0		**Antenna Measurements & Wave Propagation**	**06**
	6.1	**Antenna Measurements:** Measurement of Antenna parameters: Input Impedance, Radiation Pattern, Gain (Two and Three antenna method), Polarization.	
	6.2	**Ground Wave Propagation:** Ground waves, effect of Earth's Curvature on Ground wave propagation, impact of imperfect earth	
	6.3	**Sky Wave Propagation** Ionosphere and Earth magnetic field effect, Critical frequency, Angle of incidence, Maximum usable frequency, Skip distance, Virtual height, Variations in ionosphere and Attenuation and fading of waves in ionosphere	
	6.4	Space Wave Propagation	
		Total	**48**

Text Books:

1. C. A. Balanis, Antenna Theory: Analysis and Design (3rd eds.), John Wiley & Sons, Hoboken, NJ, 2005.
2. J. D. Kraus, R. J. Marhefka, A.S. Khan "Antennas & Wave Propagation", McGraw Hill Publications, 4th Edition, 2011
3. G. Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, 2002.

Reference Books:

1. Stutzman, Theile, " Antenna Theory and Design", John Wiley and Sons , 3rd Edition
2. R. E. Collin, "Antennas and Radio Wave Propagation", International Student Edition, McGraw Hill.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC604	Image Processing & Machine Vision	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC604	Image Processing & Machine Vision	20	20	20	80	--	--	--	100

Prerequisites:

- Signals and Systems
- Discrete Time Signal Processing

Course objectives:

- To cover the fundamentals and mathematical models in digital image processing and Machine Vision
- To develop time and frequency domain techniques for image enhancement.
- To expose the students to classification techniques in Machine Vision
- To develop Applications using image processing and Machine Vision

Course outcomes:

After successful completion of the course student will be able to

- Understand theory and models in image processing.
- Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.
- Apply quantitative models of image processing for segmentation and restoration for various applications.
- Find shape using various representation techniques and classify the object using different classification methods.

Module No.	Unit No.	Topics	Hrs.
1.0		**Digital Image Fundamentals**	**04**
	1.1	**Introduction** – Origin – Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and Acquisition, Image Sampling and Quantization – Relationships between pixels, Transformation: Orthogonal, Euclidean, Affine	
	1.2	**Color Image Processing**: Color Fundamentals Color models.	
2.0		**Image Transforms**	**06**
	2.1	1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT ,Walsh -Hadamard, Discrete Cosine Transform, Haar Transform	
3.0		**Image Enhancement**	**08**
	3.1	Image Negative, Log Transform, Power Law transform, Histogram equalization and Histogram Specification	
	3.2	**Spatial Domain**: Basics of Spatial Filtering, The Mechanics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering	
	3.3	**Frequency Domain**:, The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Laplacian, Unsharp Masking and Homomorphic filters	
4.0		**Morphological & Image Restoration**	**06**
	4.1	**Morphology**: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation.	
	4.2	**Restoration :**Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters	
5.0		**Image Segmentation and Boundary Representation**	**12**
	5.1	**Point, Line, and Edge Detection:** Detection of Isolated Points, Line detection, edge models, basic and advance edge detection, Edge linking and boundary detection , Canny's edge detection algorithm	
	5.2	**Thresholding** : Foundation, Role of illumination, Basic Global thresholding	
	5.3	**Region Based segmentation**: Region Growing, Region Splitting and merging	
	5.4	**Region Identification**, chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences, B-spline representation	
6.0		**Boundary Description & Object Recognition**	**12**

	6.1	**Texture:** Statistical Texture Description Methods- Methods based on spatial frequencies, co-occurrence matrices, edge frequency, primitive length, Law's texture energy measures	
	6.2	**Object Recognition** Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Support vector machine, cluster analysis	
		Total	**48**

Text Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Cengage Engineering, 3rd Edition, 2013
2. Gonzales and Woods, "Digital Image Processing", Pearson Education, India, Third Edition,

Reference books:

1. Anil K.Jain, "Fundamentals of Image Processing", Prentice Hall of India, First Edition, 1989.
2. W Pratt, "Digital Image Processing", Wiley Publication, 3rd Edition, 2002

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6021	Digital VLSI Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6021	Digital VLSI Design	20	20	20	80	--	--	--	100

Prerequisites:

- Digital System Design
- Microelectronics

Course objectives:

- To highlight the circuit design issues in the context of Digital VLSI technology
- A profound understanding of Digital VLSI design circuits using different design styles.
- To provides an exposure to RTL design and programming

Course outcomes:

After successful completion of the course student will be able to

- Understand the semiconductor technology, scaling and performance.
- Realize logic circuits with different design styles.
- To understand operation of memory, storage circuits and data path elements.
- Simulate and synthesize digital circuits using HDL language.
- Demonstrate an understanding of system level design issues such as protection, clocking, and routing.
- Learn the RTL design techniques and methodologies

Module No.	Unit No.	Topics	Hrs.
1.0		**MOS Circuit Design Styles**	**10**
	1.1	Static CMOS, Dynamic CMOS , Pseudo NMOS, Domino, C^2MOS, NORA logic, NP Domino logic	
	1.2	Realization of Multiplexer (upto 4:1 Mux) , Encoder, Decoder,SR Latch, JK FF, D FF, 1 Bit Shift Register with different design styles and their layouts	
2.0		**Memory and Storage circuits**	**08**
	2.1	ROM array, SRAM (operation, design strategy, leakage currents, read /write circuits), layout of SRAM	
	2.2	DRAM (Operation of 1T, 3T, operation modes, leakage currents, refresh operation, Input-Output circuits), layout of DRAM	
	2.3	Flash memory: NAND and NOR flash memory	
3.0		**Data path design**	**08**
	3.1	Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder	
	3.2	Array Multiplier	
	3.3	Barrel shifter	
4.0		**VLSI Clocking, Protection and Interconnect**	**06**
	4.1	CMOS clocking styles, pipelined systems, Clock generation, stabilization and distribution	
	4.2	ESD protection, Input circuits, Output circuits, power distribution scheme	
	4.3	Interconnect delay model, interconnect scaling and crosstalk	
5.0		**Design methods**	**08**
	5.1	Semicustom, Full custom design, ASIC	
	5.2	PLA, PLD, PAL, FPGA	
	5.3	System based and Data path design using HDL	
6.0		**RTL Design**	**08**
	6.1	High Level state machines, RTL design process	
	6.2	Soda dispenser machine, laser based distance measure, Sum of absolute	
	6.3	FIR filter design	
		Total	**48**

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.
2. P. Uyemura, "*Introduction to VLSI Circuits and Systems*", John Wiley & Sons.
3. Frank Vahid, " Digital Design with RTL design, VHDL and VERILOG", John Wiley and Sons Publisher 2011.

4. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.
5. Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis", PHI, Second Edition
6. Douglas L. Perry " VHDL: Programming by Example" , McGrawHill, 4th Edition

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition..
2. Volnei A. Pedroni ,"Circuit Design and Simulation with VHDL", MIT Press, 2nd Edition

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6022	Radar Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6022	Radar Engineering	20	20	20	80	--	--	--	100

Prerequisties:

- Communication Fundamentals
- Electromagnetic field
- Transmission Lines and Antenna

Course objectives:

- To interpret Radar equations
- To explain different types of radar
- To design RADAR transmitters and receivers for given conditions

Course outcomes:

After successful completion of the course student will be able to

- Explain generalized concept of RADAR.
- Solve problems using radar equations.
- Describe different types of radar for specific application.
- Explain concept of tracking radar.
- Evaluate the design constraints for transmitter.
- Evaluate the design constraints for receiver.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Radar**	**04**
	1.1	Basics Radar, Radar equation	
	1.2	Block Diagram, Radar Frequencies	
	1.3	Applications of Radar	
2.0		**Radar Equation**	**08**
	2.1	Detection of signal in noise	
	2.2	Receiver Noise and Signal-to-noise Ratio	
	2.3	Probability of detection and false alarm: Simple , complex Targets	
	2.4	Pulse Repetition Frequency	
3.0		**MTI and Pulse Doppler Radar**	**12**
	3.1	Introduction to Doppler and MTI radar, Doppler frequency shift	
	3.2	Simple CW Doppler radar, MTI radar block diagram	
	3.3	Delay line canceler	
	3.4	Moving-target-detection	
	3.5	Pulse Doppler radar	
4.0		**Tracking Radar**	**08**
	4.1	Monopulse tracking	
	4.2	Conical scan and sequential lobbing	
	4.3	Limitation of tracking accuracy	
	4.4	Low angle tracking	
5.0		**Radar Transmitters**	**10**
	5.1	Radar RF power sources: Klystron, Travelling wave tube	
	5.2	Solid state RF power source: low power transmitter, high power transmitter, Advantages of solid state RF power source	
	5.3	Magnetron: coaxial magnetron	
	5.4	Crossed field amplifiers: CFA operation, modulating a CFA, system implementation	
6.0		**Radar Receivers**	**06**
	6.1	Receiver noise figure	
	6.2	Superheterodyne Receiver	
	6.3	Radar Display: Types of displays	
		Total	**48**

Text Books:

1. Merill Skolnik, –Introduction to RADAR Systems, Tata McGraw Hill, Third Edition
2. Merill Skolnik, –Radar Handbook, TataMcgraw Hill, Second Edition

Reference books:

1. Mark A. Richards, James A. Scheer, William A. Holm, "Principles of Modern Radar Basic Principals", Scitech Publishing.
2. Simon Kingsley, Shaun Quegon, "Understanding Radar Systems", Scientech Publishing Inc.
3. G. S. N. Raju, "Radar Engineering and Fundamentals of Navigational Aids", I. K International publishing House Pvt. Ltd.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6023	Database Management System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6023	Database Management System	20	20	20	80	--	--	--	100

Prerequisites:

- Basic knowledge of programming

Course objectives:

- Learn and practice data modeling using the entity-relationship and developing database designs.
- Understand the use of Structured Query Language (SQL) and learn SQL syntax.
- Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access

Course outcomes:

After successful completion of the course student will be able to

- Understand the different issues involved in the design and implementation of a database system.
- Transform an information model into a relational database schema and to use a data definition language and/or utility to implement the schema using a DBMS.
- Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
- Understand the concepts of constraints, views, concurrency control, deadlock

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Databases and Transactions**	**02**
	1.1	Introduction to databases, History of database system, Benefits of Database system over file system, relational databases, database architecture, transaction management	
2.0		**Data Models**	**06**
	2.1	The importance of data models, Basic building blocks, Business rules, Evolution of data models (hierarchical, Network, Relational, Entity relationship and object model), Degrees of data abstraction.	
3.0		**Database Design, ER-Diagram and Unified Modeling Language**	**10**
	3.1	Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).	
4.0		**Relational Algebra and Calculus**	**10**
	4.1	Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	
5.0		**Constraints, Views and SQL**	**10**
	5.1	What is constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.	
6.0		**Transaction management and Concurrency control**	**10**
	6.1	Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	
		Total	**48**

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", Fifth Edition McGraw-Hill
2. Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", Seventh Edition, Person.
4. G. K. Gupta: "Database Management Systems", McGraw – Hill.

Reference Books:

1. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 5th Edition.
2. P.S. Deshpande, "SQL and PL/SQL for Oracle 11g, Black Book", Dreamtech Press
3. Mark L. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley
4. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", TMH
5. Debabrata Sahoo "Database Management Systems" Tata McGraw Hill, Schaum's Outline

E-Resources:

1. https://www.tutorialspoint.com/dbms/index.htm
2. https://www.studytonight.com/dbms/
3. https://beginnersbook.com/2015/04/dbms-tutorial/
4. https://www.w3schools.in/dbms/
5. https://www.tutorialcup.com/dbms

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 6024	Audio Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 6024	Audio Processing	20	20	20	80	--	--	--	100

Prerequisites

- Signal System

Course objectives:

- To understand basic concepts and methodologies for the analysis and modeling of speech signal.
- To characterize the speech signal as generated by a speech production model.
- To understand the mechanism of speech and audio perception.
- To understand the digital representation of the speech waveform.
- To perform the analysis of speech signal using STFT.
- To extract the information of the speech or audio signals.
- To provide a foundation for developing application in this field.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate advanced Knowledge in Digital model representation of speech signal.
- Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
- Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
- Formulate and design a system for speech recognition and speaker recognition.
- Acquired knowledge about audio and speech signal estimation and detection.
- Analyze complex engineering problems critically for conducting research in speech signal

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Review of digital signal and systems, Transforms representations of signal and systems, Sampling Theorem, Goertzel algorithm, Chirp algorithm.	
2.0		**Digital Models for Speech signals**	**06**
	2.1	Speech production and acoustic tube modeling, acoustic phonetics, anatomy, and physiology of the vocal tract and ear, hearing and perception.	
3.0		**Digital Representations of the Speech Waveform**	**08**
	3.1	Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, Direct digital code conversion.	
4.0		**Time Domain Models for Speech Processing**	**12**
	4.1	Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech V/S silence discrimination using energy & Zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.	
5.0		**Short time Fourier Transform**	**10**
	5.1	Introduction- Definition and Properties, Fourier Transform Interpretation ,Linear Filtering Interpretation ,Sampling rates of X_n (e^{jw})in Time and Frequency ,Filter Bank Summation Method of Short -Time Synthesis ,Overlap Addition Method for Short -Time Synthesis.	
6.0		**Speech and Audio Processing**	**06**
	6.1	Vocoder- Voice excited channel vocoder, Voice excited and error signal excited LPC vocoders. Adaptive predictive coding of speech, Auditory Modeling. Audio signal processing for Music applications. Speech recognition pattern comparison techniques, Artificial Neural Network.	
		Total	**48**

Text Books:

1. L R Rabiner and S W Schafer, “Digital processing of speech signals”, Pearson Education, 2009.
2. L R Rabiner, B H Juang, B Yegnanarayana, “Fundamentals of speech Recognition”, Pearson Education, 1993.

Reference Books

1. Thomas F Quateri, “ Discrete Time Speech Signal Processing “Pearson Edition,2006.
2. Ben Gold and Nelson Morgan, “Speech & Audio Signal Processing”, wiley, 2007.
3. Douglas O Shaughnessy, “Speech Communications”, 2nd Edition, Oxford university press, 2000.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL601	Microcontroller & Applications Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL601	Microcontroller & Applications Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

1. Perform Arithmetic and Logical Operations
2. Transfer of data bytes between Internal and External Memory
3. Experiments based on General Purpose Input-Output, Timers, Interrupts, Delay, etc
4. Interfacing of LED,LCD, Stepper Motor, UART

Mini project based on any application related to 8051 or ARM7 can be implemented.

Note: Mini Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL602	Computer Communication Network Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL602	Computer Communication Network Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

1. Create a Virtual Network using NETKIT emulator and use networking commands like route, arp, netstat, traceroute, ping on created topology.
2. To study installation and configuration of NS 2.35 simulator.
3. Design a connectionless and connection oriented network topology for static routing and dynamic routing with the help of NS2 simulator.
4. To study three way handshaking process as well as working process for connection oriented Protocols like FTP, TELNET and analysing packets generated by using packet capturing tool like tcpdump
5. To implement stream socket that can serve multiple clients at the same time.
6. To study requirements and scope of Subnetting and Network Translation by using Netkit Emulator.
7. Case Study: To study installation of linux operating system by using DHCP, TFTP and any repository server like HTTP, FTP or NFS.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every

experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL603	Antenna & Radio Wave Propagation Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL603	Antenna & Radio Wave Propagation Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Introduction to different Antenna parameters and its importance
- Introduction to Different Antenna Types
- Study of Radiation pattern of dipole, folded dipole and Monopole antenna
- Study of Antenna Arrays – N element array for given angle, Parametric study for various arrays parameters
- Study of Yagi-Uda Antenna
- Study of Aperture Antennas – Horn / Reflector Antennas
- Design, implementation and Pattern measurement of Regular shape MSA
- Case Study of Recent reported variations of Antenna types (Paper from reputed journal is to be referred and thoroughly study and present the report, maximum four students per group)

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will

be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL604	Image Processing and Machine Vision Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL604	Image Processing and Machine Vision Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- At least 8 programs written in C/MATLAB software

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6021	Digital VLSI Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6021	Digital VLSI Design Laboratory	--	--	--	--	25	--	--	25

Suggested Experiment List

1. At least **08** experiments covering entire syllabus of Digital VLSI should be set to have well predefined inference and conclusion.
2. The first 05 experiments as described below can be conducted by using Free or Professional tools
   - **01** experiments on Layouts of NAND and NOR gates to understand design rules
   - **01** experiment on Layout design of logical expression
   - **01** experiments on NAND/NOR gate implementation using at least 03 design styles
   - **02** experiment on Multiplexer/Decoder/Flip flop/Memory etc design
3. Last **03** experiments on HDL

Note: Small Project can be considered as a part of term-work.
Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total

ECLDLO 6022	Radar Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	**Subject Name**	**Examination Scheme**							
		Theory Marks				**Term Work**	**Practical & Oral**	**Oral**	**Total**
		Internal assessment			**End Sem. Exam**				
		Test 1	**Test2**	**Avg. Of Test 1 and Test 2**					
ECLDLO 6022	Radar Engineering Laboratory	--	--	--	--	25	--	--	25

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6023	Database Management System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6023	Database Management System Laboratory	--	--	--	--	25	--	--	25

Suggested Experiment List

- Design a Database and create required tables. For e.g. Bank, College Database
- Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
- Write a sql statement for implementing ALTER, UPDATE and DELETE
- Write the queries to implement the joins
- Write the query for implementing the following functions: MAX (), MIN (), AVG (), COUNT ()
- Write the query to implement the concept of Integrity constrains
- Write the query to create the views
- Perform the queries for triggers
- Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints
- Write the query for creating the users and their role

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Library Management System
2. Hospital Management System
3. Pharmacy Management System
4. Human Resource Database Management System in Java
5. Student Database Management System
6. Employee Management System
7. Inventory Control Management Database
8. Pay Roll Management System

9. Railway System Database
10. Airline Reservation System
11. Blood Donation System
12. School Management System

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 6024	Audio Processing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 6024	Audio Processing Laboratory	--	--	--	--	25	--	--	25

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC701	Microwave Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC701	Microwave Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna and Radio Wave Propagation
- Communication Engineering

Course objectives:

- To learn fundamentals of microwave systems.
- To learn to make system level design decisions.
- To learn passive and active device characteristics

Course outcomes:

After successful completion of the course student will be able to

- Characterize devices at higher frequencies.
- Design and analyze microwave circuits.
- Design and analyze amplifiers and oscillators at microwave frequencies.
- Demonstrate skills of planning, design and deployment of microwave networks.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Microwaves**	**08**
	1.1	Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves.	
	1.2	Scattering parameters: Characteristics and Properties.	
	1.3	Strip lines, Microstrip lines and coupled lines: Analysis and design.	
	1.4	Design of Impedance matching network using lumped and distributed parameters.	
2.0		**Waveguides and Passive Devices**	**08**
	2.1	Rectangular and circular waveguides: Construction, Working and Mode analysis.	
	2.2	Resonators, Re-entrant cavities, Tees, Hybrid ring, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Isolators, Gyrators, and Circulators.	
3.0		**Microwave Tubes**	**10**
	3.1	Two Cavity Klystron, Multi-Cavity Klystron and Reflex Klystron.	
	3.2	Helix Travelling Wave Tube and Cross Field Amplifier.	
	3.3	Backward Wave Oscillator, Cylindrical Magnetron and Gyrotron.	
4.0		**Microwave Semiconductor Devices**	**10**
	4.1	Diodes: Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT.	
	4.2	Transistors: BJT, Hetro junction BJT, MESFET, and HEMT	
	4.3	Parametric Amplifiers and Applications.	
5.0		**Microwave Measurements**	**06**
	5.1	VSWR, Frequency, Power, Noise, *Q*-Factor, Impedance, Attenuation, Dielectric Constant, Antenna Gain.	
6.0		**Microwave Integrated Circuits (MIC)**	**06**
	6.1	MIC Materials.	
	6.2	Types of MIC: Hybrid and Monolithic MIC.	
	6.3	Chip Mathematics.	
		Total	**48**

Text Books :

1. Samuel Liao, “Microwave Devices and Circuits”, Prentice Hall
2. David Pozar, “Microwave Engineering”, Wiley Publication, Fourth Edition
3. Matthew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Pearson Education.
4. Annapurna Das and S. K Das, “Microwave Engineering”, McGraw Hill Education, Third Edition.

References:

1. Colin, Foundations of Microwave Engineering, Second Edition, Wiley Interscience, 2nd Edition.
2. Devendra Misra, “ Radio Frequency and Microwave Communication Circuits- Analysis and Design”, John Wiley & Sons, 2nd Edition

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC702	Mobile Communication System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC702	Mobile Communication System	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To understand the cellular fundamentals and different types of radio propagation models.
- To study the system architecture of 2G, 2.5 G and 3G.
- To develop the concepts of emerging technologies for 4 G standards and beyond.

Course outcomes:

After successful completion of the course student will be able to

- Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.
- Classify different types of propagation models and analyze the link budget.
- Illustrate the fundamentals and system architecture of GSM, 2.5G and IS-95.
- Apply the concepts of 3G technologies of UMTS and CDMA 2000.
- Elaborate the principles of 3GPP LTE.
- Identify the emerging technologies for upcoming mobile communication systems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of Mobile Communication**	**08**
	1.1	**Introduction to wire1ess communication:** Mobile radio telephony, Examples of Wireless Communication Systems, Related design problems.	
	1.2	**The Cellular Concept System Design Fundamentals:** Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems	
2.0		**Mobile Radio Propagation**	**08**
	2.1	**Large scale fading:** Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, diffraction, scattering, practical Link budget design using path loss models	
	2.2	**Small scale fading:** Small scale multipath propagation, parameters of mobile multipath channels, types of small-scale fading, Rayleigh and Ricean distributions.	
	2.3	**Features of all conventional multiple access techniques:** Frequency division multiple access(FDMA), time division multiple access(TDMA),space spectrum multiple access (SSMA), space division multiple access (SDMA),OFDM-PAPR,OFDMA	
3.0		**2G Technologies**	**10**
	3.1	**GSM:** GSM Network architecture, GSM signalling protocol architecture, identifiers used in GSM system, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures, GSM services and features	
	3.2	**GSM evolution:** GPRS And EDGE- architecture, radio specifications, channels.	
	3.3	**IS-95:** Architecture of CDMA system, CDMA air interface, power control in CDMA system, power control, handoff, rake receiver	
4.0		**3G Technology**	**06**
	4.1	**UMTS:** Objectives, standardisation and releases, network architecture, air interface specifications, channels, security procedure, W-CDMA air interface, attributes of W-CDMA system, W-CDMA channels	
	4.2	**Cdma2000 cellular technologies:** Forward And Reverse Channels, Handoff And Power Control.	
5.0		**3GPP LTE**	**08**

	5.1	**Introduction, system overview**: Frequency bands and spectrum flexibility, network structure, protocol structure	
	5.2	**Physical layer**: Frames, slots, and symbols, modulation, coding, multiple-antenna techniques	
	5.3	**Logical and Physical Channels:** Mapping of data onto (logical) sub-channels.	
	5.4	**Physical layer procedures:** Establishing a connection, retransmissions and reliability, scheduling, power control, handover.	
6.0		**Advanced techniques for 4G deployment**	**08**
	6.1	**Multi-antenna Techniques:** Smart antennas, multiple input multiple output systems	
	6.2	**Cognitive radio:** Architecture, spectrum sensing	
	6.3	**Relaying multi-hop and cooperative communications:** Principles of relaying, fundamentals of relaying	
		Total	**48**

Text Books :

1. Theodore S. Rappaport “wireless communications - principles and practice”, PEARSON , Second edition.
2. T L Singal “wireless communications”, Mc Graw Hill Education.
3. Andreas F. Molisch “wireless communications” WILEY INDIA PVT LTD, Second edition.

References:

1. Upena Dalal “Wireless and Mobile Communications”, Oxford university Press.
2. Vijay K.Garg “Wireless Communications and Networking”,Morgan–Kaufmann series in Networking-Elsevier

E-Resources:

1. MIT Open Course ware : https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/
2. NPTL: http://nptel.ac.in/courses/117104099/
3. Virtual Lab : http://vlab.co.in/

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC703	Optical Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC703	Optical Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Physics
- Electromagnetic wave propagation
- Electronics devices and circuits
- Principles of communication

Course objectives:

- List, write and explain fundamentals and transmission characteristics of optical fiber communication
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Course outcomes:

After successful completion of the course student will be able to

- List, write and explain fundamentals and transmission characteristics of optical fiber Communication.
- List, write and explain principles and characteristics of various sources ,detectors and various fiber optic components
- Calculate parameters for optical link budgeting and analyze the link

Module No.	Unit No.	Topics	Hrs.
1.0		**Optical Fiber and their properties**	**10**
	1.1	Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wave length, and mode filed diameter. Wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, loss and bandwidth window	
2.0		**Transmission Characteristics of Optical Fiber**	**12**
	2.1	Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion, dispersion and pulse broadening, dispersion shifted and dispersion flattened fibers. General Overview of nonlinearties , Stimulated Raman Scattering, Stimulated Brillouin Scattering , Self Phase modulation , Cross –Phase modulation , Four wave mixing and its mitigation , Solitons. Measurements of attenuation, dispersion and OTDR	
3.0		**Optical Sources**	**06**
	3.1	Working principle and characteristics of sources (LED, LASER), Tunable lasers Quantum well lasers , Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers	
4.0		**Optical Detectors**	**06**
	4.1	Working principle and characteristics of detectors (PIN, APD), Material requirement for RCEPD ,Resonant cavity enhancement (RCE) Photo Detector ,Noise analysis in detectors, coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance	
5.0		**Fiber Optic Components**	**08**
	5.1	Fiber fabrication (VAD,MCVD), fiber joints, fiber connectors, splices Couplers, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.	
6.0		**Optical Link**	**06**
	6.1	Introduction, Point to point links, system considerations, link power budget, and rise time budget. RF over fiber, key link parameters, Radio over fiber links, microwave photonics.	
		Total	**48**

Text Books :

1. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications– – John M. Senior, Pearson Education. 3rd Impression, 2007.

References:

1. Fiber optics communications-Harold Kolimbiris
2. Introduction to optical fibers, Cheri, McGraw Hill.
3. An introduction to fiber optics, A. Ghatak and K.Thyagrajan, Cambridge Univ, press 10
4. Optical fiber communication and sensors-M. Arumugam Agencies, 20002 optic sensors.
5. Fiber optic communication– Joseph C Palais: 4th Edition, Pearson Education.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7031	Neural networks & Fuzzy Logic	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7031	Neural networks & Fuzzy Logic	20	20	20	80	--	--	--	100

Prerequisites:

- Numerical Methods
- Optimization Techniques

Course objectives:

- To introduce the concepts and understanding of artificial neural networks
- To provide adequate knowledge about supervised and unsupervised neural networks
- To introduce neural network design concepts
- To expose neural networks based methods to solve real world complex problems
- To teach about the concept of fuzziness involved in various systems and provide adequate knowledge about fuzzy set theory, and fuzzy logic
- To provide knowledge of fuzzy logic to design the real world fuzzy systems

Course outcomes:

After successful completion of the course student will be able to

- Comprehend the concepts of biological neurons and artificial neurons
- Analyze the feed-forward and feedback neural networks and their learning algorithms.
- Calculate Comprehend the neural network training and design concepts
- Analyze the application of neural networks to non linear real world problem
- Comprehend the concept of fuzziness involved in various systems, fuzzy set theory and fuzzy logic
- Apply fuzzy logic to real world problems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Neural Networks and their basic concepts:**	**07**
	1.1	Biological neurons and Artificial neuron, McCulloch-Pitts models *of* neuron, Types of activation functions and Neural Network architectures, Pre-requisites for training of neural networks. Linearly separable and linearly non-separable systems with examples, Features and advantages of Neural Networks over statistical techniques, Knowledge representation, Terminologies related to artificial neural networks, Concepts of Supervised learning, Unsupervised learning, Reinforcement	
2.0		**Supervised Learning Neural Networks:**	**08**
	2.1	Perceptron - Single Layer, Multilayer and their architecture, Error back propagation algorithm, Generalized delta rule, Concept of Training, Testing and Cross-validation data sets for design and validation of networks. Over-fitting. Stopping criterion for training.	
3.0		**Unsupervised Learning Neural Networks:**	**09**
	3.1	Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means and LMS algorithms, Radial Basis Function (RBF) neural network – architecture and algorithm, and Discrete Hopfield networks. Introduction to the concept of Support Vector Machine based classifier.	
4.0		**Applications of Neural Networks:**	**06**
	4.1	Applications of Neural networks in pattern classification, Character Recognition**,** Face recognition, Image compression and Decompression	
5.0		**Fuzzy logic:**	**12**
	5.1	Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems, Mamdani Fuzzy Models, Fuzzy knowledge based controllers.	
6.0		**Applications of Fuzzy Logic and Fuzzy Systems:**	**06**
	6.1	Fuzzy pattern recognition, fuzzy image processing, Simple applications of Fuzzy knowledge based controllers like washing machines, home heating system, and train break control.	
		Total	**48**

Text Books :

1. S. N. Sivanandam and S. N. Deepa *Introduction to Soft computing,* Wiley India Publications
2. Thimothy J. Ross, *Fuzzy Logic with Engineering Applications,* Wiley India Publications
3. John Yen and Reza Langari, *Fuzzy Logic- Intelligence, Control and Information,* Pearson Publications.
4. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI
5. Satish Kumar, *Neural Networks: A classroom Approach,* Tata McGraw-Hill.
6. Meherotra Kishan, Mohan C. K., Ranka Sanjay, *Elements of artificial neural networks*, Penram Publications

References:

1. Hagan, Demuth, and Beale, *Neural Network Design,* Thomson Learning
2. Simon Haykin, *Neural Network- A Comprehensive Foundation,* Pearson Education
3. Christopher M Bishop, *Neural Networks For Pattern Recognition*, Oxford University Press
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences Neural Network and Kernels,* Cambridge Publications
5. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, *Introduction to Neural Network Using Matlab* Tata McGraw-Hill Publications
6. Bart Kosko, *Neural networks and Fuzzy Systems*, Pearson Education
7. J. S. R. Jang, C.T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI
8. J. M. Zurada, *Introduction to Artificial Neural Systems,* Jaico publishers

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7032	Big Data Analytics	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7032	Big Data Analytics	20	20	20	80	--	--	--	100

Prerequisites:

- Data Base Management System

Course objectives:

- To Provide an Overview of an exciting growing field of Big Data Analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
- To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

Course outcomes:

After successful completion of the course student will be able to

- Understand the key issues in big data management.
- Acquire fundamental enabling techniques using tools in big data analytics.
- Achieve adequate perspectives of big data analytics in various applications like sensor, recommender systems, social media applications etc.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Big Data Analytics**	**06**
	1.1	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach.	
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.	
2.0		**Hadoop**	**06**
	2.1	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem, Physical Architecture, Hadoop limitations.	
3.0		**NoSQL**	**08**
	3.1	Introduction to NoSQ, NoSQL business drivers, NoSQL case studies.	
	3.2	NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns.	
	3.3	Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	
4.0		**MapReduce**	**08**
	4.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.	
		MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.	
		Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce.	
5.0		**Techniques in Big Data Analytics**	**12**
	5.1	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents	
	5.2	Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis	
	5.3	Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce	
	5.4	Frequent Itemset Mining : Market-Basket Model, Apriori Algorithm, Algorithm of Park-Chen-Yu	

6.0		**Big Data Analytics Applications**	**08**
	6.1	Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative-Filtering System: Nearest-Neighbor Technique, Example.	
	6.2	Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using MapReduce.	
		Total	**48**

Text Books :

1. Radha Shankarmani and M Vijayalakshmi "Big Data Analytics", Wiley
2. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.

References:

1. Bill Franks , "Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley
2. Chuck Lam, "Hadoop in Action", Dreamtech Press

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7033	Internet Communication Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7033	Internet Communication Engineering	20	20	20	80	--	--	--	100

Prerequisites:

- Analog communication
- Digital Communication
- Computer Communication and Networks

Course objectives:

- To focus on Internet protocol, standards, services and administration.
- To discuss the Internet security protocol and security services
- To discuss multimedia communication standards and compression techniques
- To discuss the Multimedia communication across the networks

Course outcomes:

After successful completion of the course student will be able to

- Explain the operation of the components of a router including, DHCP, NAT/PAT, Routing function, Switching function.
- Describe how DNS works in the global Internet including caching and root servers.
- Understand the current state-of-the-art developments in Internet technologies for multimedia communications.
- Understand the security protocol and services In the Internet
- Appreciate the principles used in designing multimedia protocols, and so understand why standard protocols are designed the way that they are.
- Understand the system design principles of multimedia communications systems.
- Solve problems and design simple networked multimedia systems.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Internet**	**06**
	1.1	What is the Internet, ,Evolution of the Internet, Brief History and Growth of Internet , service description, Network protocol, the network edge	
	1.2	Overview of TCP/IP, layer functions,	
	1.3	Application Layer- Host configuration, DHCP Domain Name System (DNS),Multicast DNS	
	1.4	Remote Login, TELNET and SSH , HTTPs, electronic mail	
2.0		**Transport Layer**	**10**
	2.1	Properties of reliable stream delivery, Overview of TCP segment, TCP connection	
	2.2	Flow control, error control, congestion control	
	2.3	User datagram protocol(UDP) header, pseudo header	
	2.4	SCTP, introduction, Packet format ,	
	2.5	Flow control, error control, congestion control	
3.0		**Internetworking layer**	**08**
	3.1	Overview of Internet protocol (IP) datagram, IP address classes, subnets and supernets	
	3.2	Private IP addresses, classless inter domain routing (CIDR), CIDR subnet addressing, variable length in CIDR subnet addressing, ICMP	
	3.3	Internet Protocol version 6 (IPv6), Packet format, Transition from IPv4 to IPv6, ICMPv6	
4.0		**Internet Security**	**06**
	4.1	Network layer security(AH, ESP, IPsec),	
	4.2	Transport layer security(SSL), Application layer security(secure E mail-PGP, S/MIME),	
	4.3	VPN Firewall, Intrusion Detection System.	
5.0		**Multimedia Communications**	**10**
	5.1	Information Representation- text, images, audio and video, Text and image compression, Audio and video compression, video	
	5.2	compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video	
	5.3	Multimedia Communication Across Networks- Layered video coding, error resilient video coding techniques,	

	5.4	multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, Signalling Protocols: Real-Time Streaming Protocol (RTSP) ,Multimedia across wireless- (Mobiles Networks – Broadcasting Networks – Digital Television infrastructure for interactive multimedia services)	
6.0		**Quality of Services (QoS)**	**08**
	6.1	Integrated services (intserv): Architecture and Service Model, Resource Reservation Protocol (RSVP), Packet Scheduling Disciplines in the Internet	
	6.2	Differentiated Services (diffserv): Framework and Concept, Assured and Expedited Services, Packet Classification, Routers Internals and Packet Dropping Techniques	
		Total	**48**

Text Books :

1. B. Forouzan, ―*TCP/IP Protocol Suite*‖, 4th Edition, McGraw-Hill Publication
2. K. R. Rao, Zaron S. Bojkovic, Dragorad A. Milocanovic, Multimedia Communication Systems, Prentice Hall India, 2002. ISBN: 81-203-2145-6.

References:

1. Steve Heath, Multimedia and Communication Technology, Second Edition, Focal Press, 2003.
2. ISBN: 81-8147-145-8. Ted Wallingford, ―*Switching to VoIP*‖, Oreilly Publication
3. Fred Halsall, "Multimedia Communications", Pearson education, 2001
4. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004
5. Raif steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002
6. Tay Vaughan, "Multimedia: Making it Work", 6th edition, Tata McGraw Hill, 2004
7. Pallapa Venkataram, "Multimedia information systems", Pearson education (InPress),2005.
8. Multimedia Communication Techniques and Standards

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7034	CMOS Mixed Signal VLSI	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7034	CMOS Mixed Signal VLSI	20	20	20	80	--	--	--	100

Prerequisites:

- Electronic Devices and Circuits I
- Electronic Devices and Circuits II
- Linear Integrated Circuits
- Microelectronics
- Digital VLSI

Course objectives:

- Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
- Underlying methodologies for analysis and design of fundamental CMOS Mixed signal Circuits like Data Converters.
- The issues associated with high performance Mixed Signal VLSI Circuits

Course outcomes:

After successful completion of the course student will be able to

- Analyze and design single stage MOS Amplifiers.
- Analyze and design Operational Amplifiers.
- Analyze and design data converter circuits.
- Identify design requirements of analog and mixed signal circuits
- Analyze and design CMOS based switched capacitor circuits
- Understand Oscillators and Phase Locked Loops.

Module No.	Unit No.	Topics	Hrs.
1.0		**Fundamentals of MOS Amplifiers**	**10**
	1.1	MOS Single-stage Amplifiers: Basic concepts of common source stage, source follower, common gate stage, Differential Amplifiers:	
	1.2	Current mirrors: Basic current mirror, cascode current mirror, active current mirror, Wilson and Widlar current mirrors, voltage and current references.	
2.0		**Design of MOS operational amplifier**	**08**
	2.1	General considerations, One-Stage Op amps, Two-Stage Op amps, Gain Boosting, Input Range Limitation.	
	2.2	Frequency Response and Compensation, Slew Rate.	
3.0		**Oscillators and Phase Locked Loops**	**08**
	3.1	General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators (VCO), tuning range, tuning linearity Mathematical Model of VCO.	
	3.2	Simple PLL-phase detector, Charge-pump PLL's, Non ideal effects in PLL, Delay locked Loops, applications of PLL.	
4.0		**Switched Capacitor circuits**	**06**
	4.1	Theory of sampled data systems, Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, design and analysis of switched capacitor circuits.	
	4.2	Switched capacitor amplifiers (SC), switched capacitor integrators, first and second order switched capacitor circuits.	
5.0		**Data converters**	**06**
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics. DAC specifications, ADC specifications.	
	5.2	Mixed signal Layout issues, Floor planning, power supply and Ground issues, other interconnect Considerations.	
6.0		**Data Converter Architectures**	**10**
	6.1	DAC architectures: R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC, Switched capacitor based DAC design.	
	6.2	ADC architectures: flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC, Switched capacitor based ADC design	
		Total	**48**

Text Books :

1. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
2. Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
3. P. E. Allen and D R Holberg, **“***CMOS Analog Circuit Design***”**, second edition, Oxford University Press, 2002.
4. Baker, Li, Boyce, “CMOS: Circuit Design, layout and Simulation”, PHI, 2000.
5. Sedra/Smith, “Microelectronic Circuits”, Oxford University Press.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duation of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 7035	Embedded Systems	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 7035	Embedded Systems	20	20	20	80	--	--	--	100

Course objectives:

- To develop background knowledge Embedded Systems.
- To understand communication techniques.
- To write programs for embedded systems and real time operating sytems

Course outcomes:

After successful completion of the course student will be able to

- Understand the detailed processor design techniques and methods of communication.
- Study the in-depth program modelling concepts.
- Study the concepts of Real time operating systems and write programs
- Design embedded system applications using RTOS

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction:-**	**08**
	1.1	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Classification, Major Application Areas	
	1.2	Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle	
	1.3	**Program modeling concepts:** DFG, FSM, Petri-net, UML	
2.0		**Processor**	**08**
	2.1	Overview of Custom Single-Purpose Processors, General-Purpose Processors,	
	2.2	Parallel Port example, Standard Single-Purpose Processors	
	2.3	RISC and CISC architectures	
	2.4	GCD example	
3.0		**Communication**	**06**
	3.1	CAN bus, I2C, MOD bus, SPI,	
	3.2	Examples on Parallel Communication, Serial Communication, Wireless Communication	
4.0		**Real Time Operating Systems[RTOS]**	**07**
	4.1	Operating system basics	
	4.2	Types of OS	
	4.3	Tasks, process,Threads	
	4.4	Multiprocessing and ,Multitasking	
	4.5	Task scheduling	
	4.6	Threads, Process , Scheduling :- Putting them all together	
5.0		**Task & RTOS applications**	**07**
	5.1	Task communications,	
	5.2	Task synchronization	
	5.3	Device drivers	
	5.4	How to choose RTOS	
	5.5	Examples of RTOS	
6.0		**Design examples and case studies of program model and programming with RTOS**	**12**
	6.1	Digital Camera:-Introduction to simple digital camera, Requirements and specifications, Design using Microcontroller and Microcontroller and CCDPP	
	6.2	Automatic Chocolate Vending Machine	
	6.3	Adaptive Cruise Control in car	
		Total	**48**

Text Books :

1. Frank Vahid, and Tony Givargis, "Embedded System Design: A unified Hardware/Software Introduction", Wiley Publication.
2. Raj Kamal," Embedded Systems Architecture, Programming and design", Tata MCgraw-Hill Publication.
3. Iyer, Gupta," Embedded real systems Programming", TMH
4. David Simon, "Embedded systems software primer', Pearson
5. Shibu K.V," Introduction to Embedded Systems", Mc Graw Hill, 2nd edition.
6. K.V.K.K. Prasad, "Embedded Real Time Systems: Concepts, Design & Programming",Dreamtech Publication.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7011	Product Lifecycle Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7011	Product Lifecycle Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Course outcomes:

After successful completion of the course student will be able to

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Product Lifecycle Management (PLM)**	**10**
	1.1	Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications	
	1.2	**PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	
2.0		**Product Design**	**09**
	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3.0		**Product data Management**	**05**
	3.1	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
4.0		**Virtual Product Development Tools**	**05**
	4.1	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
5.0		**Integration of Environmental Aspects in product Design**	**05**
	5.1	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	

6.0		**Life Cycle Assessment and Life Cycle Cost Analysis**	**05**
	6.1	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	
		Total	**39**

References :

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7012	Reliability Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7012	Reliability Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Course outcomes:

After successful completion of the course student will be able to

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Module No.	Unit No.	Topics	Hrs.
1.0		**Probability Theory**	**08**
	1.1	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	
2.0			**08**
	2.1	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	
3.0		**System Reliability**	**05**
	3.1	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	
4.0		**Reliability Improvement**	**08**
	4.1	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
5.0		**Maintainability and Availability**	**05**
	5.1	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
6.0		**Failure Mode, Effects and Criticality Analysis**	**05**
	6.1	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	
		Total	**39**

References :

1. L. S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.

2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B. S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7013	Management Information System	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7013	Management Information System	20	20	20	80	--	--	--	100

Course objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Course outcomes:

After successful completion of the course student will be able to

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction To Information Systems (IS)**	**04**
	1.1	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	
2.0		**Data and Knowledge Management**	**07**
	2.1	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management **Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Presenting Results	
3.0		**Ethical issues and Privacy**	**07**
	3.1	Information Security. Threat to IS, and Security Controls	
4.0		**Social Computing (SC)**	**07**
	4.1	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	
5.0			**06**
	5.1	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	
6.0		**Information System within Organization**	**08**
	6.1	Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	
		Total	**39**

References :

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K. C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7014	Design of experiments	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7014	Design of experiments	20	20	20	80	--	--	--	100

Course objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Course outcomes:

After successful completion of the course student will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**06**
	1.1	Strategy of Experimentation	
	1.2	Typical Applications of Experimental Design	
	1.3	Guidelines for Designing Experiments	
	1.4	Response Surface Methodology	
2.0		**Fitting Regression Models**	**08**
	2.1	Linear Regression Models	
	2.2	Estimation of the Parameters in Linear Regression Models	
	2.3	Hypothesis Testing in Multiple Regression	
	2.4	Confidence Intervals in Multiple Regression	
	2.5	Prediction of new response observation	
	2.6	Regression model diagnostics	
	2.7	Testing for lack of fit	
3.0		**Two-Level Factorial Designs**	**07**
	3.1	The 2^2 Design	
	3.2	The 2^3 Design	
	3.3	The General2^k Design	
	3.4	A Single Replicate of the 2^k Design	
	3.5	The Addition of Center Points to the 2^k Design,	
	3.6	Blocking in the 2^k Factorial Design	
	3.7	Split-Plot Designs	
4.0		**Two-Level Fractional Factorial Designs**	**07**
	4.1	The One-Half Fraction of the 2^k Design	
	4.2	The One-Quarter Fraction of the 2^k Design	
	4.3	The General 2^{k-p} Fractional Factorial Design	
	4.4	Resolution III Designs	
	4.5	Resolution IV and V Designs	
	4.6	Fractional Factorial Split-Plot Designs	
5.0		**Response Surface Methods and Designs**	**07**
	5.1	Introduction to Response Surface Methodology	
	5.2	The Method of Steepest Ascent	
	5.3	Analysis of a Second-Order Response Surface	
	5.4	Experimental Designs for Fitting Response Surfaces	
6.0		**Taguchi Approach**	**04**
	6.1	Crossed Array Designs and Signal-to-Noise Ratios	
	6.2	Analysis Methods	
	6.3	Robust design examples	
		Total	**39**

References :

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7015	Operations Research	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7015	Operations Research	20	20	20	80	--	--	--	100

Course objectives:

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models

Course outcomes:

After successful completion of the course student will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Operations Research**	**14**
	1.1	Introduction, , Structure of the Mathematical Model, Limitations of Operations Research	
	1.2	**Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method,	
	1.3	**Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	
	1.4	**Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	
	1.5	**Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	
	1.6	**Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
2.0		**Queuing Models**	**05**
	2.1	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	
3.0		**Simulation**	**05**
	3.1	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
4.0		**Dynamic programming**	**05**
	4.1	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	
5.0		**Game Theory**	**05**

	5.1	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	
6.0		**Inventory Models**	**05**
	6.1	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	
		Total	**39**

References :

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7016	Cyber Security and Laws	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7016	Cyber Security and Laws	20	20	20	80	--	--	--	100

Course objectives:

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Cybercrime**	**04**
	1.1	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the	
2.0		**Cyber Offenses & Cybercrime**	**09**
	2.1	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
3.0		**Tools and Methods Used in Cyberline**	**06**
	3.1	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
4.0		**The Concept of Cyberspace**	**08**
	4.1	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	
5.0		**Indian IT Act**	**06**
	5.1	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	
6.0		**Information Security Standard compliances**	**06**
	6.1	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	
		Total	**39**

References :

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi

6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7017	Disaster Management and Mitigation Measures	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7017	Disaster Management and Mitigation Measures	20	20	20	80	--	--	--	100

Course objectives:

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Course outcomes:

After successful completion of the course student will be able to

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction**	**03**
	1.1	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change	
2.0		**Natural Disaster and Manmade disasters**	**09**
	2.1	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion	
	2.2	Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters	
3.0		**Disaster Management, Policy and Administration**	**06**
	3.1	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management	
	3.2	**Policy and administration:** Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
4.0		**Institutional Framework for Disaster Management in India**	**06**
	4.1	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.	
		Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
5.0		**Financing Relief Measures**	**09**
	5.1	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	
	5.2	International relief aid agencies and their role in extreme events	
6.0		**Preventive and Mitigation Measures**	**06**

	6.1	Pre-disaster, during disaster and post-disaster measures in some events in general	
	6.2	Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication	
	6.3	Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans	
	6.4	Do's and don'ts in case of disasters and effective implementation of relief aids.	
		Total	**39**

References :

1. Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7018	Energy Audit and Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7018	Energy Audit and Management	20	20	20	80	--	--	--	100

Course objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course outcomes:

After successful completion of the course student will be able to

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Module No.	Unit No.	Topics	Hrs.
1.0		**Energy Scenario**	**04**
	1.2	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	
2.0		**Energy Audit Principles**	**08**
	2.1	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	
3.0		**Energy Management and Energy Conservation in Electrical System**	**10**
	3.1	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. **Energy conservation opportunities in**: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4.0		**Energy Management and Energy Conservation in Thermal Systems**	**10**
	4.1	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
5.0		**Energy Performance Assessment**	**04**
	5.1	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	
6.0		**Energy conservation in Buildings**	**03**

	6.1	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	
		Total	**39**

References :

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 7019	Development Engineering	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 7019	Development Engineering	20	20	20	80	--	--	--	100

Course objectives:

- To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
- To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
- An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
- To understand the Nature and Type of Human Values relevant to Planning Institutions

Course outcomes:

After successful completion of the course student will be able to

- Apply knowledge for Rural Development.
- Apply knowledge for Management Issues.
- Apply knowledge for Initiatives and Strategies
- Develop acumen for higher education and research.
- Master the art of working in group of different nature.
- Develop confidence to take up rural project activities independently

Module No.	Unit No.	Topics	Hrs.
1.0			**08**
	1.1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	
2.0			**04**
	2.1	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	
3.0			**06**
	3.1	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
4.0			**04**
	4.1	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	
5.0			**10**

	5.1	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
6.0			**04**
	6.1	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	
		Total	**36**

References :

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL701	Microwave Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL701	Microwave Engineering Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL702	Mobile Communication System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL702	Mobile Communication System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- To observe the effect of velocity and direction of arrival of a vehicle on Doppler frequency
- To observe the effect of N on C/I ratio and comment on the voice quality
- To observe the effect of incidence angle on reflection coefficient using MATLAB
- To observe the effect of different propogation models on coverage distance
- To observe the effect of C/I ratio in a sectorised cell site and perform worst case analysis for different values of N and degree of sectorisation
  - A) Worst case C/I in a 3 sector cellular system for K=7
  - B) Worst case C/I in a 3-sector cellular system for K=4
  - C) Worst case C/I in a 6 sector cellular system for K=7
  - D) Worst case C/I in a 6 sector cellular system for K=4
- To generate Pseudo noise code used in a CDMA system
- To generate Walsh Codes using Hadamard Matrix.
- To plot Knife edge diffraction gain as a function of Fresnel diffraction parameter
- To plot channel capacity versus SNR for different MIMO systems
- Simulation of OFDMA system
- Simulation of spectrum sensing using energy detection method in cognitive radio

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Developing automated Notification based System using GSM
2. Mobile Communication Based App development
3. Creating Virtual Lab Experiments**.**

Software Tools:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.co.in/
3. Scilab Experiments Book: http://www.scilab.in/textbook_companion/generate_book/2081

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL703	Optical Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL703	Optical Communication Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Calculation of Numerical aperture
- Calculation of dispersion for given fiber
- Calculation of link Loss for given link
- Performance analysis of Single mode fiber
- Performance Analysis of Optical Link with Different Sources
- Performance Analysis of Optical Link with Different Detectors
- Performance Analysis of Optical Amplifier
- Calculation of link Loss for given link with nonlinearities

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.
Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.
The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7031	Neural networks & Fuzzy Logic Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7031	Neural networks & Fuzzy Logic Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program for implementing perceptron based linear functions AND and OR function. Conclude about the noise tolerance of the function.
- Write a program for implementing optimal neural network based XOR functions. Conclude about the noise tolerance of the function
- Write a program for training and testing of Multilayer Perceptron for pattern classification application
- Write a program for training and testing of Multilayer Perceptron for interpolation application
- Program for Support vector Machine based classifiers and compare result with that of Multilayer Perceptron based neural network classification
- Program for application of Multilayer perceptron for character recognition
- Program to develop Fuzzy Inference System for Speed control of DC motor
- Program for fuzzy logic based train brake control with suitable input variable assumptions
- Program to develop Fuzzy Inference System for fuzzy control of washing machines

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7032	Big Data Analytics Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7032	Big Data Analytics Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Study of Hadoop ecosystem
- Programming exercises on Hadoop
- Programming exercises in No SQL
- Implementing simple algorithms in Map- Reduce - Matrix multiplication, Aggregates.

List of Mini project

1. Design and implementation of any case study/ applications based on standard Datasets available on the web

a. Twitter data analysis b. Fraud Detection c. Text Mining etc. using modern tools.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7033	Internet Communication Engineering Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7033	Internet Communication Engineering Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Simulation study on congestion control
- Multimedia networking
- Multimedia streaming
- Assignments / Practicals can be given on writing the programs to encode and decode the various kinds of data by using the algorithms. Students can collect several papers from journals/conferences/Internet on a specific area of Internet and multimedia communications and write a review paper and make a presentation.
- Form small groups to complete projects in audio, image and video coding. The use of C/C++ is encouraged
- Conduct network simulations using OPNET and protocol analysis using Wireshark.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every

experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECLDLO 7034	CMOS Mixed Signal VLSI Laboratory	--	--	02	--	--	01	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7034	CMOS Mixed Signal VLSI Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 7035	Embedded System Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 7035	Embedded System Laboratory	--	--	--	--	25	25	--	50

Suggested Experiment List

- Interfacing of I2C,CAN,SPI,zigbee etc with ARM
- Simulation of multitasking using RTOS
- Simulation of mutex using RTOS
- Simulation of mailboxes using RTOS
- Interprocess communication using semaphore in RTOS
- Simulation of message queues using RTOS

Minimum One project based on any application related to RTOS and embedded system can be implemented.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL704	Project Stage-I	--	06	--	--	3	--	3

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL704	Project Stage-I	--	--	--	--	50	50	--	100

Objective: The Project work enables the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a specific problem or issue, via a substantial piece of work which is carried out over an extended period. It also enables the students to demonstrate the proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Guidelines:

1. **Project Topic:**

- To proceed with the project work it is very important to select a right topic. Project can be undertaken on any domain of electronics and telecommunication programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum four and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decision regarding selection of projects.
- Student has to submit weekly progress report to the internal guide and whereas internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding the term work marks.
- In case of industry projects, visit by internal guide will be preferred.

2. **Project Report Format:**

At the end of semester a project report should preferably contain at least following details:-

- Abstract
- Introduction
- Literature Survey
  a) Survey Existing system
  b) Limitation of the Existing system or research gap
  c) Problem Statement and Objective
  d) Scope
- Proposed System
  a) Analysis/Framework/ Algorithm
  b) Details of Hardware & Software
  c) Design details
  d) Methodology (your approach to solve the problem)
- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**

Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day
b) Contribution in the Project work
c) Project Report (Spiral Bound)
d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. **Oral & Practical :**

Oral &Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project- I.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC801	RF Design	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC801	RF Design	20	20	20	80	--	--	--	100

Prerequisites:

- Electromagnetic Engineering
- Antenna & Radio Wave Propagation
- Communication Engineering
- Microwave Engineering

Course objectives:

- To learn RF circuit fundamentals for designing various circuit building blocks in a typical RF transceiver
- To learn importance of EMI/EMC

Course outcomes:

After successful completion of the course student will be able to

- Design impedance matching networks and passive RF filters.
- Design and appraise RF amplifiers and oscillators.
- Analyze EMI and EMC in RF circuits.

Module No.	Unit No.	Topics	Hrs.
1.0		**RF Filter Design**	**10**
	1.1	Image parameter method	
	1.2	Insertion loss method- Maximally flat low pass prototype, Equal ripple low pass prototype, Filter transformation and filter implementation	
2.0		**Amplifier Design**	**08**
	2.1	Two-port power gain stability	
	2.2	Single stage amplifier design: Design for maximum gain, design for specified gain, low noise amplifier design	
	2.3	Power amplifier design.: Characteristics of power amplifier and classes of amplifiers, design of class A power amplifier	
3.0		**Frequency Generation & Mixer**	**08**
	3.1	One-port and two-port microwave oscillator design.	
	3.2	Analysis of phase noise in oscillators.	
	3.3	Mixers: Characteristics, Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers.	
4.0		**Frequency Synthesizers**	**06**
	4.1	Direct Frequency Synthesis, Frequency Synthesis by Phase Lock, Effects of Reference Frequency on Loop Performance,	
	4.2	Variable-Modulus Dividers, Down Conversion, Methods for Reducing Switching Time, Direct Digital Synthesis, Synthesizer Design .	
	4.3	Phase Noise: A Model for Oscillator Phase Noise, Phase Noise in Phase-Locked Loops, Effect of Frequency Division and Multiplication on Phase Noise.	
5.0		**Electromagnetic Interference in RF circuits**	**08**
	5.1	Introduction. Natural and Nuclear Sources of EMI, EMI From Apparatus and Circuits. **Quantification Of Communication System EMI**	
	5.2	Elements Of Interference, Including Antennas, Transmitters, Receivers And Propagation. **Electronic Equipment And System EMI Concepts.** Examples Of EMI Coupling Modes	
	5.3	**Equipment Emissions And Susceptibilities- Types of coupling: Common-Mode Coupling:** Common-Mode Coupling Mechanisms Including Field To Cable, Ground Impedance, Ground Loop And Coupling Reduction Techniques **Differential-Mode Coupling** : Differential-Mode Coupling Mechanisms Including Field To Cable, Cable To Cable And Coupling Reduction Techniques.	
	5.4	**Other Coupling mechanisms:** Power Supplies And Victim Amplifiers	

6.0		**Electromagnetic Compatibility**	**08**
	6.1	**The Importance Of Grounding For Achieving EMC.** Grounding, Including The Reasons (I.E., Safety, Lightning Control, EMC, Grounding Schemes (Single Point, Multi-Point And Hybrid), Shield Grounding And Bonding. Shielding Effectiveness, Shielding Considerations (Reflective And Absorptive), Shielding Compromises (I.E., Apertures, Gaskets, Waveguide Beyond Cut-Off)	
	6.2	**EMI Diagnostics And Fixes:** Techniques Used In EMI Diagnostics And Fixes	
	6.3	**EMC Specifications, Standards And Measurements.** A Discussion Of The Genesis Of EMC Documentation Including A Historical Summary, The Rationale, And A Review Of MIL-Stds, FCC And CISPR Requirements.	
		Total	**48**

Text Books

1. David M Pozar, Microwave Engineering, John Wiely and Sons, 2005
2. Ludwig R. and Bogdanov G, RF Circuit Design, Prentice Hall, 2007.
3. Jack Smith, Modern Communication circuits,Tata McgrawHill.
4. W. Prasad Kodali, Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models, 2nd Edition, ISBN: 978-0-7803-4743-4, January 2001, Wiley-IEEE Press
5. David. A. Weston, Electromagnetic Compatibility-principles and applications, Second Edition, Publisher: Marcel Dekker, Inc. 2001, ISBN 0-8247-8889-3

References:

1. Guillermo Gonzalez, 'Microwave Transistor Amplifiers Analysis and Design', Prentice Hall, 2nd Edition.
2. Devendra Misra, 'Radio Frequency and Microwave Communication Circuits-Analysis and Design', John Wiley & Sons, 2nd Edition.
3. Clayton R. Paul, 'Electromagnetic Compatibility', John Wiley & Sons, 2nd Edition.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECC802	Wireless Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECC802	Wireless Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Computer Communication and Networks
- Mobile Communication

Course objectives:

- To understand architecture, planning and design of various mobile and wireless networks.
- To study various WBAN, WPAN and WLAN technologies like Bluetooth, Zigbee, Wimax etc.
- To develop the concepts of wireless adhoc network architecture and the protocol to build WSN applications.

Course outcomes:

After successful completion of the course student will be able to

- Explain the fundamentals, architecture, design issues and standards of wireless networks
- List and compare Body area network (BAN) and personal area network (PAN) technologies such as Zigbee, Bluetooth, UWB, RFID, NFC etc.
- Classify different LAN topologies and technologies
- Illustrate the fundamentals and architecture of wireless Metropolitan Area Networks (WMAN) and describe the phases of planning and design of wireless networks
- Discuss various wireless adhoc networks architecture, traffic related protocols and transmission technology
- Understand the basic architecture and working of IOT

Module No.	Unit No.	Topics	Hrs.
1.0		**Basics of Wireless Networks**	**04**
	1.1	Wire1ess Network Architecture, Classifications, Switching Technology, Communication Problems, Reference Models, Networking Issues, Networking Standards	
	1.2	**Wireless Body Area Networks:** Properties, Network Architecture, Network Components, Applications.	
2.0		**Wireless Personal Area Networks**	**12**
	2.1	**WPAN: Bluetooth (802.15.1):** Radio Specifications, Protocol Stack, Link Types, Security, State Model, Error Correction, Topologies, Applications	
	2.2	**ZigBee (802.15.4):** Radio Specifications, Components, Topologies, Protocol Stack, Applications.	
	2.3	**RFID : Radio Specifications, Architecture & Types**	
	2.4	**Near Field Communication & UWB (802.15.3 a):** Introduction and working.	
3.0		**Wireless Local Area Network**	**06**
	3.1	Equipment, Topologies, Technologies, Applications, IEEE802.11 WLAN	
	3.2	Joining an existing Basic Service Set, Security and Power Management	
	3.3	Main features of IEEE802.11a,b, i and n	
4.0		**Wireless Metropolitan and Wide Area Networks**	**12**
	4.1	**WMAN(IEEE802.16):**Introduction, WMAN Network Architecture, Network Protocols, Broadband Wireless Networks, Applications	
	4.2	**WWAN**: Planning and design of Wireless Network: Radio Link and Coverage Planning	
	4.3	Link Budgets for GSM, CDMA, CDMA2000, HSDPA Systems	
5.0		**Wireless Adhoc Networks**	**06**
	5.1	**Wireless Adhoc Networks:** Features, advantages & Applications	
	5.2	**Mobile Adhoc Networks:** Network Architecture, MAC Protocols	
	5.3	**Vehicular Adhoc Networks** (VANETs): Characteristics, Protocols & Applications	

6.0		**Wireless Sensor Networks**	**08**
	6.1	**Wireless Sensor Networks** : Network architecture, Protocols, technologies & Applications	
	6.2	**Wireless Mesh Networks** : Network architecture, Protocols, technologies & Applications	
	6.3	**Internet of Things:** Frame work, Architecture, Technology & examples, M2M communication	
		Total	**48**

Text Books & References :

1. Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann Series in Networking—Elsevier
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley Student Edition
3. Dr SunilkumarS. Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocol"Wiley India Pvt Ltd.
4. Raj Kamal, "Internet of Things Architecture & Design Principles" Mcgraw Hill

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8041	Optical Networks	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8041	Optical Networks	20	20	20	80	--	--	--	100

Prerequisites:

- Principles of Communication Engineering
- Digital Communication
- Antenna Wave Propagation
- Optical Communication

Course objectives:

- The issues related to signal degradation due to linear impairment
- High data rate WDM optical transport networks
- Link budget and optical networks, design and management.

Course outcomes:

After successful completion of the course student will be able to

- Identify the issues related to signal degradation and multiplexing.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.
- Apply the knowledge developed in-class to contemporary optical fiber communication research and industrial areas.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Optical Components and Networks**	**06**
	1.1	OPTICAL Components - Couplers, Isolators and Circulators, Multiplexes and Filters Optical Amplifiers. Transmitters, Detectors, Switches, Wavelength Converters	
	1.2	OPTICAL Networks - Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, System and network evolution	
2.0		**Optical Networks Architecture**	**08**
	2.1	SONET/SDH, Computer interconnects, MANS, Layered architecture for SONET and second generation networks.	
	2.2	Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols,	
	2.3	Operational principle of WDM, WDM network elements and Architectures, Introduction to DWDM, Solitons	
3.0		**Packet Switching and Access Networks**	**08**
	3.1	Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing,	
	3.2	Synchronization, Broadcast OTDM networks, Switch-based networks	
	3.3	Access Networks – Network Architecture overview, Future Access Networks,	
	3.4	Optical Access Networks Architectures; and OTDM networks	
4.0		**Wavelength Routing Networks**	**10**
	4.1	Optical layer, Node design, Network design and operation, routing and wavelength assignment architectural variations	
	4.2	Optical Network Routing Principles - Impairment Aware Routing Optical Circuit Switching ,Optical Packet Switching Optical Burst Switching	
	4.3	Energy Awareness in Optical Networking ,Network Modeling Tools Network Design Guidelines	
5.0		**Design of Optical Networks**	**10**
	5.1	Core Optical Networks, Metro Optical networks, Access Optical Networks	
	5.2	Wavelength Routing and Assignment, Traffic Grooming and Protection, Multilayer Network Structure	
	5.3	Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization	
6.0		**Virtual topology, Network Control and Management**	**06**
	6.1	Virtual topology design problem, Combines SONET/WDM network design, an ILP formulation, Regular virtual topologies,	

	6.2	Control and management, Network management configuration management, Performance management, fault management. Network management functions, Optical safety	
		Total	**48**

Text Books :

1. Kumar Sivarajan and Rajiv Ramaswamy, Morgan Kauffman, Optical Networks: A Practical Perspective, Elsevier Publication Elsevier India Pvt. Ltd, 3rd Edition, 2010.
2. Harry G. Parros, Communication Oriented Networks, Wiley
3. G. Agrwal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Edition, New York, 2014.

References:

1. C. Siva Ram Moorthy and Mohan Gurusamy, WDM Optical Networks: Concept, Design and Algorithms, Prentice Hall of India, 1st Edition, 2002.
2. Biswajit Mukherjee, Optical Communication Networks, TMG1998.
3. Jane M. Simoons, Optical Network Design and Planning, Second Edition, Springer
4. Ulysees Black, Optical Networks, Pearson education 2007.
5. Milorad Cvijetic, Ivan B. Djordjevic, Advanced Optical Communication Systems and Networks, Artech House Applied Photonics, 2012.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8042	Advanced Digital Signal Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8042	Advanced Digital Signal Processing	20	20	20	80	--	--	--	100

Prerequisites:

- Discrete Time Signal Processing

Course objectives:

The aim of this course is to provide in-depth treatment on methods and techniques on

- Multirate Signal Processing, Power Spectrum Estimation, Adaptive Filtering and Wavelet Transform.
- Application of signal processing to real world problems.

Course outcomes:

After successful completion of the course student will be able to

- Demonstrate an understanding of multirate sampling and its mechanism.
- Study and apply the techniques of power spectrum estimation and wavelet theory for various applications.
- Implement adaptive filters for given applications.
- Apply signal processing tools to Biomedical and Telecommunication Applications

Module No.	Unit No.	Topics	Hrs.
1.0		**Multirate Digital Signal Processing**	**08**
	1.1	Advantages of Multirate Signal Processing	
	1.2	Interpolation and Decimation	
	1.3	Sampling Rate Conversion by Non Integer Factor	
	1.4	Multistage Interpolation and Decimation	
	1.5	Polyphase Decomposition	
	1.6	Digital Filter Banks	
	1.7	Applications of Multirate Signal Processing	
2.0		**Power Spectrum Estimation**	**10**
	2.1	**Non Parametric Method of Power Spectrum Estimation:** Periodogram, Modified Periodogram, Barlett Method, Welch's Method, Blackman-Tukey Approach	
	2.2	**Parametric Methods of Power Spectrum Estimation:** Auto Regressive Spectrum Estimation, Model Parameters-Yule-Walker Equation, Least Square Method and Linear Prediction, Moving Average Spectrum Estimation, Autoregressive Moving Average Spectrum Estimation	
	2.3	Eigen Analysis Algorithm for Spectrum Estimation	
3.0		**Linear Prediction and Optimum Linear Filters**	**10**
	3.1	Representation of Stationary Random Process	
	3.2	Forward and Backward Linear Prediction	
	3.3	Solution of Normal Equation(Levinson-Durbin and Schur Algorithm)	
	3.4	AR Lattice and ARMA Lattice Ladder Filters	
	3.5	Weiner Filters for Filtering and Prediction	
4.0		**Adaptive Filters**	**10**
	4.1	**Applications of Adaptive Filters:** System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation, Suppression of Narrowband Interference in Wideband Signals, Adaptive Arrays.	
	4.2	**Adaptive Algorithms:** LMS Algorithm, RLS Algorithm, Lattice Ladder Algorithm	
5.0		**Wavelet Transform**	**06**
	5.1	Introduction to Time Frequency Analysis	
	5.2	Short Time Fourier Transform	
	5.3	Continuous Wavelet Transform	
	5.4	Discrete Wavelet Transform	
	5.5	Multiresolution Analysis	

	5.6	Applications	
6.0		**Application Of Signal Processing**	**04**
	6.1	Biomedical Applications	
	6.2	Audio Applications	
	6.3	Telecommunication Applications(Radar)	
		Total	**48**

Textbooks

1. John G. Proakis, Dimitris G. Monolakis " Digital Signal Processing", PHI 2007.
2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing A Practical Approach", Pearson Education 2008.

Reference Books

1. Simon Haykin, "Adaptive Filter Theory", Pearson Education 2013.
2. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press.
3. Raghuveer M. Rao and Ajit S. Bopardikar, "Wavelet Transforms", "Introduction to Theory and Applications", Pearson Education Asia 2000.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8043	Satellite Communication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8043	Satellite Communication	20	20	20	80	--	--	--	100

Prerequisites:

- Analog Communication
- Digital Communication

Course objectives:

- To understand the basics of satellite communications and different satellite communication orbits
- Provide an in-depth understanding of satellite communication system operation, launching techniques, satellite link design and earth station technology
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- Review the state of the art in new research areas such as speech and video coding, satellite networking and satellite personal communications, mobile satellite communication, Laser satellite

Course outcomes:

After successful completion of the course student will be able to

- Explain basics of satellite communication, space segment and earth segment
- Understand different satellite orbits and orbital parameters
- Explain and analyze link budget of satellite signal for proper communication
- Understand various applications of satellite communications

Module No.	Unit No.	Topics	Hrs.
1.0		**Overview of Satellite Systems, Orbits and Launching**	**09**
	1.1	An overview of space and satellite, Frequency allocation for satellite communication, Polar orbiting satellites, Kepler's First, second and third law, orbital elements, apogee, perigee heights, orbital perturbations, effects of a non-spherical earth, atmospheric drag	
	1.2	Wave Propagation & Polarization, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other impairments, Antenna Polarization, Polarization of Satellite signals, Cross polarization discrimination, Ionospheric depolarization, Rain depolarization, Ice depolarization	
	1.3	Sub-satellite Point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage	
	1.4	Selection of launching site, launch window, zero and non-zero degree latitude launching, sea launch, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV)	
2.0		**Space Segment**	**06**
	2.1	Satellite configuration, Transponder sub-system, Antenna sub-system, AOC Sub-system, TT&C Sub-system, power sub-system, Thermal sub-system, reliability and quality Assurance.	
3.0		**Earth station**	**05**
	3.1	Design consideration	
	3.2	General configuration- Block diagram, Receive only type earth, transmit-receive type earth station, Antenna system, Feed system, Tracking system, LNA, HPA	
4.0		**Satellite Links**	**10**
	4.1	Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, link power budget	
	4.2	System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio	
	4.3	Uplink: Saturation flux density, input back off, earth station HPA, Downlink: Output back off, satellite TWTA output	
	4.4	Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise	
5.0		**The Space Segment Access and Utilization**	**08**
	5.1	Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system, bandwidth-limited and power-limited TWT amplifier operation	

	5.2	TDMA: Reference Burst; Preamble and Postamble, carrier recovery, network synchronization, unique word detection, traffic date, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA, satellite switched TDMA	
	5.3	Code Division Multiple Access: Direct-sequence spread spectrum–acquisition and tracking, spectrum spreading and dispreading – CDMA throughput	
6.0		**Satellite Applications**	**10**
	6.1	VSAT systems: Advantages, configurations, frequency bands, elements, Applications	
	6.2	Broadcast services: Television broadcast systems, DAB,	
	6.3	Mobile satellite communication: INMARSAT, LMSS, mobile satellite systems with non GEO satellites	
	6.4	Satellite navigation systems	
	6.5	Laser Satellite Communication: Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link	
	6.6	Recent applications	
	6.7	Modern development and future trends	
		Total	**48**

Text Books & References :

1. Dennis Roddy, “Satellite Communications”, 4th Ed., Mc. Graw-Hill International Ed. 2009.
2. M. Richharia, “Satellite Communication Systems Design Principles”, Macmillan Press Ltd. Second Edition 2003.
3. R. N. Mutangi, “ Satellite Communication”, Oxford university press, 2016.
4. Gerard Maral and Michel Bousquet, “Satellite Communication Systems”, 4th Edition Wiley Publication
5. Gerard Maral, “VSAT Networks”, John Willy & Sons
6. Timothy Pratt, Charles Bostian, and Jeremy Allmuti, “Satellite Communications”, John Willy & Sons (Asia) Pvt. Ltd. 2004
7. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, “Satellite Communication systems Engineering”, Pearson Publication

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCDLO 8044	Network Management in TeleCommunication	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCDLO 8044	Network Management in TeleCommunication	20	20	20	80	--	--	--	100

Prerequisites:

- Computer Communication and Networks,
- Operating System
- Basic Programming skills

Course objectives:

- To understand the concept of Telecommunication, network management, architecture and protocol

Course outcomes:

After successful completion of the course student will be able to

- Explain the need for interoperable network management & analyze the trends and development of the Telecommunications Network Management.
- Demonstrate broad knowledge of fundamental principles and technical standards underlying.
- Describe the concepts and architecture behind standards based network management associated with SNMP and CMIP.
- Apply basic of telecommunication, networking and information technologies and architect and implement networked informative systems.
- Continuously improve their technology knowledge and communication skills.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction of Network Management**	**10**
	1.1	Introducing Network Design Concepts: Network designers ensure that our communications networks can adjust and scale to the demands for new services. To support our network-based economy, designers must work to create networks that are available nearly 100 percent of the time. Challenges of IT managers.	
	1.2	Network Management: Goals, organization and functions	
	1.3	Network management architecture and organization network management perspectives	
2.0		**OSI Network Management**	**04**
	2.1	Network management standards	
	2.2	Network management models	
	2.3	Organization model	
	2.4	Information model	
	2.5	Communication model and functional model	
	2.6	Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE	
3.0		**Internet Management**	**12**
	3.1	SNMP-organizational model-	
	3.2	System overview.	
	3.3	Information model, communication model, functional model	
	3.4	SNMP proxy server, Management information, Protocol	
	3.5	SNMPv1,v2 and V3	
	3.6	Remote monitoring. RMON	
4.0		**Telecommunication Management Networks(TMN)**	**04**
	4.1	Need for TMN , Conceptual TNM model	
	4.2	TMN Network Management Architecture	
	4.3	TMN management services architecture and TMN implementation	
5.0		**Network Management Tools and Applications**	**12**
	5.1	System Utilities for network management	
	5.2	Network statistics and measurements	
	5.3	NMS Design, NMS components, NMS Server Architecture	
	5.4	Network Management Systems and FCAPS	
	5.5	Automatic Fault Management and Event correlation Techniques	
	5.6	Security Management	
6.0		**Broadband Network Management**	**06**
	6.1	Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN	

	6.2	ATM Network Management – ATM network reference model, integrated local management interface. ATM management management information base, role of SNMP and ILMI in ATM.	
	6.3	M1, M2, M3, M4 interface. ATM digital exchange interface management	
		Total	**48**

Text Books & References :

1. Mani Subramaniam, ―Network Management Principles and Practise", Addison Wisely, New York, 2000.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide By Kenneth Stewart, Aubrey Adams, Allan Reid, Jim Lorenz, Cisco Press
3. Network Management: Concepts and Practice, A Hands-On Approach by J. Richard Burke, Pearson Publications.
4. Network Management: Accounting and Performance Strategies by Benoit Claise - CCIE No. 2686; Ralf Wolter CISCO Press
5. Network Management Fundamentals, Alexander Clemm, Cisco Press, December 2006, ISBN-13: 978-158720137
6. Python for Software Design by Allen B. Downey, Cambridge University Press, March 2009, ISBN-13: 978-0521725965. A free manuscript is available at the author's website.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8021	Project Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8021	Project Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course outcomes:

After successful completion of the course student will be able to

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module No.	Unit No.	Topics	Hrs.
1.0		**Project Management Foundation**	**05**
	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	
2.0		**Initiating Projects**	**06**
	2.1	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	
3.0		**Project Planning and Scheduling**	**08**
	3.1	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	
4.0		**Planning Projects**	**06**
	4.1	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
5.0			**08**
	5.1	**Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings	
	5.2	**Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	
	5.3	**Project Contracting** Project procurement management, contracting and outsourcing,	
6.0			**06**
	6.1	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects	

	6.2	**Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	
		Total	**39**

References:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8022	Finance Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8022	Finance Management	20	20	20	80	--	--	--	100

Course objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Course outcomes:

After successful completion of the course student will be able to

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module No.	Unit No.	Topics	Hrs.
1.0			**06**
	1.1	**Overview of Indian Financial System** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2.0			**06**
	2.1	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3.0			**09**
	3.1	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4.0			**10**
	4.1	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	

5.0			**05**
	5.1	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
6.0			**03**
	6.1	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	
		Total	**39**

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8023	Entrepreneurship Development and Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8023	Entrepreneurship Development and Management	20	20	20	80	--	--	--	100

Course objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Module No.	Unit No.	Topics	Hrs.
1.0			**04**
	1.1	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
2.0			**09**
	2.1	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	
3.0			**05**
	3.1	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	
4.0			**08**
	4.1	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
5.0			**08**
	5.1	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	
6.0			**05**
	6.1	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	
		Total	**39**

References:

1. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
2. T N Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
3. C N Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
4. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
5. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
6. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8024	Human Resource Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8024	Human Resource Management	20	20	20	80	--	--	--	100

Course objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
- To familiarize the students about the latest developments, trends & different aspects of HRM
- To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Course outcomes:

After successful completion of the course student will be able to

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to HR**	**05**
	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions	
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	
2.0		**Organizational Behaviour (OB)**	**07**
	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues	
	2.2	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness	
	2.3	Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour	
	2.4	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor)	
	2.5	Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team	
	2.6	Case study	
3.0		**Organizational Structure &Design**	**06**
	3.1	Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	
	3.2	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	
	3.3	Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
4.0		**Human resource Planning**	**05**
	4.1	Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale	
	4.2	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning	
	4.3	Training & Development: Identification of Training Needs, Training Methods	
5.0		**Emerging Trends in HR**	**06**

	5.1	Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment	
	5.2	Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	
6.0			**10**
	6.1	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries	
	6.2	**Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	
	6.3	**Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	
		Total	**39**

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8025	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	20	80	--	--	--	100

Course objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Course outcomes:

After successful completion of the course student will be able to

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Module No.	Unit No.	Topics	Hrs.
1.0			**04**
	1.1	**Professional Ethics and Business :** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	
2.0			**08**
	2.1	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	
3.0			**06**
	3.1	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	
4.0			**05**
	4.1	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	
5.0			**08**
	5.1	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	
6.0			**08**
	6.1	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	
		Total	**39**

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8026	Research Methodology	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8026	Research Methodology	20	20	20	80	--	--	--	100

Course objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Course outcomes:

After successful completion of the course student will be able to

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction and Basic Research Concepts**	**09**
	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	
	1.2	Need of Research in Business and Social Sciences	
	1.3	Objectives of Research	
	1.4	Issues and Problems in Research	
	1.5	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	
2.0		**Types of Research**	**07**
	2.1	Basic Research	
	2.2	Applied Research	
	2.3	Descriptive Research	
	2.4	Analytical Research	
	2.5	Empirical Research	
	2.6	Qualitative & Quantitative Approaches	
3.0		**Research Design and Sample Design**	**07**
	3.1	Research Design – Meaning, Types and Significance	
	3.2	Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	
4.0		**Research Methodology**	**08**
	4.1	Meaning of Research Methodology	
	4.2	Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
5.0		**Formulating Research Problem**	**04**
	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	
6.0		**Outcome of Research**	**04**

	6.1	Preparation of the report on conclusion reached	
	6.2	Validity Testing & Ethical Issues	
	6.3	Suggestions and Recommendation	
		Total	**39**

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C. R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.), Singapore, Pearson Education

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8027	IPR and Patenting	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8027	IPR and Patenting	20	20	20	80	--	--	--	100

Course objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Course outcomes:

After successful completion of the course student will be able to

- Understand Intellectual Property assets
- Assist individuals and organizations in capacity building
- Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module No.	Unit No.	Topics	Hrs.
1.0			**05**
	1.1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	
2.0			**07**
	2.1	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	
3.0			**05**
	3.1	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	
4.0			**07**
	4.1	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5.0			**08**
	5.1	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	
6.0			**07**
	6.1	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	
		Total	**39**

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8028	Digital Business Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8028	Digital Business Management	20	20	20	80	--	--	--	100

Course objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Course outcomes:

After successful completion of the course student will be able to

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Module No.	Unit No.	Topics	Hrs.
1.0			**09**
	1.1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	
2.0			**06**
	2.1	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	
3.0			**06**
	3.1	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	
4.0			**06**
	4.1	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
5.0			**04**
	5.1	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	

6.0			**08**
	6.1	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	
		Total	**39**

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ECCILO 8029	Environmental Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECCILO 8029	Environmental Management	20	20	20	80	--	--	--	100

Course objectives:

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Course outcomes:

After successful completion of the course student will be able to

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Module No.	Unit No.	Topics	Hrs.
1.0			**10**
	1.1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	
2.0			**06**
	2.1	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3.0			**05**
	3.1	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	
4.0			**10**
	4.1	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	
5.0			**05**
	5.1	Total Quality Environmental Management, ISO-14000, EMS certification	
6.0			**03**
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	
		Total	**39**

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management **V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC

Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Internal Assessment:
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL801	RF Design Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL801	RF Design Laboratory	--	--	--	--	25	25	--	50

Suggested List of experiments

- Calibration of Network analyser for measurements.
- Characterization of RF low pass filter.
- Characterization of RF high pass filter.
- Characterization of RF band pass filter.
- Design of passive matching networks.
- Stability circles for microwave transistor
- Gain and Noise circles for transistor amplifier design
- Measurement of radiated emission using EMI Probes for DOT.
- Measurement of conducted radiations.
- Grounding & shielding for EMC.
- Testing of various emission standards like MIL CESPARE.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL802	Wireless Networks Laboratory	--	--	--	--	25	25	--	50

Sample List of Experiments:

Note: These are few examples of experiments; teachers may prepare their own list.

1. Study of Hardware and Software aspects of Wireless Network and Internet of Things
2. Study, discussion and installation of different network simulation tools such as NS2/NS3, Netstumbler, Wireshark etc.
3. Analysis of Zigbee Network to compute the energy efficiency of the network
4. Simulation of a simple wireless network (IEEE802.11)using NS2 or any other simulator
5. Configuration of WPAN using Xbee S2 series modules and XCTU software
6. Use of wireshark to capture WiFi or Bluetooth packets.
7. Configuration of WLAN
8. Analysis of WiFi network to compute average end to end delay and packet delivery ratio
9. Link budget analysis of a GSM Network using Scilab / Matlab
10. Link budget analysis of a WCDMA Network using Scilab / Matlab
11. Simulation of Wireless Sensor Network (IEEE802.15.4)in NS2 or any other simulator
12. Mini Project
13. Virtual Lab experiments covered from the syllabus

List of Mini projects:

Note: These are few examples of mini projects; teachers may prepare their own list.

1. Creating a small wireless sensor networks for agriculture application./smart home/ hospital/ industry/ or similar applications
2. Creating a monitoring application using IOT
3. Creating Virtual Lab Experiments.

Software Tools:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.amrita.edu/index.php?sub=78&brch=256
3. Scilab Experiments Book: https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjgwcelodTTAhVJrI8KHTQUC9AQFggqMAA&url=http%3A%2F%2Fscilab.in%2Ftextbook_companion%2Fenerate_book%2F3446&usg=AFQjCNGDs2a6AHGKL93l3_j8Ra1UN-5SQQ&sig2=yT9ep5_ZlhfRDVsv-GmsWw&cad=rja

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Term Work:

1. At least 08 experiments covering entire syllabus and one mini project should be set to have well predefined inference and conclusion.

2.The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.

3.The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

4. Students are encouraged to share their experiments/mini project codes on online repository.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8041	Optical Networks Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8041	Optical Networks Laboratory	--	--	--	--	25	25	--	50

Term Work:

At least 05 Experiments, 02 tutorials and 1 mini project covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8042	Advanced Digital Signal Processing Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8042	Advanced Digital Signal Processing Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Write a program to implement multirate sampling technique for Interpolation.
- Write a program to implement multirate sampling techniques for Decimation.
- Design Anti-aliasing and Anti-Imaging filters.
- Write a program to demonstrate LMS algorithm for noise cancellations.
- Write a program to demonstrate RLS algorithm to calculate it's error function.
- Demonstrate application of Wavelet Transform for denoising.
- Analyse the frequency contents in EEG record.
- Write a program to generate ECG signal and isolate the QRS complex.

Instructions:

1. Minimum 4 experiments and 4 assignments must be submitted by each student.
2. Assignments can be designed on problem based learning from the content of the syllabus.
3. Simulation tools like Matlab/Scilab can be used.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments including 02 simulations covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also

encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8043	Satellite Communication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8043	Satellite Communication Laboratory	--	--	--	--	25	25	--	50

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECLDLO 8044	Network Management in TeleCommunication Laboratory	--	02	--	--	1	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECLDLO 8044	Network Management in TeleCommunication Laboratory	--	--	--	--	25	25	--	50

Suggested List of Experiments

- Network Monitoring tools

a) Status b)Route c)Traffic Tools

- Network Audit using NMAP Gui
- Monitoring and management network using SNMP

a) Basic SNMP b) Advanced SNMP v3 Authentication/Encryption and ACL

c) SNMP Trap Daemon Implementation

- Configuration SNMP Protocol on Cisco Router using Packet Tracer
- Install and configure SNMP MIB browser

a) qtmib b)snmpB c) OpManager MIB browser

- Configuration manageable Switch: Dlink DES 3026 24 Port L2 Switch
- Network Statistics and measurement

a] LAN Traffic Monitoring b) Protocol statistics

- LAN Troubleshooting using Wireshark
- Monitoring of services and Servers using Observium\
- Monitoring of services and Servers using Cacti
- Install and configure NAGIOS and monitor server
- Installation and Configuration of OpenNMS as a NMS.
- Implementation of Centralized Log Management System: Syslog-ng
- Study of commercial network management tools: HPOpenView, OpManager, GFILanguard and IBM NMS.

Note: Small Project can be considered as a part of term-work.

Term Work:

At least 08 Experiments covering entire syllabus must be given during the "**Laboratory session batch wise"**. Computation/simulation based experiments are also encouraged. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for maximum batch of four students.

Term work assessment must be based on the overall performance of the student with every experiments/tutorials and mini-projects (if included) are graded from time to time. The grades will be converted to marks as per "**Choice Based Credit and Grading System"** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done. **The practical and oral examination will be based on entire syllabus.**

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Pracs	Tutorial	Total
ECL803	Project Stage-II	--	12	--	--	6	--	6

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. Of Test 1 and Test 2					
ECL803	Project Stage-II	--	--	--	--	100	50	--	150

Objective: The primary objective is to meet the milestones formed in the overall project plan decided in Project - I. The idea presented in Project -I should be implemented in Project -II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

Guidelines:

Project Report Format:

At the end of the semester the student needs to prepare a project report which should be prepared as per the guidelines issued by the University of Mumbai. Along with the project report a CD containing: project documentation, Implementation code, required utilities, Software's and user Manuals need to be attached.

Term Work:

Student has to submit weekly progress report to the internal guide and the internal guide has to keep a track on the progress of the project and also has to maintain the attendance report. This progress report can be used for awarding the term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project. Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day

b) Project work contributions as per objective

c) Project Report (Hard Bound)

d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral & Practical:

Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-II.

UG- Information Technology

Sr.No.	Subject Code	Subject Name	Count
1	ITC302,ITL301	Data Structure and Analysis,Data Structure Lab	2
2	ITC303,ITL302	Database Management System,SQL Lab	2
3	ITC305,ITL303	Paradigms and Computer Programming Fundamentals, Computer programming Paradigms Lab	2
4	ITL304	Java Lab (SBL)	1
5	ITM301	Mini Project – 1 A Front end /backend Application using JAVA	1
6	ITC402,ITL401	Computer Network and Network Design, Network Lab	2
7	ITC403,ITL402	Operating System,Unix Lab	2
8	ITC405,ITL403	Computer Organization and Architecture, Microprocessor Lab	2
9	ITL404	Python Lab (SBL)	1
10	ITM401	Mini Project – 1 B Python based automation projects	1
11	ITC501	Microcontroller and Embedded Programming,	1
12	ITC502,ITL501	Internet Programming,Internet Programming Lab	2
13	ITC503,ITL503	Advanced Data Management Technology,OLAP Lab	2
14	ITC504,ITL502	Cryptography & Network Security,Security Lab	2
15	ITL504	IOT (Mini Project) Lab	1

16	ITC601,ITL601	Software Engineering with Project Management,Software Design Lab	2
17	ITC602,ITL602	Data Mining and Business Intelligence,Business Intelligence Lab	2
18	ITC603,ITL603	Cloud Computing & Services,Cloud Service Design Lab	2
19	ITC604,ITL604	Wireless Networks,Sensor Network Lab	2
20	ITM605	Mini-Project	1
21	ITC701,ITL701	Enterprise Network Design,Network Design Lab	2
22	ITC702,ITL702	Infrastructure Security,Advanced Security Lab	2
23	ITC703,ITL703	Artificial Intelligence,Intelligence System Lab	2
24	ITL704	Android Apps Development Lab	1
25	ITC801,ITL801	Big Data Analytics,Big Data Lab	2
26	ITC802,ITL802	Internet of Everything,Internet of Everything Lab	2
27	ITL803	DevOps Lab	1
28	ITL804	R Programming Lab	1
29	ITM805	Project-II	1
		Total	47

AC: **23/7/2020**

Item No. : **126**

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Information Technology Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC: 23/7/2020
Item No. 126

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Second Year B.E. Information Technology Engineering**
2	Eligibility for Admission	**After Passing First Year Engineering as per the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	**New** / ~~Revised~~ (Strike out which is not applicable)
9	To be implemented from Academic Year	**With effect from Academic Year: 2020-2021**

Date :23/7/2020

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C ' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface By BoS

It is our honor and a privilege to present the Rev-2019 'C' scheme syllabus of Bachelor of Engineering in Information Technology (effective from year 2019-20) with inclusion of cutting edge technology. Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement.

The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions. Industries views are considered as stakeholders will design of the syllabus of Information Technology. As per Industries views only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also first time we are giving skill-based labs and Mini-project to students from third semester onwards which will help students to work on latest IT technologies. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain. The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

We would like to thank senior faculties of IT department of all colleges affiliated to University of Mumbai for significant contribution in framing the syllabus. Also on behalf of all faculties we thank all the industry experts for their valuable feedback and suggestions. We sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Specific Outcome for graduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology and security domain.
3. Ability to work in multidisciplinary projects and make it IT enabled.
4. Ability to adapt latest trends and technologies like **A**nalytics, **B**lockchain, **C**loud, **D**ata science.

Board of Studies in Information Technology Engineering - Team
Dr. Deven Shah (Chairman)
Dr. Lata Ragha (Member)
Dr. Vaishali D. Khairnar (Member)
Dr. Sharvari Govilkar (Member)
Dr. Sunil B. Wankhade (Member)
Dr. Anil Kale (Member)
Dr. Vaibhav Narwade (Member)
Dr. GV Choudhary (Member)
Ad-hoc Board Information Technology
University of Mumbai

Program Structure for Second Year
Engineering Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ITC301	Engineering Mathematics-III	3	--	1	3	--	1	4
ITC302	Data Structure and Analysis	3		--	3		--	3
ITC303	Database Management System	3	--	--	3	--	--	3
ITC304	Principle of Communication	3	--	--	3	--	--	3
ITC305	Paradigms and Computer Programming Fundamentals	3	--	--	3	--	--	3
ITL301	Data Structure Lab	--	2	--	--	1	--	1
ITL302	SQL Lab	--	2	--	--	1	--	1
ITL303	Computer programming Paradigms Lab	--	2	--	--	1	--	1
ITL304	Java Lab (SBL)	--	4	--	--	2	--	2
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	4[$]	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**07**	**1**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ITC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ITC302	Data Structure and Analysis	20	20	20	80	3	--	--	100
ITC303	Database Management System	20	20	20	80	3	--	--	100
ITC304	Principle of Communication	20	20	20	80	3	--	--	100
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	3	--	--	100
ITL301	Data Structure Lab	--	--	--	--	--	25	25	50
ITL302	SQL Lab	--	--	--	--	--	25	25	50
ITL303	Computer programming Paradigms Lab	--	--	--	--	--	25	25	50
ITL304	Java Lab (SBL)	--	--	--	--	--	25	25	50
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	--	25	25	50
Total		--	--	**100**	**400**	--	**150**	**125**	**775**

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load : 1 hour per week per four groups.

Program Structure for Second Year
Engineering Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ITC401	Engineering Mathematics-IV	3	--	1	3	--	1	4
ITC402	Computer Network and Network Design	3	--	--	3	--	--	3
ITC403	Operating System	3	--	--	3	--	--	3
ITC404	Automata Theory	3	--	--	3	--	--	3
ITC405	Computer Organization and Architecture	3	--	--	3	--	--	3
ITL401	Network Lab	--	2	--	--	1	--	1
ITL402	Unix Lab	--	2	--	--	1	--	1
ITL403	Microprocessor Lab	--	2	--	--	1	--	1
ITL404	Python Lab (SBL)	--	4	--	--	2	--	2
ITM401	Mini Project – 1 B for Python based automation projects	--	4$	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**7**	**1**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ITC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
ITC402	Computer Network and Network Design	20	20	20	80	3	--	--	100
ITC403	Operating System	20	20	20	80	3	--	--	100
ITC404	Automata Theory	20	20	20	80	3	--	--	100
ITC405	Computer Organization and Architecture	20	20	20	80	3	--	--	100
ITL401	Network Lab	--	--	--	--	--	25	25	50
ITL402	Unix Lab	--	--	--	--	--	25	25	50
ITL403	Microprocessor Lab	--	--	--	--	--	25	25	50
ITL404	Python Lab (SBL)	--	--	--	--	--	25	25	50
ITM401	Mini Project – 1 B for Python based automation projects	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**75**	**775**

$ indicates work load of Learner (Not Faculty), for Mini Project. Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load : 1 hour per week per four groups

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ITC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2	To acquaint with the concept of Fourier series, its complex form and enhance the problem solving skills.
3	To familiarize the concept of complex variables, C-R equations with applications.
4	The fundamental knowledge of Trees, Graphs etc.
5	To study the basic techniques of statistics like correlation, regression and curve fitting for data analysis, Machine learning and AI.
6	To understand some advanced topics of probability, random variables with their distributions and expectations.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply the concept of Laplace transform to solve the real integrals in engineering problems.	L1, L2
2	Apply the concept of inverse Laplace transform of various functions in engineering problems.	L1, L2

3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems.	L1, L2, L3
4	Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.	L1, L2, L3
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning and AI.	L2, L3
6	Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.	L1, L2

Module	**Detailed Contents**	**Hours**	**CO Mapping**
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of real integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	7	CO1
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives, 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations	6	CO1, CO2
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity(without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	7	CO3

04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z), Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function *f*(z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	7	CO4
05	**Module: Statistical Techniques** 5.1 Karl Pearson's Coefficient of correlation (r) 5.2 Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks) 5.3 Lines of regression 5.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	6	CO5
06	**Module: Probability** 6.1 Definition and basics of probability, conditional probability, 6.2 Total Probability Theorem and Baye's theorem 6.3 Discrete and continuous random variable with probability distribution and probability density function. 6.4 Expectation of random variables with mean, variance and standard deviation, moment generating function up to four moments. **Self-learning Topics:** Skewness and Kurtosis of distribution (data)	6	CO6

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
5. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
6. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:
Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC302	Data Structure and Analysis	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC302	Data Structure and Analysis	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	The fundamental knowledge of data structures.
2	The programming knowledge which can be applied to sophisticated data structures.
3	The fundamental knowledge of stacks queue, linked list etc.
4	The fundamental knowledge of Trees, Graphs etc.
5	The fundamental knowledge of different sorting, searching, hashing and recursion techniques
6	The real time applications for stacks, queue, linked list, trees, graphs etc.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Classify and Apply the concepts of stacks, queues and linked list in real life problem solving.	L1, L2, L3
2	Classify, apply and analyze the concepts trees in real life problem solving.	L2, L3,L4
3	Illustrate and justify the concepts of graphs in real life problem solving.	L3, L5
4	List and examine the concepts of sorting, searching techniques in real life problem solving.	L2, L3, L4
5	Use and identify the concepts of recursion, hashing in real life problem solving.	L3, L4
6	Examine and justify different methods of stacks, queues, linked list, trees and graphs to various applications.	L3, L4, L5

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Defining, Declaring and Initialization of structure variables. Accessing members of a structure, Array of structures, Nested structures, Pointers to structures. Passing structure, structure members, structure arrays and pointer to structure as function parameters. Self-referential structures.	**02**	---
I	Introduction to Stacks, Queues and Linked Lists	Introduction to Data Structures: Linear and Non Linear Data Structures, Static and Dynamic Data Structures. Concept of Stack and Queue. Array Implementation of Stack and Queue, Circular Queue, Double Ended Queue, Priority Queue. Concept of Linked Lists. Singly linked lists, doubly linked lists and circular linked lists. Insertion, deletion, update and copying operations with Singly linked lists, doubly linked lists and circular linked lists. Reversing a singly linked list. **Self-learning Topics:** Linked List Implementation of Stack, Linked List implementation of Queue, Circular Queue, Double Ended Queue, Priority Queue.	**08**	CO1
II	Trees	Introduction to Trees: Terminology, Types of Binary trees. Non recursive Preorder, in-order and post-order traversal. Creation of binary trees from the traversal of binary trees. Binary search tree: Traversal, searching, insertion and deletion in binary search tree. Threaded Binary Tree: Finding in-order successor and predecessor of a node in threaded tree. Insertion and deletion in threaded binary tree. AVL Tree: Searching and traversing in AVL trees. Tree Rotations: Right Rotation, Left Rotation. Insertion and Deletion in an AVL Tree. B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node. B+ Tree, Digital Search Tree, Game Tree & Decision Tree **Self-learning Topics:** Implementation of AVL and B+ Tree	**07**	CO1, CO 2
III	Graphs	Introduction to Graphs: Undirected Graph, Directed Graph, graph terminology, Connectivity in Undirected and Directed Graphs. Spanning tree. Representation of graph: adjacency matrix, adjacency list, Transitive closure of a directed graph and path matrix.	**05**	CO1, CO3

		Traversals: Breadth First Search, Depth First Search. **Self-learning Topics:** Implementation of BFS, DFS		
IV	Recursion and Storage Management	Recursion: Writing a recursive function, Flow of control in recursive functions, Winding and unwinding phase, Recursive data structures, Implementation of recursion. Tail recursion. Indirect and Direct Recursion. Storage Management: Sequential Fit Methods: First Fit, Best Fit and Worst Fit methods. Fragmentation, Freeing Memory, Boundary Tag Method. Buddy Systems: Binary Buddy System, Fibonacci Buddy System. Compaction, Garbage Collection. **Self-learning Topics:** Implementation of recursion function.	**06**	CO5
V	Searching and Sorting	Searching: Sequential Search, Binary Search. Hashing: Hash Functions: Truncation, Mid-square Method, Folding Method, Division Method. Collision Resolution: Open Addressing: Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining Bucket Hashing. Analysis of all searching techniques Sorting: Insertion sort, Selection sort, Merge sort, Quick sort and Radix sort. Analysis of all sorting techniques **Self-learning Topics:** Implementation of different sorting techniques and searching.	**05**	CO 4, CO5
VI	Applications of Data Structures	Applications of Linked Lists: Addition of 2 Polynomials and Multiplication of 2 polynomials. Applications of Stacks: Reversal of a String, Checking validity of an expression containing nested parenthesis, Function calls, Polish Notation: Introduction to infix, prefix and postfix expressions and their evaluation and conversions. Application of Queues: Scheduling, Round Robin Scheduling Applications of Trees: Huffman Tree and Heap Sort. Applications of Graphs: Dijkstra's Algorithm, Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm. **Self-learning Topics:** Implementation of applications for Stack, Queues, Linked List, Trees and Graph.	**06**	CO6

Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Online References:

Sr. No.	Website Name
2.	https://www.nptel.ac.in
3.	https://opendatastructures.org/
3.	https://www.coursera.org/

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC303	Database Management System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC303	Database Management System	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn the basics and understand the need of database management system.
2	To construct conceptual data model for real world applications
3	To Build Relational Model from ER/EER.
4	To introduce the concept of SQL to store and retrieve data efficiently.
5	To demonstrate notions of normalization for database design.
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the need of Database Management System.	L1, L2
2	Design conceptual model for real life applications.	L6
3	Create Relational Model for real life applications	L6
4	Formulate query using SQL commands.	L3
5	Apply the concept of normalization to relational database design.	L3
6	Demonstrate the concept of transaction, concurrency and recovery.	L2

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Comment**Basic knowledge of operating systems and file systems, Any programming	**02**	--
I	**Database System Concepts and Architecture**	Introduction, Characteristics of Databases, File system v/s Database system, Data abstraction and Data Independence, DBMS system architecture, Database Administrator (DBA), Role of DBA **Self-learning Topics:** Identify the types of Databases.	**05**	CO1
II	**The Entity-Relationship Model**	Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Weak entity Types Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model. **Self-learning Topics:** Design an ER model for any real time case study.	**05**	CO2
III	**Relational Model & Relational Algebra**	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Kay, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebra expressions for Unary Relational Operations, • Set Theory operations, • Binary Relational operation Relational Algebra Queries **Self-learning Topics:** Map the ER model designed in module II to relational schema..	**05**	CO3
IV	**Structured Query Language (SQL) & Indexing**	Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Complex Retrieval Queries using Group By, Recursive Queries, nested Queries ; Integrity constraints in SQL. Database Programming with JDBC, Security and authorization: Grant & Revoke in SQL Functions and Procedures in SQL and cursors. Indexing:Basic Concepts, Ordered Indices, Index Definition in SQL **Self-learning Topics:** Physical design of database for the relational model designed in module III and fire various queries.	**08**	CO4

V	**Relational Database Design**	Design guidelines for relational Schema, Functional Dependencies, Database tables and normalization, The need for normalization, The normalization process, Improving the design, Definition of Normal Forms- 1NF, 2NF, 3NF & The Boyce-Codd Normal Form (BCNF). **Self-learning Topics:** Consider any real time application and normalization upto 3NF/BCNF	**07**	CO5
VI	**Transactions Management and Concurrency and Recovery**	Transaction: Transaction concept, State Diagram, ACID Properties, Transaction Control Commands, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based-protocols, Deadlock handling Timestamp-based protocols, Recovery System: Recovery Concepts, Log based recovery. **Self-learning Topics:** Study the various deadlock situation which may occur for a database designed in module V.	**07**	CO6

Text Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, ―Database Systems Design, Implementation and Management‖, Thomson Learning, 9th Edition.
2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : "Database Management Systems", McGraw – Hill

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.oreilly.com
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC304	Principle of Communication	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC304	Principle of Communication	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Study the basic of Analog and Digital Communication Systems.
2	Describe the concept of Noise and Fourier Transform for analyzing communication systems.
3	Acquire the knowledge of different modulation techniques such as AM, FM and study the block diagram of transmitter and receiver.
4	Study the Sampling theorem and Pulse Analog and digital modulation techniques
5	Learn the concept of multiplexing and digital band pass modulation techniques
6	Gain the core idea of electromagnetic radiation and propagation of waves.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe analog and digital communication systems	L1,L2
2	Differentiate types of noise, analyses the Fourier transform of time and frequency domain.	L1, L2, L3, L4
3	Design transmitter and receiver of AM, DSB, SSB and FM.	L1,L2,L3,L4
4	Describe Sampling theorem and pulse modulation systems.	L1,L2,L3
5	Explain multiplexing and digital band pass modulation techniques.	L1, L2
6	Describe electromagnetic radiation and propagation of waves.	L1,L2

Prerequisite: Basic of electrical engineering

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Terminologies in communication systems, analog and digital electronics	**02**	
I	**Introduction**	Basics of analog communication and digital communication systems (Block diagram), Electromagnetic Spectrum and application, Types of Communication channels. **Self-learning Topics:** Applications areas of analog and digital communication.	**03**	**CO1**
II	**Noise and Fourier Representation of Signal and System**	Basics of signal representation and analyses, Introduction to Fourier Transform, its properties (time and frequency shifting, Fourier transform of unit step, delta and gate function. Types of Noise, Noise parameters –Signal to noise ratio, Noise factor, Noise figure, Friss formula and Equivalent noise temperature. **Self-learning Topics:** Practice Numerical on above topic.	**06**	**CO2**
III	**Amplitude and Angle modulation Techniques.**	Need for modulation, Amplitude Modulation Techniques: DSBFC AM,DSBSC-AM, SSB SC AM- block diagram spectrum, waveforms, bandwidth, Power calculations. Generation of AM using Diode, generation of DSB using Balanced modulator, Generation of SSB using Phase Shift Method. AM Transmitter (Block Diagram) AM Receivers – Block diagram of TRF receivers and Super heterodyne receiver and its characteristics- Sensitivity, Selectivity, Fidelity, Image frequency and its rejection and double spotting **Angle Modulation** **FM:** Principle of FM- waveforms, spectrum, bandwidth. Pre- emphasis and de-emphasis in FM, FM generation: Direct method –Varactor diode Modulator, Indirect method (Armstrong method) block diagram and waveforms. FM demodulator: Foster Seeley discriminator, Ratio detector. **Self-learning Topics:** Use of AM and FM in Modern Communication Technology. Challenges faced by radio business.	**12**	**CO1, CO2, CO3**
IV	**Pulse Analog Modulation and Digital Modulation**	Sampling theorem for low pass and band pass signals with proof, Anti- aliasing filter, PAM, PWM and PPM generation and Degeneration. Quantization process, Pulse code modulation, Delta modulation, Adaptive delta modulation. Introduction to Line Codes and ISI.	**08**	**CO1, CO2, CO4**

		Self-learning Topics: Implementation of Pulse code modulation and demodulation.		
V	**Multiplexing and Digital Band Pass Modulation Techniques**	Principle of Time Division Multiplexing, Frequency Division Multiplexing , Orthogonal Frequency Division Multiplexing and its applications .ASK, FSK, PSK QPSK Generation and detection. **Self-learning Topics:** Implement TDM, FDM, OFDM.	**04**	**CO1, CO2, CO5**
VI	**Radiation and Propagation of Waves**	Electromagnetic radiation, fundamentals, types of propagation, ground wave, sky wave, space wave tropospheric scatter propagation **Self-learning Topics:** List the real time examples for different types of propagation waves.	**04**	**CO6**

Text Books:

[1]. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed
[2]. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.
[3].Wireless Communication and Networking, Vijay Garg

References:

[1]. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.
[2]. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University
[3]. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata McGraw Hill, 3rdEd.
[4]. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.classcentral.com
3.	http://www.vlab.co.in/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC305	Paradigms and Computer Programming Fundamentals	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC305	Paradigms and Computer Programming Fundamentals	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce various programming paradigms and the basic constructs that underline any programming language.
2	To understand data abstraction and object orientation
3	To introduce the basic concepts of declarative programming paradigms through functional and logic programming.
4	To design solutions using declarative programming paradigms through functional and logic programming.
5	To introduce the concepts of concurrent program execution.
6	To understand use of scripting language for different problem domains

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and Compare different programming paradigms.	L1, L2
2	Understand the Object Oriented Constructs and use them in program design.	L1, L2
3	Understand the concepts of declarative programming paradigms through functional and logic programming.	L1, L2
4	Design and Develop programs based on declarative programming paradigm using functional and/or logic programming.	L5, L6
5	Understand the role of concurrency in parallel and distributed programming.	L1, L2
6	Understand different application domains for use of scripting languages.	L1. L2

Prerequisite: Students must have learned C Programming (FEC205 and FEL204),

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Compilation and interpretation Focus on overview of compilation steps.	**02**	CO1
I	Introduction to Programming Paradigms and Core Language Design Issues	Introduction to different programming paradigms. Names, Scopes, and Bindings, Scope Rules, Storage Management. Type Systems, Type Checking, Equality Testing and Assignment. Subroutine and Control Abstraction: Stack Layout, Calling sequence, parameter passing Generic subroutines and modules. Exception handling, Coroutines and Events. **Self-Learning Topic:** Implementation of basic concepts using programming language.	**10**	CO1
II	Imperative Paradigm: Data Abstraction in Object Orientation	Grouping of data and Operations- Encapsulation, Overloading, Polymorphism, Inheritance, Initialization and Finalization, Dynamic Binding. **Self-Learning Topic:** Implementation of OOP concepts using preferrably C++ and Java language.	**05**	CO2
III	Declarative Programming Paradigm: Functional Programming	Introduction to Lambda Calculus, Functional Programming Concepts, Evaluation order, Higher order functions, I/O-Streams and Monads. **Self-Learning Topic:** Implementation of programs using functional programming Language Haskel can refer to hacker rank website for problem statements.	**07**	CO3, CO4
IV	Declarative Programming Paradigm: Logic Programming	Logic Programming with PROLOG - Resolution and Unification, Lists, Arithmetic execution order, imperative control flow, database manipulation, PROLOG facilities and deficiencies. **Self-Learning Topic:** Identification of different application domains for use of Prolog and Logic programming	**06**	CO3, CO4
V	Alternative Paradigms: Concurrency	Concurrent Programming Fundamentals, Implementing synchronisation, Message Passing - Background and Motivation, Multithreaded programs, Communication and Synchronization, Language and Libraries, Thread creation Syntax. **Self-Learning Topic:** Study Implementation of concurrency concepts for real time application.	**04**	CO5
VI	Alternative Paradigms: Scripting Languages	Common characteristics, Different Problem domains for using scripting,Use of scripting in Web development–server and clients side scripting, Innovative features of scripting languages - Names and Scopes, string and pattern manipulation, data types, object orientation.	**05**	CO6

		Self-Learning Topic: Review small client server application code in any scripting language to realise applicability of features learned in Module.		

Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
3. Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia, 1996.

References:

1. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition) (February 2, 2016)
2. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000
3. Rajkumar Buyya, Object-oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited
4. Max Bramer, Logic Programming with Prolog, Springer ISBN-13: 978-1852-33938-8

Online References:

Sr No	Website Name	Link
1	Principles of programming Languages (Videos)	https://nptel.ac.in/courses/106/102/106102067/
2	Edx course Paradigms of Computer Programming – Fundamentals	https://www.classcentral.com/course/edx-paradigms-of-computer-programming-fundamentals-2298
3	Udemy Couses	https://www.udemy.com

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

► Question paper format

- Question Paper will comprise of a total of six questions each carrying 20 marks Q.1 will be compulsory and should cover maximum contents of the syllabus.
- Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of four questions need to be answered

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL301	Data Structure Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL301	Data Structure Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To use data structures as the introductory foundation for computer automation to engineering problems.
2	To use the basic principles of programming as applied to complex data structures.
3	To learn the principles of stack, queue, linked lists and its various operations.
4	To learn fundamentals of binary search tree, implementation and use of advanced tree like AVL, B trees and graphs.
5	To learn about searching, hashing and sorting.
6	To learn the applications of linked lists, stacks, queues, trees and graphs.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and use the basic concepts and principles of various linked lists, stacks and queues.	L1, L2, L3
2	Understand the concepts and apply the methods in basic trees.	L1, L2
3	Use and identify the methods in advanced trees.	L3, L4
4	Understand the concepts and apply the methods in graphs.	L2, L3
5	Understand the concepts and apply the techniques of searching, hashing and sorting	L2, L3
6	Illustrate and examine the methods of linked lists, stacks, queues, trees and graphs to various real time problems	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	Turbo/Borland C complier

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Introduction of C programming language.	**02**	----
I	Stacks, Queues and Linked Lists	• Array Implementation of Stack and Queue. • Insertion, deletion operations with Singly linked lists • Insertion, deletion operations Doubly linked lists • Insertion, deletion operations Circular linked lists. • Reversing a singly linked list. • *** Linked List implementation of Stack and Queue**	**04**	LO 1
II	Trees	• *** Implementation of operations (insertion, deletion, counting of nodes, counting of leaf nodes etc.) in a binary search tree.** • Implementation of insertion, deletion and traversal for fully in-threaded binary search tree.	**04**	LO 2
III	Advanced Trees	• *** Implementation of AVL tree.** • Implementation of operations in a B tree.	**04**	LO 3
IV	Graphs	• Implementation of adjacency matrix creation. • Implementation of addition and deletion of edges in a directed graph using adjacency matrix. • Implementation of insertion and deletion of vertices and edges in a directed graph using adjacency list. •	**04**	LO 4
V	Searching and Sorting	• Implementation of Heap Sort • Implementation of Binary Search. • Implementation of Selection sort, Bubble sort, Insertion sort, Quick sort	**04**	LO 5

VI	Applications of Data Structures	• *** Implementation of infix to postfix conversion and evaluation of postfix expression** • *** Implementation of Josephus Problem using circular linked list** • *** Implementation of traversal of a directed graph through BFS and DFS.** • Implementation of finding shortest distances using Dijkstra's algorithm • ***Implementation of hashing functions with different collision resolution techniques**	**04**	LO 6

Text Books:

1. S. K Srivastava, Deepali Srivastava; Data Structures through C in Depth; BPB Publications; 2011.
2. Yedidya Langsam, Moshej Augenstein, Aaron M. Tenenbaum; Data Structure Using C & C++; Prentice Hall of India; 1996.
3. Reema Thareja; Data Structures using C; Oxford.

References:

1. Ellis Horowitz, Sartaj Sahni; Fundamentals of Data Structures; Galgotia Publications; 2010.
2. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGrawHill; 1984.
3. Rajesh K. Shukla; Data Structures using C and C++; Wiley India; 2009.

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL302	SQL Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL302	SQL Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To identify and define problem statements for real life applications
2	To construct conceptual data model for real life applications
3	To Build Relational Model from ER/EER and demonstrate usage of relational algebra.
4	To Apply SQL to store and retrieve data efficiently
5	To implement database connectivity using JDBC
6	To understand the concepts of transaction processing- concurrency control & recovery procedures.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define problem statement and Construct the conceptual model for real life application.	L1, L3, L4, L6
2	Create and populate a RDBMS using SQL.	L3, L4
3	Formulate and write SQL queries for efficient information retrieval	L3, L4
4	Apply view, triggers and procedures to demonstrate specific event handling.	L1, L3, L4
5	Demonstrate database connectivity using JDBC.	L3
6	Demonstrate the concept of concurrent transactions.	L3, L4

Prerequisite: C Programming

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	Any SQL Compiler, Java Programming Language

DETAILED SYLLABUS:

Sr. No.	Detailed Content	Hours	LO Mapping
1.	Identify real world problem and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.	02	LO1
2.	Mapping ER/EER to Relational schema model.	02	LO1
3.	Create a database using DDL and apply integrity constraints.	02	LO2, LO3
4.	Perform data manipulations operations on populated database.	02	LO3
5.	Perform Authorization using Grant and Revoke.	02	LO2, LO3
6.	Implement Basic and complex SQL queries.	02	LO3, LO4
7.	Implementation of Views and Triggers.	02	LO4
8.	Demonstrate database connectivity using JDBC.	02	LO5
9.	Execute TCL commands.	02	LO4
10.	Implement functions and procedures in SQL	02	LO3, LO4
11.	Implementation of Cursor.	02	LO3, LO4
12.	Implementation and demonstration of Transaction and Concurrency control techniques using locks.	02	LO6

Text Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, ― Database Systems Design, Implementation and Management‖, Thomson Learning, 9th Edition.
2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : "Database Management Systems", McGraw – Hill

Term Work:

Term Work shall consist of at least 10 Practical's based on the above list, but not limited to. Also, Term work Journal must include at least 2 assignments:

The first assignment may be based on: Relational Algebra and Second may be based on Transactions

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL303	Computer programming Paradigms Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL303	Computer programming Paradigms Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Understand data abstraction and object orientation
2	Design and implement declarative programs in functional and logic programming languages
3	Introduce the concepts of concurrent program execution
4	Understand run time program management
5	Understand how to implement a programming solution using different programming paradigms.
6	Learn to compare implementation in different programming paradigms.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Implement Object Oriented concepts in C++.	L1, L2, L3
2	Design and Develop solution based on declarative programming paradigm using functional and logic programming.	L6
3	Understand the multi threaded programs in Java and C++	L1, L2
4	Understand the need and use of exception handling and garbage collection in C++ and JAVA	L2, L3
5	Implement a solution to the same problem using multiple paradigms.	L6
6	Compare the implementations in multiple paradigms at coding and	L4

	execution level.	

Prerequisite: Students must have learned C Programming (FEC205 and FEL204)

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	C++ compiler, Java Languge support, SWI Prolog, GHC Compiler.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Demonstrate Compilation and interpretation stages to students for C, C++, JAVA along with how to debug the code.	**02**	--
I	Imperative Paradigm: Data Abstraction in Object Orientation	At least two Programming Implementations Preferably in C++ to demonstrate concepts like - Encapsulation, Inheritance, Initialization and Finalization, Dynamic Binding.	**05**	LO1
II	Declarative Programming Paradigm: Functional Programming	• Tutorial Introduction to Haskell programming environment • Tutorial exercise on operators, types etc. in Haskell • At least 5 Haskell Programs to demonstrate Functional Programming Concepts. • Sample Programs but not limited to: ◦ Implement safetail function that behaves in the same way as tail, except that safetail maps the empty list to the empty list, whereas tail gives an error in this case. Define safetail using: (a) a conditional expression; (b) guarded equations; (c) pattern matching. Hint: the library function null :: [a]-> Bool can be used to test if a list is empty. ◦ Simple List Comprehension ◦ Higher-Order Functions ◦ Write recursive function to multiply two natural numbers that uses pre defined add funion. ◦ Implement the game of nim in Haskell to apply list processing. ◦ Haskell code to represent infinite list e.g. fibobacci series ◦ Implement simple Calculator Students should clearly understand the syntax and the execution of the Functional Implementation using Haskell.	**06**	LO2

III	Declarative Programming Paradigm: Logic Programming	• Tutorial Installation and working of SWI Prolog Environment • Implement at least 5 Prolog programs to understand declarative programming concepts. Students should clearly understand the syntax and the execution of the Prolog code Implementation.	**05**	LO2
IV	Alternative Paradigms: Concurrency	At least two Programs preferably in c++ and java to demonstrate Thread management and synchronization	**02**	LO4
V	Run Time Program Management	A Program to understand Exception handling and Garbage collection, preferably in C++ and JAVA Students should understand the syntactic differences in the solutions in both Object Oriented Languages.	**02**	LO4
VI	Programming Assignment For comparative study of Different Paradigms	At Least two implementations each implemented on multiple paradigms like procedural, object oriented, functional, logic. The implementations should be done in a group of two/three students with appropriate difficulty level. Student should prepare small report and present the solution code and demonstrate execution for alternative solutions they build.	**04**	LO5, LO6

Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition)
3. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016
4.

References:

1. Sethi R, Programming Languages Concepts and Constructs , 2nd Ed, Pearson Education
2. Yogesh Sajanikar, Haskell Cookbook, Packt Publishing, 2017

Online References:

Sr No	Website Description	Link
1	University Stuttgart Germany Lab Course on Programming Paradigms	http://software-lab.org/teaching/winter2019/pp/
2	Course at MIT Structure and Interpretation of Computer Programs [2019]	https://web.mit.edu/u/6.037
3	Edx Course Paradigms of Computer Programming – Fundamentals,	https://www.edx.org/course/paradigms-of-computer-programming-fundamentals
4	Tutorials point link for Haskel	https://www.tutorialspoint.com/haskell

Term Work: Term Work shall consist of at least 15 Practicals based on the above modules, but not limited to. Also, Term work Journal must include at least 3 tutorial reports and 01 report of programming assignment

as mentioned in module VI.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments/Tutorials) + 5 Marks (Assignment write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & 1 Hr Practical exam will be held based on the above syllabus

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL304	Java Lab (SBL)	--	04	--	--	02	--	02

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL304	Java Lab (SBL)	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand the concepts of object-oriented paradigm in the Java programming language.
2	To understand the importance of Classes & objects along with constructors, Arrays ,Strings and vectors
3	To learn the principles of inheritance, interface and packages and demonstrate the concept of reusability for faster development.
4	To recognize usage of Exception Handling, Multithreading, Input Output streams in various applications
5	To learn designing, implementing, testing, and debugging graphical user interfaces in Java using Swings and AWT components that can react to different user events.
6	To develop graphical user interfaces using JavaFX controls.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the fundamental concepts of Java Programing.	L1, L2
2	Use the concepts of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem.	L3
3	Demonstrate how to extend java classes and achieve reusability using Inheritance, Interface and Packages.	L3
4	Construct robust and faster programmed solutions to problems using concept of Multithreading, exceptions and file handling	L3
5	Design and develop Graphical User Interface using Abstract Window Toolkit and Swings along with response to the events.	L6
6	Develop Graphical User Interface by exploring JavaFX framework based on MVC architecture.	L6

Prerequisite: Basics of Computer Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 2 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. JDK 1.8 or higher 3. Notepad ++ 4.JAVA IDEs like Netbeans or Eclipse	1. Internet Connection for installing additional packages if required

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basics of Computer Programming.	**02**	-
I	Java Fundamentals	**Overview of procedure and object oriented Programming**, Java Designing Goals and Features of Java Language. **Introduction to the principles of object-oriented programming**: Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism. Keywords, Data types, Variables, Operators, Expressions, Types of variables and methods. **Control Statements**: If Statement, If-else, Nested if, switch Statement, break, continue. **Iteration Statements:** for loop, while loop, and do-while loop (Perform any 2 programs that covers Classes, Methods, Control structures and Looping statements) 1) Implement a java program to calculate gross salary & net salary taking the following data. Input: empno, empname, basic Process: DA=70% of basic HRA=30% of basic CCA=Rs240/- PF=10% of basic PT= Rs100/- 2) Five Bikers Compete in a race such that they drive at a constant speed which may or may not be the same as the other. To qualify the race, the speed of a racer must be more than the average speed of all 5 racers. Write a Java program to take as input the speed of each racer and print back the speed of qualifying racers. 3) Write a Java program that prints all real solutions to the quadratic equation $ax^2+bx+c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate b^2-4ac is negative, display a message stating that there are no real solutions? 4) Write a Menu driven program in java to implement simple banking application. Application should read	**07**	LO1

		the customer name, account number, initial balance, rate of interest, contact number and address field etc. Application should have following methods. 1. createAccount() 2. deposit() 3. withdraw() 4. computeInterest() 5. displayBalance() 5)Write a menu driven Java program which will read a number and should implement the following methods 1. factorial() 2. testArmstrong() 3. testPalindrome() 4. testPrime() 5. fibonacciSeries() 6) Create a Java based application to perform various ways of Method overloading.		
II	Classes, objects, Arrays and Strings	**Classes & Objects**: Reference Variables, Passing parameters to Methods and Returning parameters from the methods, Static members, Non-Static members Nested and Inner Classes. Static Initialization Block(SIB), Instance Initialization Block(IIB) **Constructors**: Parameterized Constructors, chaining of constructor, finalize() Method, Method overloading, Constructors Overloading. Recursion, Command-Line Arguments. Wrapper classes, InputBufferReader, OutputBufferReader, String Buffer classes, String functions. **Arrays & Vectors**: One and Two Dimensional arrays, Irregular arrays, dynamic arrays, Array List and Array of Object. (Perform any 3 programs that covers Classes & objects, Constructors, Command Line Arguments, Arrays/Vectors,String function and recursions). **Experiments:** 1) Write a program that would print the information (name, year of joining, salary, address) of three employees by creating a class named 'Employee'. The output should be as follows: Name Year of joining Address Robert 1994 64C- WallsStreat Sam 2000 68D- WallsStreat John 1999 26B- WallsStreat 2) Write a program to print the area of a rectangle by creating a class named 'Area' having two methods. First method named as 'setDim' takes length and breadth of rectangle as parameters and the second method named as 'getArea' returns the area of the rectangle. Length and breadth of rectangle are entered through keyboard. 3) Write a Java program to illustrate Constructor Chaining.	**07**	LO1 LO2

		4) Create a class 'Student' with three data members which are name, age and address. The constructor of the class assigns default values name as "unknown", age as '0' and address as "not available". It has two members with the same name 'setInfo'. First method has two parameters for name and age and assigns the same whereas the second method takes has three parameters which are assigned to name, age and address respectively. Print the name, age and address of 10 students. Hint - Use array of objects. 5) Write a java programs to add n strings in a vector array. Input new string and check whether it is present in the vector. If it is present delete it otherwise add it to the vector. 6) Print the sum, difference and product of two complex numbers by creating a class named 'Complex' with separate methods for each operation whose real and imaginary parts are entered by user. 7)Write menu driven program to implement recursive Functions for following tasks. a) To find GCD and LCM b) To print n Fibonacci numbers c) To find reverse of number d) To solve 1 +2+3+4+.....+(n- l)+n 8) Print Reverse Array list in java by writing our own function.		
III	Inheritance, Packages and Interfaces.	**Inheritance**: Inheritance Basics, Types of Inheritance in Java, member access, using Super- to call superclass Constructor, to access member of super class(variables and methods), creating multilevel hierarchy, Constructors in inheritance, method overriding, Abstract classes and methods, using final, Dynamic Method Dispatch **Packages**: Defining packages, creating packages and Importing and accessing packages **Interfaces**: Defining, implementing and extending interfaces, variables in interfaces, Default Method in Interface ,Static Method in interface, Abstract Classes vs Interfaces. (Perform any 3 programs covering Inheritance, Interfaces and Packages). **Experiments** 1) Create a Teacher class and derive Professor/ Associate_Professor/Assistant_Professor class from Teacher class. Define appropriate constructor for all the classes. Also define a method to display information of Teacher. Make necessary assumptions as required. 2) Create a class Book and define a display method to display book information. Inherit Reference_Book and Magazine classes from Book class and override display method of Book class in Reference_Book and Magazine classes. Make necessary assumptions required.	**10**	LO1 LO3

3) A university has two types of students — graduate students and research students. The University maintains the record of name, age and programme of every student. For graduate students, additional information like percentage of marks and stream, like science, commerce, etc. is recorded; whereas for research students, additionally, specialization and years of working experience, if any, is recorded. Each class has a constructor. The constructor of subclasses makes a call to constructor of the superclass. Assume that every constructor has the same number of parameters as the number of instance variables. In addition, every subclass has a method that may update the instance variable values of that subclass. All the classes have a function display_student_info( ), the subclasses must override this method of the base class. Every student is either a graduate student or a research student.
Perform the following tasks for the description given above using Java :

(i) Create the three classes with proper instance variables and methods, with suitable inheritance.
(ii) Create at least one parameterised constructor for each class.
(iii) Implement the display_student_info( ) method in each class.

4) An employee works in a particular department of an organization. Every employee has an employee number, name and draws a particular salary. Every department has a name and a head of department. The head of department is an employee. Every year a new head of department takes over. Also, every year an employee is given an annual salary enhancement. Identify and design the classes for the above description with suitable instance variables and methods. The classes should be such that they implement information hiding. You must give logic in support of your design. Also create two objects of each class.

5) Consider a hierarchy, where a sportsperson can either be an athlete or a hockey player. Every sportsperson has a unique name. An athlete is characterized by the event in which he/she participates; whereas a hockey player is characterised by the number of goals scored by him/her.
Perform the following tasks using Java :
(i)Create the class hierarchy with suitable instance variables and methods.
(ii) Create a suitable constructor for each class.
(iii) Create a method named display_all_info with suitable parameters. This method should display all the information about the object of a class.
(iv) Write the main method that demonstrates polymorphism.

6) Create an interface vehicle and classes like bicycle,

		car, bike etc, having common functionalities and put all the common functionalities in the interface. Classes like Bicycle, Bike, car etc implement all these functionalities in their own class in their own way 7) Create a class "Amount In Words" within a user defined package to convert the amount into words. (Consider amount not to be more than 100000).		
IV	Exception Handling, Multithreading, Input Output streams	**Exception Handling:** Exception-Handling Fundamentals, Exception Types, Exception class Hierarchy, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally , Java's Built-in Exceptions, Creating Your Own Exception Subclasses **Multithreaded Programming:** The Java Thread Model and Thread Life Cycle, Thread Priorities, Creating a Thread, Implementing Runnable, Extending Thread, Creating Multiple Threads, Synchronization: Using Synchronized Methods, The synchronized Statement **I/O Streams:** Streams, Byte Streams and Character, The Predefined Streams, Reading Console Input, Reading Characters, Reading Strings, Writing Console Output, Reading and Writing Files. (Perform any 3 programs that cover Exception Handling, Multithreading and I/O Streams). **Experiments:** 1) Write java program where user will enter loginid and password as input. The password should be 8 digit containing one digit and one special symbol. If user enter valid password satisfying above criteria then show "Login Successful Message". If user enter invalid Password then create InvalidPasswordException stating Please enter valid password of length 8 containing one digit and one Special Symbol. 2) Java Program to Create Account with 1000 Rs Minimum Balance, Deposit Amount, Withdraw Amount and Also Throws LessBalanceException. It has a Class Called LessBalanceException Which returns the Statement that Says WithDraw Amount(_Rs) is Not Valid. It has a Class Which Creates 2 Accounts, Both Account Deposite Money and One Account Tries to WithDraw more Money Which Generates a LessBalanceException Take Appropriate Action for the Same. 3) Create two threads such that one thread will print even number and another will print odd number in an ordered fashion. 4) Assume that two brothers, Joe and John, share a common bank account. They both can, independently, read the balance, make a deposit, and withdraw some	**10**	LO1 LO3 LO4

		money. Implement java application demonstrate how the transaction in a bank can be carried out concurrently. 5) You have been given the list of the names of the files in a directory. You have to select Java files from them. A file is a Java file if it's name ends with ".java". For e.g. File- "Names.java" is a Java file, "FileNames.java.pdf" is not. **Input:** test.java, ABC.doc, Demo.pdf, add.java, factorial.java, sum.txt **Output:** tset.java, add.java, factorial.java		
V	GUI programming- I (AWT, Event Handling, Swing)	**Designing Graphical User Interfaces in Java**: Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features **Event-Driven Programming in Java**: Event-Handling Process, Event-Handling Mechanism, Delegation Modelof Event Handling, Event Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling. **Introducing Swing:** AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, TablesScroll pane Menus and Toolbar (Perform any 3 programs that contain AWT, Event handling and Swing to build GUI application). 1)Write a Java program to implement Swing components namely Buttons, ,JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars to design interactive GUI. 2) Write a program to create a window with four text fields for the name, street, city and pincode with suitable labels. Also windows contains a button MyInfo. When the user types the name, his street, city and pincode and then clicks the button, the types details must appear in Arial Font with Size 32, Italics. 3) Write a Java program to create a simple calculator using java AWT elements. .Use a grid layout to arrange buttons for the digits and basic operation +, -, /, *. Add a text felid to display the results. 4) Write a Java Program to create a Student Profile form using AWT controls. 5) Write a Java Program to simulate traffic signal light using AWT and Swing Components.	**12**	LO1 LO4 LO5

		6) Write a Java Program to create a color palette. Declare a grid of Buttons to set the color names. Change the background color by clicking on the color button. 7) Build a GUI program that allows the user to add objects to a collection and perform search and sort on that collection.(Hint. Use Swing components like JButton, JList, JFrame, JPanel and JOptionPane.)		
VI	GUI Programming-II (JavaFX)	JavaFX Basic Concepts, JavaFX application skeleton, Compiling and running JavaFX program,Simple JavaFX control:Label,Using Buttons and events, Drawing directly on Canvas. (Perform any one program that contains the concept of JavaFX). 1)Write a Java program to design a Login Form using JavaFX Controls. 2)Write Java program to draw various shapes on Canvas using JavaFX.	**04**	LO1 LO5 LO6

Text Books:

1. Herbert Schildt, "Java-The Complete Reference", Tenth Edition, Oracle Press, Tata McGraw Hill Education.
2. E. Balguruswamy, "Programming with Java A primer", Fifth edition, Tata McGraw Hill Publication
3. Anita Seth, B.L.Juneja, " Java One Step Ahead", oxford university press.

References:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press.
2. Learn to Master Java by Star EDU Solutions

3. Yashvant Kanetkar, "Let Us Java" ,4th Edition ,BPB Publications.

Term Work:

The Term work shall consist of at least 15 practical based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world applications which cover concepts from more than one modules of syllabus**.**

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM301	Mini Project – 1 A for Front end /backend Application using JAVA	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Program Structure for Second Year
Engineering Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ITC401	Engineering Mathematics-IV	3	--	1	3	--	1	4
ITC402	Computer Network and Network Design	3	--	--	3	--	--	3
ITC403	Operating System	3	--	--	3	--	--	3
ITC404	Automata Theory	3	--	--	3	--	--	3
ITC405	Computer Organization and Architecture	3	--	--	3	--	--	3
ITL401	Network Lab	--	2	--	--	1	--	1
ITL402	Unix Lab	--	2	--	--	1	--	1
ITL403	Microprocessor Lab	--	2	--	--	1	--	1
ITL404	Python Lab (SBL)	--	4	--	--	2	--	2
ITM401	Mini Project – 1 B for Python based automation projects	--	4[$]	--	--	2	--	2
Total		**15**	**14**	**1**	**15**	**7**	**1**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ITC401	Engineering Mathematics-IV	20	20	20	80	3	25	--	125
ITC402	Computer Network and Network Design	20	20	20	80	3	--	--	100
ITC403	Operating System	20	20	20	80	3	--	--	100
ITC404	Automata Theory	20	20	20	80	3	--	--	100
ITC405	Computer Organization and Architecture	20	20	20	80	3	--	--	100
ITL401	Network Lab	--	--	--	--	--	25	25	50
ITL402	Unix Lab	--	--	--	--	--	25	25	50
ITL403	Microprocessor Lab	--	--	--	--	--	25	25	50
ITL404	Python Lab (SBL)	--	--	--	--	--	25	25	50
ITM401	Mini Project – 1 B for Python based automation projects	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**75**	**775**

$ indicates work load of Learner (Not Faculty), for Mini Project. Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load : 1 hour per week per four groups

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC401	Engineering Mathematics-IV	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ITC401	Engineering Mathematics-IV	20	20	20	80	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution.

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To study Matrix algebra and its application in engineering problems.
2	To learn Line and Contour integrals and expansion of complex valued function in a power series.
3	To study Z-Transforms and Inverse Z-Transforms with its properties.
4	To acquaint with the concepts of probability distributions and sampling theory for small samples.
5	To study and apply Linear and Non-linear programming Techniques to solve the optimization problems

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply the concepts of eigen values and eigen vectors to solve engineering problems.	L1, L2, L3
2	Illustrate the use of concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.	L3
3	Apply the concept of Z- transformation and its inverse in engineering problems.	L1,L2,L3

4	Apply the concept of probability distribution to engineering problems & testing hypothesis of small samples using sampling theory.	L3
5	Apply the concept of Linear Programming to solve the optimization problems	L1, L2, L3
6	Use the Non-Linear Programming techniques to solve the optimization problems.	L3

Module	Detailed Contents	Hours	CO Mapping
01	**Module: Linear Algebra (Theory of Matrices)** 1.1 Characteristic Equation, Eigenvalues and Eigenvectors and properties (without proof) 1.2 Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials 1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices **Self-learning Topics:** Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	7	CO1
02	**Module: Complex Integration** 2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 2.2 Taylor's and Laurent's series (without proof). 2.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof) **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations.	7	CO2
03	**Module: Z Transform** 3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}, \{a^{\lvert k\rvert}\}, \{^{k+n}_{n}C.\, a^k\}, \{c^k \sin(\alpha k+\beta)\}, \{c^k \sinh \alpha k\}, \{c^k \cosh \alpha k\}$. 3.2 Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem. 3.3 Inverse Z transform: Partial Fraction Method, Convolution Method. **Self-learning Topics:** Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion	5	CO3
04	**Module: Probability Distribution and Sampling Theory** 4.1 Probability Distribution: Poisson and Normal distribution 4.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 4.3 Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table. **Self-learning Topics:** Test significance for Large samples, Estimate parameters of a population., Yate's Correction.	7	CO4
05	**Module: Linear Programming Problems**	6	

	5.1 Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method. 5.2 Artificial variables, Big-M method (Method of penalty) 5.3 Duality, Dual of LPP and Dual Simplex Method **Self-learning Topics: Sensitivity** Analysis, Two-Phase Simplex Method, Revised Simplex Method		CO5
06	**Module: Nonlinear Programming Problems** 6.1 NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers 6.2 NLPP with two equality constraints 6.3 NLPP with inequality constraint: Kuhn-Tucker conditions **Self-learning Topics:** Problems with two inequality constraints, Unconstrained optimization: One dimensional search method (Golden Search method, Newton's method). Gradient Search method	7	CO6

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
3. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
4. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
5. Operations Research: An Introduction, Hamdy A Taha, Pearson.
6. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.
7. Operations Research, Hira and Gupta, S. Chand Publication.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC402	Computer Network and Network Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC402	Computer Network and Network Design	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Understand the division of network functionalities into layers.
2	Understand the types of transmission media along with data link layer concepts, design issues and protocols
3	Analyze the strength and weaknesses of routing protocols and gain knowledge about IP addressing
4	Understand the data transportation, issues and related protocols for end to end delivery of data.
5	Understand the data presentation techniques used in presentation layer & client/server model in application layer protocols.
6	Design a network for an organization using networking concepts

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the functionalities of each layer of the models and compare the Models.	L1
2	Categorize the types of transmission media and explain data link layer concepts, design issues and protocols.	L2, L3, L4
3	Analyze the routing protocols and assign IP address to networks.	L4
4	Explain the data transportation and session management issues and related protocols used for end to end delivery of data.	L1, L2
5	List the data presentation techniques and illustrate the client/server model in application layer protocols.	L1, L3
6	Use of networking concepts of IP address, Routing, and application services to design a network for an organization	L3

Prerequisite: PCOM

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Terminologies of communication	**02**	-
I	**Introduction to Computer Networks**	Uses Of Computer Networks, Network Hardware, Network Software, Protocol Layering, Reference Models: OSI, TCP/IP, Comparison of OSI & TCP/IP, Network Devices. **Self-learning Topics:** Identify the different devices used in Network connection. College campus	**03**	CO1
II	**Physical Layer & Data Link Layer**	**Physical layer:** Guided Media, Unguided Media, Wireless Transmission: Electromagnetic Spectrum. Switching: Circuit-Switched Networks, Packet Switching, Structure Of A Switch **DLL Design Issues** (Services, Framing, Error Control, Flow Control), Error Detection and Correction(Hamming Code,Parity, CRC, Checksum) , Elementary Data Link protocols : Stop and Wait, Sliding Window(Go Back N, Selective Repeat), Piggybacking, HDLC **Medium Access Protocols:** Random Access, Controlled Access, Channelization. Ethernet Protocol: Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10-Gigabit Ethernet. **Self-learning Topics:** Differentiate link layer in IOT network and Normal Network.	**08**	CO2
III	**Network Layer**	Network Layer Services, Packet Switching, Network Layer Performance, IPv4 Addressing (classful and classless), Subnetting, Supernetting ,IPv4 Protocol, DHCP, Network Address Translation (NAT). **Routing algorithms**: Distance Vector Routing, Link state routing,Path Vector Routing. **Protocols** –RIP,OSPF,BGP. **Next Generation IP:** IPv6 Addressing,IPv6 Protocol, Transition fromIPV4 to IPV6 **Self-learning Topics:** Study difference between IPV4 and IPV6. Network Class A, B, C, D, E and subnet mask.	**08**	CO3

IV	**Transport Layer & Session Layer**	**Transport Layer:** Transport Layer Services, Connectionless & Connection-oriented Protocols, Transport Layer protocols: User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers. **Session Layer:** Session layer design issues, Session Layer protocol - Remote Procedure Call (RPC), **Self-learning Topics:** List real time example of UDP and TCP.	**07**	CO4
V	**Presentation Layer & Application Layer**	**Presentation layer** :Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Image Compression – GIF,JPEG. **Application layer:** Standard Client-Server Protocols: World Wide Web, HTTP, FTP, Electronic Mail, Domain Name System (DNS), SNMP **Self-learning Topics:** Difference between HTTP and FTP Protocol.	**05**	CO5
VI	**Network Design Concepts**	Introduction to VLAN ,VPN A case study to design a network for an organization meeting the following guidelines: Networking Devices, IP addressing: Subnetting, Supernetting, Routing Protocols to be used, Services to be used: TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server. **Self-learning Topics:** Study the Network Design of your college campus.	**06**	CO6

Text Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.
2. Behrouz A. Forouzan, Data Communications and Networking ,4th Edition,Mc Graw Hill education.

References:

1. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
2.B. A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill edition, Third Edition.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGrawHill , Second Edition.
4. Khalid Sayood, Introduction to Data Compression, Third Edition, Morgan Kaufman.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org/

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC403	Operating System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC403	Operating System	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the major components of Operating System &its functions.
2	To introduce the concept of a process and its management like transition, scheduling, etc.
3	To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4	To understand the concepts and implementation of memory management policies and virtual memory.
5	To understand functions of Operating System for storage management and device management.
6	To study the need and fundamentalsof special-purpose operating system with the advent of new emerging technologies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts related to Operating System.	L1, L2
2	Describe the process management policies and illustrate scheduling of processes by CPU.	L1
3	Explain and apply synchronization primitives and evaluate deadlock conditionsas handled by Operating System.	L2
4	Describe and analyze the memory allocation and management functions of Operating System.	L1
5	Analyze and evaluate the services provided by Operating System for storage management.	L4, L5
6	Compare the functions of various special-purpose Operating Systems.	L2

Prerequisite: Programming Language C

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Programming Language C; Basic of Hardware i.e. ALU, RAM, ROM, HDD, etc.; Computer-System Organization.	**02**	-
I	Fundamentals of Operating System	Introduction to Operating Systems; Operating System Structure and Operations; Functions of Operating Systems; Operating System Services and Interface; System Calls and its Types; System Programs; Operating System Structure; System Boot. **Self-learning Topics:** Study of any three different OS. System calls with examples for different OS.	**03**	CO1
II	Process Management	Basic Concepts of Process; Operation on Process; Process State Model and Transition; Process Control Block; Context Switching; Introduction to Threads; Types of Threads, Thread Models; Basic Concepts of Scheduling; Types of Schedulers; Scheduling Criteria; Scheduling Algorithms. **Self-learning Topics:** Performance comparison of Scheduling Algorithms, Selection of Scheduling Algorithms for different situations, Real-time Scheduling	**06**	CO2
III	ProcessCoordination	Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Classic Problems of Synchronization; Message Passing; Introduction to Deadlocks; System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance. **Self-learning Topics:** Study a real time case study for Deadlock detection and recovery.	**09**	CO3
IV	Memory Management	Basic Concepts of Memory Management; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation; Basic Concepts of Virtual Memory; Demand Paging, Copy-on Write; Page Replacement Algorithms; Thrashing. **Self-learning Topics:** Memory Management for any one Operating System, Implementation of Page Replacement Algorithms.	**09**	CO4

V	Storage Management	Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass-Storage Structure; Disk Structure; Disk Scheduling; RAID Structure; Introduction to I/O Systems. **Self-learning Topics:** File System for Linux and Windows, Features of I/O facility for different OS.	**06**	CO5
VI	Special-purpose Operating Systems	Open-source and Proprietary Operating System; Fundamentals of Distributed Operating System; Network Operating System;Embedded Operating Systems;Cloud and IoT Operating Systems; Real-Time Operating System;Mobile Operating System; Multimedia Operating System;Comparison between Functions of various Special-purpose Operating Systems. **Self-learning Topics:** Case Study on any one Special-purpose Operating Systems.	**04**	CO6

Text Books:

1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.

Reference Books:

1. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
2. A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson.
3. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 1st ed., 2018.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC404	Automata Theory	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC404	Automata Theory	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn fundamentals of Regular and Context Free Grammars and Languages.
2	To understand the relation between Regular Language and Finite Automata and machines.
3	To learn how to design Automata's as Acceptors, Verifiers and Translators.
4	To understand the relation between Regular Languages, Contexts free Languages, PDA and TM.
5	To learn how to design PDA as acceptor and TM as Calculators.
6	To learn applications of Automata Theory.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain, analyze and design Regular languages, Expression and Grammars.	L2, L4, L6
2	Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.	L6
3	Analyze and design Context Free languages and Grammars.	L4, L6
4	Design different types of Push down Automata as Simple Parser.	L6
5	Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine.	L6
6	Develop understanding of applications of various Automata.	L6

Prerequisite: Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping

0	Prerequisite	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.	**02**	-
I	Introduction and Regular Languages	Languages: Alphabets and Strings. Regular Languages: Regular Expressions, Regular Languages, Regular Grammars, RL and LL grammars, Closure properties **Self-learning Topics:** Practice exercise on Regular Expressions. Identify the tools also.	**05**	CO1
II	Finite Automata	Finite Automata: FA as language acceptor or verifier, NFA (with and without ε) , DFA, RE to NFA, NFA to DFA, Reduced DFA , NFA-DFA equivalence, FA to RE. Finite State Machines with output : Moore and Mealy machines. Moore and Mealy M/C conversion. Limitations of FA. **Self-learning Topics:** Practice exercise on FA and NFA	**09**	CO2
III	Context Free Grammars	Context Free Languages: CFG, Leftmost and Rightmost derivations, Ambiguity, Simplification and Normalization (CNF & GNF) and Chomsky Hierarchy (Types 0 to 3) **Self-learning Topics:** Practice numerical or exercise on CFG	**08**	CO3
IV	Push Down Automata	Push Down Automata: Deterministic (single stack) PDA, Equivalence between PDA and CFG. Power and Limitations of PDA. **Self-learning Topics:** List the examples of PDA.	**05**	CO4
V	Turing Machine	Turing Machine: Deterministic TM, Variants of TM, Halting problem, Power of TM. **Self-learning Topics:** Practice numerical of TM.	**07**	CO5
VI	Applications of Automata	Applications of FA, CFG, PDA & TM. Introduction to Compiler & Its phases. **Self-learning Topics:** Case study on any one compiler.	**03**	CO2,CO 3, CO4,CO 5, CO6

Text books

1. J.C.Martin, “Introduction to languages and the Theory of Computation”, TMH.
2. Kavi Mahesh, “Theory of Computation A Problem Solving Approach”, Wiley India
3. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman , “Compilers Principles, Techniques and Tools “,Pearson Education.

References

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education.
2. Daniel I.A. Cohen, “Introduction to Computer Theory”, John Wiley & Sons.
3. Vivek Kulkarni,” Theory of Computation”, Oxford University.
4. N.Chandrashekhar, K.L.P. Mishra, “Theory of Computer Science, Automata Languages & Computations”, PHI publications.
5.J. J. Donovan, “ Systems Programming”, TMH.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://online.stanford.edu
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**

- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

- A total of **four questions** need to be answered

.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC405	Computer Organization and Architecture	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITC405	Computer Organization and Architecture	20	20	20	80	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Learn the fundamentals of Digital Logic Design.
2	Conceptualize the basics of organizational and features of a digital computer.
3	Study microprocessor architecture and assembly language programming.
4	Study processor organization and parameters influencing performance of a processor.
5	Analyse various algorithms used for arithmetic operations.
6	Study the function of each element of memory hierarchy and various data transfer techniques used in digital computer.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate the fundamentals of Digital Logic Design	L1, L2
2	Describe basic organization of computer, the architecture of 8086 microprocessor and implement assembly language programming for 8086 microprocessors.	L1
3	Demonstrate control unit operations and conceptualize instruction level parallelism.	L1, L2
4	List and Identify integers and real numbers and perform computer arithmetic operations on integers.	L1,L4
5	Categorize memory organization and explain the function of each element of a memory hierarchy.	L4
6	Examine different methods for computer I/O mechanism.	L3

Prerequisite: Basics of Electrical Engineering, Fundamentals of Computer.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basics of Electrical Engineering, Fundamentals of Computer	**02**	
I	**Fundamentals of Logic Design**	Number systems: Introduction to Number systems, Binary Number systems, Signed Binary Numbers, Binary, Octal, Decimal and Hexadecimal number and their conversions, 1's and 2's complement Combinational Circuits: NOT,AND,OR,NAND,NOR,EX-OR,EX-NOR Gates. Half & Full Adder and subtractor, Reduction of Boolean functions using K-map method (2,3,4 Variable), introduction to Multiplexers and Demultiplexers, Encoders & Decoders. Sequential Circuits: Introduction to Flip Flops: SR, JK, D, T, master slave flip flop, Truth Table. **Self-learning Topics:** Number System, Quine-McCluskey,Flip-Flop conversion, Counter Design.	**07**	CO1
II	**Overview of Computer Architecture & Organization**	Introduction of Computer Organization and Architecture. Basic organization of computer and block level description of the functional units. Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture, Amdahl's Law Architecture of 8086 Family, Instruction Set, Addressing Modes, Assembler Directives, Mixed-Language Programming, Stack, Procedure, Macro. **Self-learning Topics:** Interfacing of I/O devices with 8086(8255,ADC,DAC).	**08**	CO2
III	**Processor Organization and Architecture**	CPU Architecture, Instruction formats, basic instruction cycle with Interrupt processing. Instruction interpretation and sequencing. Control Unit: Soft wired (Microprogrammed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nano programming. Introduction to parallel processing concepts, Flynn's classifications, instruction pipelining, pipeline hazards. **Self-learning Topics**: Study the examples on instruction pipelining for practice.	**07**	CO3
IV	**Data Representation and Arithmetic Algorithms**	Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, basics of floating-point representation IEEE 754 floating point (Single & double precision) number representation. **Self-learning Topics:** Implement Booth's Algorithm and Division methods.	**04**	CO4
V	**Memory Organization**	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics. Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory	**07**	CO5

		Self-learning Topics: Case study on Memory Organization, Numerical on finding EAT, Address mapping.		
VI	**I/O Organization**	Input/output systems, I/O module-need & functions and Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA **Self-learning Topics:** Comparison of all I/O methods.	**04**	CO6

Text Books:

1. R. P. Jain,"Modern Digital Electronics", TMH
2. M. Morris Mano,"Digital Logic and Computer Design", PHI
3. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, Fifth Edition, Tata McGraw-Hill.
4. William Stallings, Computer Organization and Architecture: Designing for Performance, Eighth Edition,, Pearson
5. John Uffenbeck, 8086/8088 family: Design Programming and Interfacing, (Pearson Education

References:

1. A. Anand Kumar, "Fundamentals of Digital Circuits",. PHI
2. Donald P Leach, Albert Paul Malvino, "Digital Principals & Applications", TMH.
3. B. Govindarajulu,, Computer Architecture and Organization: Design Principles and Applications, Computer Architecture and Organization: Design Principles and Applications, Tata McGraw-Hill
4. Dr. M. Usha, T. S. Srikanth, Computer System Architecture and Organization, First Edition, Wiley-India.
5. John P. Hayes, Computer Architecture and Organization, Third Edition., McGraw-Hill
6. K Bhurchandi, Advanced Microprocessors & Peripherals, Tata McGraw-Hill Education

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.geeksforgeeks.org
3.	https://www.coursera.org/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL401	Network Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL401	Network Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To get familiar with the basic network administration commands
2	To install and configure network simulator and learn basics of TCL scripting.
3	To understand the network simulator environment and visualize a network topology and observe its performance
4	To implement client-server socket programs.
5	To observe and study the traffic flow and the contents of protocol frames.
6	To design and configure a network for an organization

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Execute and evaluate network administration commands and demonstrate their use in different network scenarios	L3, L5
2	Demonstrate the installation and configuration of network simulator.	L1, L2
3	Demonstrate and measure different network scenarios and their performance behavior.	L1, L2
4	Implement the socket programming for client server architecture.	L3
5	Analyze the traffic flow of different protocols	L4
6	Design a network for an organization using a network design tool	L6

Prerequisite: C /Java

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	NS2.34, Protocol Analyzer (eg. Wireshark), C/Java/python

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Programming Language (C/Java), Basic commands of windows and Unix/Linux operating system. editor commands (eg nano/vi editor etc)	**02**	-
I	**Fundamentals of Computer Network**	Understanding Basic networking Commands: ifconfig ,ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, hostname, curl or wget, mtr, whois, tcpdump • Execute and analyze basic networking commands.	**02**	LO1
II	**Basics of Network simulation**	Installation and configuration of NS2. Introduction to Tcl Hello Programming • Installation and configuring of NS-2 simulator and introduction to Tcl using Hello program	**02**	LO2
III	**Simulation of Network Topology with different Protocols**	Implementation of Specific Network topology with respect to 1. Number of nodes and physical layer configuration 2. Graphical simulation ofnetwork with RoutingProtocols(Distance Vector/ Link State Routing) and trafficconsideration (TCP, UDP)using NAM. 3. Analysis of networkperformance for quality ofservice parameters such aspacket-delivery-ratio, delayand throughput 4. Comparative analysis of routing protocols with respect to QOS parametersusing Xgraph/gnuplot fordifferent load conditions. • Write TCL scripts to create topologies. Create and run traffics and analyze the result using NS2 • Write TCL scripts for topology with Graphical simulation of traffic consideration (TCP, UDP) using NAM and plot the graph • Implement distance vector and link state routing protocols in NS2.	**06**	LO3 LO5
IV	**Socket Programming**	Socket Programming with C/Java/python 1. TCP Client, TCP Server 2. UDP Client, UDP Server • To study and Implement Socket Programming using TCP.	**04**	LO4

		• To study and Implement Socket Programming using UDP		
V	**Protocol Analyzer**	1. Study of various Network Protocol Analyzer Tools likeWireshark, tcpdump, Windump, Microsoft Message Analyzer, Ettercap, Nirsoft SmartSniff etc. 2. Install one of the Network protocol analyzer tools and analyze the traffic • Study various network protocol analyzer tools and analyze the network traffics using one of the network protocol analyzer tools.	**04**	LO5
VI	**Network Design**	Network Design for an organization using the following concepts: 1. Addressing (IP Address Assignment), 2. Naming (DNS) 3. Routing • Perform remote login using Telnet Server • Design a network for an organization using the concepts of Addressing (IP Address Assignment), Naming (DNS) and Routing. Also mention the internetworking devices used	**06**	LO6

Text Books:

1. Computer Network Simulation in NS2 Basic Concepts and Protocol Implementation.-Prof Neeraj Bhargava,Pramod Singh Rathore,Dr.Ritu Bhargava,Dr.Abhishek Kumar, First Edition.BPB Publication.
2. Packet analysis with Wire shark, Anish Nath, PACKT publishing
3. TCP/IP Protocol Suite 4th Edition by Behrouz A. Forouzan

References:

1. NS2.34 Manual
2. Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems by Chris Sanders

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL402	Unix Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL402	Unix Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand architecture and installation of Unix Operating System
2	To learn Unix general purpose commands and programming in Unix editor environment
3	To understand file system management and user management commands in Unix.
4	To understand process management and memory management commands in Unix
5	To learn basic shell scripting.
6	To learn scripting using awk and perl languages.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the architecture and functioning of Unix	L1, L2
2	Identify the Unix general purpose commands	L4
3	Apply Unix commands for system administrative tasks such as file system management and user management.	L3
4	Execute Unix commands for system administrative tasks such as process management and memory management	L4
5	Implement basic shell scripts for different applications.	L3
6	Implement advanced scripts using awk & perl languages and grep, sed, etc. commandsfor performing various tasks.	L3

Prerequisite: Programming Language C

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	Unix, Editor, Bash shell, Bourne shell and C shell

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic Programming Skills, Concepts of Operating System	**02**	-
I	Introduction to Unix	Case Study: Brief History of UNIX, Unix Architecture; Installation of Unix Operating System	**03**	LO1
II	Basic Commands	a) Execution of Unix General Purpose Utility Commands like echo, clear, exit, date, time, uptime, cal, cat, tty, man, which, history, id, pwd, whoami, ping, ifconfig, pr, lp, lpr, lpstat, lpq, lprm, cancel, mail, etc. b) Working with Editor Vi/other editor.	**03**	LO2
III	Commands for File System Management and User Management	a) Study of Unix file system (tree structure), file and directory permissions, single and multiuser environment. b) Execution of File System Management Commands like ls, cd, pwd, cat, mkdir, rmdir, rm, cp, mv, chmod, wc, piping and redirection, grep, tr, echo, sort, head, tail, diff, comm, less, more, file, type, wc, split, cmp, tar, find, vim, gzip, bzip2, unzip, locate, etc. c) Execution of User Management Commands like who, whoami, su, sudo, login, logout, exit, passwd, useradd/adduser, usermod, userdel, groupadd, groupmod, groupdel, gpasswd, chown, chage, chgrp, chfn, etc.	**04**	LO3
IV	Commands for Process Management and Memory Management	a) Execution of Process Management Commands like ps, pstree, nice, kill, pkill, killall, xkill, fg, bg, pgrep, renice, etc. b) Execution of Memory Management Commands like free, /proc/meminfo, top, htop, df, du, vmstat, demidecode, sar, pagesize, etc.	**04**	LO4
V	Basic Scripts	a) Study of Shell, Types of Shell, Variables andOperators b) Execute the following Scripts (at least 6): (i) Write a shell script to perform arithmetic operations. (ii) Write a shell script to calculate simple interest. (iii) Write a shell script to determine largest among three integer numbers. (iv) Write a shell script to determine a given year is leap year or not. (v) Write a shell script to print multiplication table of given number using while statement.	**04**	L02, L03, L05

		(vi) Write a shell script to search whether element is present is in the list or not. (vii) Write a shell script to compare two strings. (viii) Write a shell script to read and check if the directory / file exists or not, if not make the directory / file. (ix) Write a shell script to implement menu-driven calculator using case statement. (x) Write a shell script to print following pattern: * * * * * * * * * * (xi) Write a shell script to perform operations on directory like: display name of current directory; display list of directory contents; create another directory, write contents on that and copy it to a suitable location in your home directory; etc.		
VI	Advanced Scripts	a) Execute the following scripts using grep / sed commands: (i) Write a script using grep command to find the number of words character, words and lines in a file. (ii) Write ascriptusing egrep command to display list of specific type of files in the directory. (iii) Write a script using sed command to replace all occurrences of particular word in given a file. (iv) Write a script using sedcommand to print duplicated lines in input. b) Execute the following scripts using awk / perl languages: (i) Write an awk script to print all even numbers in a given range. (ii) Write an awk script to develop a Fibonacci series (take user input for number of terms). (iii) Write a perl script to sort elements of an array. (iv) Write a perl script to check a number is prime or not.	**06**	LO2, L03, L06

Text Books:

1. S. Das, Unix Concepts and Applications, 4th ed., McGraw Hill, 2017.
2. R. Michael, Mastering Unix Shell Scripting, 2nd ed., Wiley, 2008.
3. D. Ambawade, D. Shah, Linux Labs and Open Source Technologies, Dreamtech Press, 2014.

References:

1. Y. Kanetkar, Unix Shell Programming, BPB Publications, 2003.
2. B. Forouzan and R. Gilberg, Unix and Shell Programming, Cengage Learning, 2003.

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL403	Microprocessor Lab	--	02	--	--	01	--	01

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL403	Microprocessor Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Learn assembling and disassembling of PC
2	Design, simulate and implement different digital circuits
3	Get hands on experience with Assembly Language Programming.
4	Study interfacing of peripheral devices with 8086 microprocessor.
5	Realize techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.
6	Write and debug programs in TASM/MASM/hardware kits

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate various components and peripheral of computer system	L2
2	Analyze and design combinational circuits	L4, L6
3	Build a program on a microprocessor using arithmetic & logical instruction set of 8086.	L3
4	Develop the assembly level programming using 8086 loop instruction set	L6
5	Write programs based on string and procedure for 8086 microprocessor.	L1
6	Design interfacing of peripheral devices with 8086 microprocessor.	L6

Prerequisite: Logic Design, Programming Languages(C, C++)

Hardware & Software Requirements:

NOTE: Programs can be executed on assembler or hardware boards.

Hardware Requirement:	**Software requirement:**
➢ Motherboard, RAM, Processor, Connectors, Cables, SMPS, HDD, Monitor, Graphics card (optional), and Cabinet. ➢ 8086 microprocessor experiment kits with specified interfacing study boards	➢ Microsoft Macro Assembler (TASM)/Turbo Assembler (TASM) ➢ Virtual simulator lab. ➢ Proteus design suite

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	PC Assembly	Study of PC Motherboard Technology (South Bridge and North Bridge), Internal Components and Connections used in computer system.	**02**	LO1
II	Implementation of combinational circuits	1. Verify the truth table of various logic gates (basic and universal gates) 2. Realize Half adder and Full adder 3. Implementation of MUX and DeMUX	**06**	LO2
III	Arithmetic and logical operations in 8086 Assembly language programming	1. Program for 16 bit BCD addition 2. Program to evaluate given logical expression. 3. Convert two digit Packed BCD to Unpacked BCD. (any two)	**05**	LO3
IV	Loop operations in 8086 Assembly language programming	1. Program to move set of numbers from one memory block to another. 2. Program to count number of 1's and 0's in a given 8 bit number 3. Program to find even and odd numbers from a given list 4. Program to search for a given number (any three)	**06**	LO4
V	String &Procedure in 8086 Assembly language programming	1. Check whether a given string is a palindrome or not. 2. Compute the factorial of a positive integer 'n' using procedure. OR Generate the first 'n' Fibonacci numbers.	**04**	LO5
VI	Interfacing with 8086 microprocessor	1. Interfacing Seven Segment Display 2. Interfacing keyboard matrix 3. Interfacing DAC (any one)	**03**	LO6

Text Books:

1. Scott Mueller, ”Upgrading and repairing PCs”, Pearson,
2. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill.
3. John Uffenbeck, “8086/8088 family: Design Programming and Interfacing:”Pearson Education

Reference Books:

1. M. Morris Mano, “Digital Logic and computer Design”, PHI
2. K Bhurchandi, “Advanced Microprocessors & Peripherals”, Tata McGraw-Hill Education

Term Work: Term Work shall consist of at least 10 to 12 practical’s based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Lab Code	Lab Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL404	Python Lab (SBL)	--	04	--	--	02	--	02

Lab Code	Lab Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITL404	Python Lab (SBL)	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Basics of python including data types, operator, conditional statements, looping statements, input and output functions in Python
2	List, tuple, set, dictionary, string, array and functions
3	Object Oriented Programming concepts in python
4	Concepts of modules, packages, multithreading and exception handling
5	File handling, GUI & database programming
6	Data visualization using Matplotlib, Data analysis using Pandas and Web programming using Flask

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the structure, syntax, and semantics of the Python language.	L1, L2
2	Interpret advanced data types and functions in python	L1, L2
3	illustrate the concepts of object-oriented programming as used in Python	L2
4	Create Python applications using modules, packages, multithreading and exception handling.	L6
5	Gain proficiency in writing File Handling programs ,also create GUI applications and evaluate database operations in python.	L1, L2
6	Design and Develop cost-effective robust applications using the latest Python trends and technologies	L6

Prerequisite: Structured Programming Approach & Java Programming Lab

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Dual core Processor or higher 2. Minimum 2 GB RAM 3. Minimum 40 GB Hard disk 4. Network interface card	1. Windows or Linux Desktop OS 2. Python 3.6 or higher 3. Notepad ++ 4.Python IDEs like IDLE, Pycharm, Pydev, Netbeans or Eclipse 5. Mysql	1. Internet Connection for installing additional packages if required

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Python IDE installation and environment setup.	**02**	
I	**Basics of Python**	Introduction, Features, Python building blocks – Identifiers, Keywords, Indention, Variables and Comments, Basic data types (Numeric, Boolean, Compound) Operators: Arithmetic, comparison, relational, assignment, logical, bitwise, membership, identity operators, operator precedence Control flow statements: Conditional statements (if, if…else, nested if) Looping in Python (while loop, for loop, nested loops) Loop manipulation using continue, pass, break. Input/output Functions, Decorators, Iterators and Generators.	**08**	LO 1
II	**Advanced data types & Functions**	Lists: a) Defining lists, accessing values in list, deleting values in list, updating lists b) Basic list operations c) Built-in list functions Tuples: a) Accessing values in Tuples, deleting values in Tuples, and updating Tuples b) Basic Tuple operations c) Built-in Tuple functions Dictionaries: a) Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary b) Basic Dictionary operations c) Built-in Dictionary functions Sets: a) Accessing values in Set, deleting values in Set, updating Sets b) Basic Set operations, c) Built-in Set functions Strings: a) String initialization, Indexing, Slicing, Concatenation, Membership & Immutability b) Built-in String functions Arrays: a) Working with Single dimensional Arrays: Creating, importing, Indexing, Slicing, copying and processing array arrays. b) Working with Multi-dimensional Arrays using Numpy: Mathematical operations, Matrix operations, aggregate and other Built-in functions	**09**	LO 1 LO 2

		Functions: a) Built-in functions in python b) Defining function, calling function, returning values, passing parameters c) Nested and Recursive functions d) Anonymous Functions (Lambda, Map, Reduce, Filter)		
III	**Object Oriented Programming**	Overview of Object-oriented programming, Creating Classes and Objects, Self-Variable, Constructors, Inner class, Static method, Namespaces. Inheritance: Types of Inheritance (Single, Multiple, Multi-level, Hierarchical), Super() method, Constructors in inheritance, operator overloading, Method overloading, Method overriding, Abstract class, Abstract method, Interfaces in Python.	**08**	LO 1 LO 3
IV	**Exploring concept of modules, packages, multithreading and exception handling**	Modules: Writing modules, importing objects from modules, Python built-in modules (e.g. Numeric and Mathematical module, Functional Programming module, Regular Expression module), Namespace and Scoping. Packages: creating user defined packages and importing packages. Multi-threading: process vs thread, use of threads, types of threads, creating threads in python, thread synchronization, deadlock of threads. Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, Assert statement, User-Defined Exceptions.	**06**	LO 1 LO 4
V	**File handling, GUI & database programming**	File Handling: Opening file in different modes, closing a file, writing to a file, accessing file contents using standard library functions, reading from a file – read (), readline (), readlines (), Renaming and Deleting a file, File Exceptions, Pickle in Python. Graphical user interface (GUI): different GUI tools in python (Tkinter, PyQt, Kivy etc.), Working with containers, Canvas, Frame, Widgets (Button, Label, Text, Scrollbar, Check button, Radio button, Entry, Spinbox, Message etc.) Connecting GUI with databases to perform CRUD operations. (on supported databases like SQLite, MySQL, Oracle, PostgreSQL etc.).	**09**	LO 1 LO 5
VI	**Data visualization, analysis and web programming using python**	Visualization using Matplotlib: Matplotlib with Numpy, working with plots (line plot, bar graph, histogram, scatter plot, area plot, pie chart etc.), working with multiple figures. Data manipulation and analysis using Pandas: Introduction to Pandas, importing data into Python, series, data frames, indexing data frames, basic operations with data frame, filtering, combining and merging data frames, Removing Duplicates. SciPy: Linear algebra functions using Numpy and Scipy. Web programming: Introduction to Flask, Creating a Basic Flask Application, Build a Simple REST API using Flask	**10**	LO 1 LO 6

List of Experiments/Mini-Project.

1)	Write python programs to understand a) Basic data types, Operators, expressions and Input Output Statements b) Control flow statements: Conditional statements (if, if…else, nested if) c) Looping in Python (while loop, for loop, nested loops) d) Decorators, Iterators and Generators.
2)	Write python programs to understand a) Different List and Tuple operations using Built-in functions b) Built-in Set and String functions c) Basic Array operations on 1-D and Multidimensional arrays using Numpy d) Implementing User defined and Anonymous Functions
3)	Write python programs to understand a) Classes, Objects, Constructors, Inner class and Static method b) Different types of Inheritance c) Polymorphism using Operator overloading, Method overloading, Method overriding, Abstract class, Abstract method and Interfaces in Python.
4)	Write python programs to understand a) Creating User-defined modules/packages and import them in a program b) Creating user defined multithreaded application with thread synchronization and deadlocks c) Creating a menu driven application which should cover all the built-in exceptions in python
5)	Write python programs to understand a) Different File Handling operations in Python b) Designing Graphical user interface (GUI) using built-in tools in python (Tkinter, PyQt, Kivy etc.). c) GUI database connectivity to perform CRUD operations in python (Use any one database like SQLite, MySQL, Oracle, PostgreSQL etc.)
6)	Write python programs to implement a) Different types of plots using Numpy and Matplotlob b) Basic operations using pandas like series, data frames, indexing, filtering, combining and merging data frames. c) Different Linear algebra functions using Scipy. d) A Basic Flask Application to build a Simple REST API.

- **Mini Project**

Mini-project have to be developed in a group of three students which should cover all above topics.
Suggested Mini-Project Topics:

1. Railway reservation system	27 IT Team Workspace	52. Business Directory	78. Practice Test Management.
2. Inventory Management system.	29 Job Requisition and Interview Management	53. Education Directory	79. Asset Management System
3 Classroom Management	28 Knowledge Base	54. Dental Clinic Management	80. Travel Agency System.
4 Clinical Trial Initiation and Management	29 Lending Library	55. Fund Raising Management	81. Placement Management System.

5 Competitive Analysis Web Site	30 Physical Asset Tracking and Management	56. Clinic/ Health Management	82. Polls Management
6 Discussion Forum website	31 Project Tracking Workspace	57. Cable Management System	83. Customer Management
7 Disputed Invoice Management	32. Shopping Cart .	58. Survey Creation and Analytics	84. Project Management System.
8 Employee Training Scheduling and Materials	33 Knowledge Base	59. Museum Management System	85. Network Marketing System
9 Equity Research Management	34 Lending Library	60. Multi-Level Marketing System	86. Yoga Health Care Management
10 Integrated Marketing Campaign Tracking	35 Physical Asset Tracking and Management	61. Learning Management System	87. Personal Finance Management System
11 Manufacturing Process Managements	36 Project Tracking Workspace	62. Knowledge Management System	88. Real Estate Management System
12 Product and Marketing Requirements Planning	37 Room and Equipment Reservations	63. Missing Person Site	89. Stock Mutual Funds Management
13 Request for Proposal Software	38 Sales Lead Pipeline	64. Disaster Management Site	90. Careers and Employment Management System
14 Sports League Management	39. Yellow Pages & Business Directory	65. Job Management Site	91. Music Albums Management System
15 Absence Request and Vacation Schedule Management	40. Time & Billing	66. Financial Portfolio Management	92. Classified Ads Managements
16 Budgeting and Tracking Multiple Projects	41. Class Room Management	67. Market Research Management	93. Property Management System
17 Bug Database Management	42. Expense Report Database	68. Order Management System	94. Sales & Retail Management
18 Call Center Management Software	43. Sales Contact Management Database	69. Point of Sale	95. Dating Site
19 Change Request Management	44. Inventory Management Database	70. Advertisement /Banner Management and Analytics	96. Hotel Management System
20 Compliance Process Support Site	45. Issue Database	71. Export Management System	97. Search Engine
21 Contacts Management Software	46. Event Management Database	72. Invoice Management	98. Online News Paper Site
22 Document Library and Review	47. Service Call Management Database	73. Recruitment Management System	99. Image Gallery
23 Event Planning and Management	48. Accounting Ledger Database	74. Articles / Blog / Wiki Web site	100. Staffing and Human Capital Management
24 Expense Reimbursement and Approval	49. Asset Tracking Database	75. Online Planner	101. Development of a feature-rich, practical Online Survey Tool (OST)
25 Help Desk and Ticket Management	50. Cycle Factory Works Management	76. Mock Tests and Examination Management	102 Development of a Web/Email based Search Engine
26 Inventory Tracking	51. Sales Corporation Management	77. Examination System	103. Development of a web-based Recruitment Process System for the HR group for a company

Text Books:

1. Dr. R. Nageswara Rao," Core Python Programming" , Dreamtech Press, Wiley Publication
2. M. T. Savaliya , R. K. Maurya, "Programming through Python", StarEdu Solutions.
3. E Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Publication.

References:

1. Zed A. Shaw, "Learn Python 3 the Hard Way", Zed Shaw's Hard Way Series.
2. Martin C. Brown," Python: The Complete Reference", McGraw-Hill Publication.
3. Paul Barry," Head First Python", 2nd Edition, O'Reilly Media, Inc.

Online resources:

1) https://docs.scipy.org/doc/numpy/user/quickstart.html
2) https://matplotlib.org/tutorials/
3) https://pandas.pydata.org/docs/getting_started/
4) https://www.geeksforgeeks.org/python-build-a-rest-api-using-flask/

Term Work:

The Term work shall consist of at least 15 practical based on the above list. The term work Journal must include at least 2 Programming assignments. The Programming assignments should be based on real world applications which cover concepts from more than one modules of syllabus**.**

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM401	Mini Project – 1 B for Python based automation projects	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM401	Mini Project – 1 B for Python based automation projects	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentalsto attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

AC 11.5.2017

Item No. 4.180

UNIVERSITYOFMUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Information Technology

Second Year with Effect from **AY 2017-18**

Third Year with Effect from **AY 2018-19**

Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Preamble

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.
Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.
Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.
The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.
I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.
I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Outcome for graduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

Chairman (Ad-hoc Board Information Technology)
University of Mumbai)

University of Mumbai

Program Structure B.E. Information Technology, (Rev. 2016)

T. E. Information Technology (Semester-V)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC501	Microcontroller and Embedded Programming	4	-	-	4	-	-	4
ITC502	Internet Programming	4	-	-	4	-	-	4
ITC503	Advanced Data Management Technology	4	-	-	4	-	-	4
ITC504	Cryptography & Network Security	4	-	-	4	-	-	4
ITDLO-I	Department Level Optional Course-I	4	-	-	4	-	-	4
ITL501	Internet Programming Lab	-	2	-	-	1		1
ITL502	Security Lab	-	2	-	-	1	-	1
ITL503	OLAP Lab	-	2	-	-	1	-	1
ITL504	IOT (Mini Project) Lab	-	2	-	-	1	-	1
ITL505	Business Communication and Ethics	-	2+2*	-	-	2	-	2
	Total	**20**	**14**	-	**20**	**7**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC501	Microcontroller and Embedded Programming	20	20	20	80	3	-		-	100
ITC502	Internet Programming	20	20	20	80	3	-		-	100
ITC503	Advanced Data Management Technology	20	20	20	80	3	-		-	100
ITC504	Cryptography & Network Security	20	20	20	80	3	-		-	100
ITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--		-	100
ITL501	Internet Programming Lab	-	-	-	-	-	25	--	25	50
ITL502	Security Lab	-	-	-	-	-	25	25	--	50
ITL503	OLAP Lab	-	-	-	-	-	25	25	--	50

ITL504	IOT (Mini Project) Lab	-	-	-	-	-	25	25	--	50
ITL505	Business Communication and Ethics	-	-	-	-	-	50	--	--	50
Total		100	100	100	400	-	150	75	25	750

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester V. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	**Department Level Optional Course** **(DLO)**
Semester V	
ITDLO5011	Advanced Data Structures & Analysis of Algorithms
ITDLO5012	Image Processing
ITDLO5013	E-Commerce & E-Business
ITDLO5014	IT Enabled Services
ITDLO5015	Computer Graphics & Virtual Reality

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC501	Microcontroller and Embedded Programming	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC501	Microcontroller and Embedded Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts and architecture of embedded systems
2. Basic of microcontroller 8051.
3. The concepts of microcontroller interface.
4. The concepts of ARM architecture
5. The concepts of real-time operating system
6. Different design platforms used for an embedded systems application

Course Outcomes: Students will be able to:

1. Explain the embedded system concepts and architecture of embedded systems
2. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.
3. Design the interfacing for 8051 microcontroller.
4. Understand the concepts of ARM architecture.
5. Demonstrate the open source RTOS and solve the design issues for the same.
6. Select elements for an embedded systems tool.

Prerequisite: COA, Microprocessors and Assembly Programming languages

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Revision of microcomputer system terminologies, High level, Machine level and Assembly level programming language , difference between microprocessor and microcontroller	02	

I	Introduction to Embedded systems	Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.	05	CO1
II	The Microcontroller Architecture and Programming of 8051:	Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts. Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR.	14	CO2
III	Interfacing with 8051Microcontroller	Interfacing ADC, DAC, Stepper motor, LCD, KBD matrix, 8255 PPI	06	CO3
IV	ARM 7 Architecture	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, Instruction set: Data processing, Data Transfer, Control flow. Addressing modes. Writing simple assembly language programs. Pipelining, Brief introduction to exceptions and interrupts handling.	10	CO4
V	Open source RTOS	Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matrix in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparative study.	07	CO5
VI	Introduction to Embedded target boards	Introduction to Arduino, Raspberry Pi, ARM Cortex, Intel Galileo etc. Open-source prototyping platforms. Basic Arduino programming; Extended Arduino libraries; Arduino-based Internet communication; Raspberry pi; ARM	08	CO6

		Cortex Processors; Intel Galileo boards; Sensors and Interfacing: Temperature, Pressure, Humidity		

Text Books:

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay ,"The 8051 microcontroller & Embedded systems Using Assembly and C", Pearson, 3rd edition
2. Embedded / real – time systems: concepts, design & programming, Black Book, Dr. K. V. K. K. Prasad, Dreamtech press, Reprint edition 2013
3. Shibu K. V., "Introduction to embedded systems", McGraw Hil

References:

1. Laya B. Das, "Embedded systems an integrated approach", Pearson, Third impression, 2013
2. Steve Furber, "ARM System on chip Architecture", Pearson, edition second
3. Michael Margolis, "Arduino Cookbook", O'reilly
4. Simon Monk," Raspberry Pi Cookbok", O'reilly
5. Raspberry Pi User Guide.
6. Massimo Banzi, "Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)", O'Reilly Media.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC502	Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC502	Internet Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1 To get familiar with basics of the Internet Programming.
2. To acquire knowledge and skills for creation of web site considering both client and server side programming
3. To gain ability to develop responsive web applications
4. To explore different web extensions and web services standards
5. To learn characteristics of RIA –Web Mashup Eco System
6. To be familiarized with Python web framework-Django.

Course Outcomes: Students will be able to:

1. Implement interactive web page(s) using HTML,CSS and JavaScript.
2. Design a responsive web site using HTML5 and CSS3.
3. Demonstrate Rich Internet Application .
4. Build Dynamic web site using server side PHP Programming and Database connectivity.
5. Describe and differentiate different Web Extensions and Web Services.
6. Demonstrate web application using Python web Framework-Django

Prerequisite: Basic Java Programming and Python Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Introduction to web technologies**: Introduction to OSI layers,	02	---
I	Client Side Programming :HTML, CSS and JavaScript	**Basic of HTML:** Web System architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators. Formatting and Fonts, Anchors, images, lists, tables, frames and forms. **Introduction to CSS**: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS. **Introduction to JavaScript:** JavaScript language constructs, Objects in JavaScript- Built in, Browser objects and DOM objects, event handling, form validation and cookies.	09	CO1
II	HTML5 and Responsive Web Design with CSS3	**HTML 5 :** Fundamental Syntax and Semantics, Native Audio and Video, Micro data and Custom data, Accessibility, Geo-location, Canvas **CSS3 and Responsive Web Design** Media Queries: Supporting Differing Viewports, Embracing Fluid Layout. CSS3: Selectors, Typography and color Modes, Stunning Aesthetics with CSS3, CSS3 Transitions, Transformations and Animations, Conquer Forms HTML5 and CSS3	12	CO1 CO2
III	Rich Internet Application(RIA)	Characteristics of RIA, **Introduction to AJAX** :AJAX design basics, AJAX vs Traditional Approach, , Rich User Interface using Ajax. **Working with JavaScript Object Notation(JSON)**: Create data in JSON format, JSON Parser .	09	CO3

		Web Mashup Eco Systems –Mashup Techniques: Mashing on the Web Server, Mashing with JSON		
IV	Server Side Programming: PHP	Introduction to PHP- Data types, control structures, built in functions, Building web applications using PHP- tracking users, PHP and Mysql database connectivity with example. Introduction to PHP Framework.	08	CO4
V	Web Extensions and Web Services	**Web Extensions**: Introduction to XML, Introducing XSL. Web services: Evolution and differences with Distributed computing, WSDL, SOAP, UDDI. REST-ful web services, Resource Oriented Architecture	07	CO5
VI	Python Web Framework: Django	Introduction, Web Frameworks, Introduction to Django ,Projects and Apps, "Hello World" Application.	05	CO6

Text Books:

1. HTML 5 Black Book: Kogent Learning solutions
2. "Learning PHP 5", David Sklar, O'Reilly Publication
3. Rich Internet Application AJAX and Beyond WROX press
4. Responsive Web Design with HTML5 and CSS3, Ben Frain, PACKT Publication

References:

1. "Web Technologies: Black Book", Dreamtech publication
2. HTML5 Cookbook, By Christopher Schmitt, Kyle Simpson, O'Reilly Media
3. Core Python Applications Programming by Wesley J Chun Third edition Pearson Publication
4. Advanced Internet Technologies (includes practicals), Deven Shah, Dreamtech publication

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC503	Advanced Data Management Technology	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC503	Advanced Data Management Technology	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To introduce concepts of advanced access control techniques like role based and discretionary methods
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Course Outcomes: Students will be able to:

1. Explain and understand the concept of a transaction and how ACID properties are maintained when concurrent transaction occur in a database
2. Measure query costs and design alternate efficient paths for query execution**.**
3. Apply sophisticated access protocols to control access to the database.
4. Implement alternate models like Distributed databases and Design applications using advanced models like mobile, spatial databases**.**
5. Organize strategic data in an enterprise and build a data Warehouse.
6. Analyze data using OLAP operations so as to take strategic decisions.

Prerequisite: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Reviewing basic concepts of a Relational database, SQL concepts	02	
I	Query Processing and Optimization:	Overview, Measures of Query Cost Selection Operation, Sorting, Join Operation, Other Operations Evaluation of Expressions. Query Optimization Overview, Transformation of Relational Expressions Estimating Statistics of Expression Results Choice of Evaluation Plans	06	CO1
II	Transactions Management and Concurrency:	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Implementation of isolation, Concurrency Control: Lock-based, Time-stamp based Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery & atomicity, Log based recovery, Checkpoints, Shadow Paging, ARIES Algorithm.	10	CO2
III	Advanced Data Management techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges; Mandatory Access Control and Role-Based Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.	09	CO3 CO4
IV	Distributed Databases	Introduction : Distributed Data Processing, What is a Distributed Database System? Design Issues . Distributed DBMS Architecture. Distributed Database Design : Top-Down Design Process, Distribution Design Issues, Fragmentation , Allocation . Overview of Query Processing : Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing, Query Optimization in Distributed Databases;	09	CO4

		Overview of Transaction Management in DDB; Overview of Concurrency Control in DDB; Overview of Recovery in DDB		
V	Data Warehousing, Dimensional Modeling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Benefits of Data Warehousing ; Features of a Data Warehouse; Data Warehouse Architecture; Data Warehouse and Data Marts; Data Warehousing Design Strategies. Dimensional Model Vs ER Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; Factless Fact Table; Updates To Dimension Tables, Primary Keys, Surrogate Keys & Foreign Keys; Aggregate Tables; Fact Constellation Schema or Families of Star Need for Online Analytical Processing; OLTP vs OLAP; OLAP Operations in a cube: Roll-up, Drill-down, Slice, Dice, Pivot ; OLAP Models: MOLAP, ROLAP, HOLAP.	10	CO5
VI	ETL Process	Challenges in ETL Functions; Data Extraction; Identification of Data Sources; Immediate Data Extraction, Deferred Data Extraction; Data Transformation: Tasks Involved in Data Transformation, Techniques of Data Loading, Loading the Fact Tables and Dimension Tables	06	CO6

Text Books:

1. Korth, Slberchatz,Sudarshan, :"Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Theraja Reema, "Data Warehousing", Oxford University Press, 2009.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

1. Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, Wiley India.
2. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom “Database System Implementation”, Pearson Ltd. 1/ e
3. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e, Pearson Ltd.
4. Ralph Kimball, Margy Ross, “The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling”, 3rd Edition. Wiley India.
5. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC504	Cryptography & Network Security	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of two Tests					
ITC504	Cryptography & Network Security	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts of classical encryption techniques and concepts of finite fields and number theory.
2. And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3. And explore the design issues and working principles of various authentication protocols, PKI standards.
4. And explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
5. The ability to use existing cryptographic utilities to build programs for secure communication.
6. The concepts of cryptographic utilities and authentication mechanisms to design secure applications

Course Outcomes: Students will be able to:

1. Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes
4. Apply different digital signature algorithms to achieve authentication and create secure applications
5. Apply network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Prerequisite: Computer Networks

Detailed syllabus:

Sr No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basic concepts of OSI Layer	02	--
I	Introduction & Number Theory	Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vignere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography).	09	CO1
II	Block Ciphers & Public Key Cryptography	Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, El-Gamal Algorithm. Key management – Diffie Hellman Key exchange	09	CO2 CO6
III	Cryptographic Hashes, Message Digests and Digital Certificates	Authentication requirement – Authentication function , Types of Authentication, MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC, Digital Certificate: X.509, PKI	09	CO3
IV	Digital signature schemes and authentication Protocols	Digital signature and authentication protocols : Needham Schroeder Authentication protocol, Digital Signature Schemes – RSA, EI Gamal and Schnorr, DSS.	07	CO4
V	Network Security	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing. Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial of Service Attacks.	10	CO5

		Firewalls, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots.		
VI	Network Security Applications	Authentication Applications, Kerberos, Internet Security Protocols: SSL, TLS, IPSEC:AH, ESP, Secure Email: PGP and S/MIME, Key Management.	06	CO5 CO6

Text Books:

1. Mark Stamp's Information Security Principles and Practice, Wiley
2. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
3. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
4. Bernard Menezes, "Cryptography & Network Security", Cengage Learning

Reference Books:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL501	Internet Programming Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of two Tests				
ITL501	Internet Programming Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. To Acquire knowledge and Skills for creation of Web Site considering both client- and server-side Programming.
2. To create Web application using tools and techniques used in industry.
3. To learn the characteristics of RIA
4. To Demonstrate Amazon/Google or Yahoo mashup
5. To be well versed with XML and web services Technologies.
6. To be familiarized with open source Frameworks for web development.

Lab Outcomes: Students will learn to;

1. Design a basic web site using HTML5 and CSS3 to demonstrate responsive web design.
2. Implement dynamic web pages with validation using JavaScript objects by applying different event handling mechanism.
3. Use AJAX Programming Technique to develop RIA
4. Develop simple web application using server side PHP programing and Database Connectivity using MySQL.
5. Build well-formed XML Document and implement Web Service using Java.
6. Demonstrate simple web application using Python Django Framework.

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. HTML5 compatible web browsers(Chrome, Opera, Firefox, Safari etc) 3. HTML,CSS editors like Dreamweaver, Notepad++ etc. 4. Netbeans or Eclipse IDE 5. XAMPP	1. Internet Connection installation of web frameworks

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students may do will visit different websites to identify their website topic for the mini project.
4. Each group will identify the Hardware and software requirement for their mini project problem statement.
5. Mini Project consists of Responsive Website Development.
6. Which includes following points
    a. Introduction to RWD frame work?
    b. Identify tools
    c. CSS preprocessor
    d. Construction and design of skeleton for website
    e. Enhancing CSS3 and HTML5 in website
    f. Server Side Programming: website using server side scripting in PHP and database connectivity using MySQL (PHP framework like Laravel/Joomla can be used)
    g. XML ,XSL and Web Services

h. Developing RIA using AJAX including -A browser built-in XMLHttpRequest object (to request data from a web server) and JavaScript and HTML DOM (to display or use the data) Building Amazon/Yahoo /Google Web Mashups for the website.

i. Website Security

j. Develop full website and launch it.

7. Each group may present their work in various project competitions and paper presentations.

8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Responsive Web Design by Example Beginner's Guide by Thoriq Firdaus, PACKT
2. Responsive Web Design with HTML5 and CSS3 PACKT
3. Professional Rich Internet Application : AJAX and Beyond WROX press

References:

1. Laravel: Up and Running, By Matt Stauffer O'Reilly Media.
2. Advanced Internet Technologies (includes practicals) ,Deven Shah ,Dreamtech publication
3. Django By Example By Antonio Melé,Pakt Publication

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL502	Security Lab	--	2	-	--	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL502	Security Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers
2. To be able to analyze and implement public key algorithms like RSA and El Gamal
3. To analyze and evaluate performance of hashing algorithms
4. To explore the different network reconnaissance tools to gather information about networks
5. To explore and use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Lab Outcome: Students will learn to:

1. Apply the knowledge of symmetric cryptography to implement simple ciphers
2. Analyze and implement public key algorithms like RSA and El Gamal
3. Analyze and evaluate performance of hashing algorithms
4. Explore the different network reconnaissance tools to gather information about networks
5. Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. Apply and set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Hardware and Software requirements:

Hardware Requirements	**Software Requirements**
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. wireshark 3. ARPWATCH 4. Kismet, NetStumbler 5. NESSUS

Prerequisite: Computer Networks, Operating System, Basics of Java and Python Programming

Detail Syllabus:

Module No.	Description	Hours	CO mapping
I	a) Design and Implementation of a product cipher using Substitution and Transposition ciphers b) Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal	4	LO1 LO2
II	a) Implementation of Diffie Hellman Key exchange algorithm b) For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs c) Exploring wireless security tools like Kismet, NetStumbler etc.	4	LO2 LO3
III	a) Study the use of network reconnaissance tools like WHOIS, dig,traceroute, nslookup to gather information about networks and domain registrars. b)Study of packet sniffer tools wireshark, :- **1**. Observer performance in promiscuous as well as non-promiscuous mode. **2**. Show the packets can be traced based on different filters.	4	LO4 LO5
IV	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.	4	LO5
V	a) Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark. b) Simulate DOS attack using Hping and other tools c) Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities.	6	LO4 LO5

VI	a) Set up IPSEC under LINUX. b) Set up Snort and study the logs. c) Explore the GPG tool of linux to implement email security	4	LO6

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, TIm Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL503	OLAP Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test	Test2	Avg. of two Tests					
ITL503	OLAP Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To initiate awareness about the potential security threats that exists in database systems and how to tackle them.
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Lab Outcomes: Student should be able:

1. Implement simple query optimizers and design alternate efficient paths for query execution**.**
2. Simulate the working of concurrency protocols, recovery mechanisms in a database
3. Design applications using advanced models like mobile, spatial databases**.**
4. Implement a distributed database and understand its query processing and transaction processing mechanisms
5. Build a data warehouse
6. Analyze data using OLAP operations so as to take strategic decisions.

Hardware and Software requirements:

Hardware Requirements	**Software Requirements**
PC With following Configuration 1. Intel Core i3/i5/i7	1. ETL tools 2. Warehouse tools 3. Java/Python compiler

Processor 2. 4 GB RAM 3. 500 GB Harddisk	

Prerequisite: DBMS.

Detailed syllabus:

Module No.	Detailed Content	Hours	CO Mapping
I	a) Implementation of any Query optimizer (Java/Python) b) Assignments for query evaluation path expressions.	4	LO 2
II	c) Simulation of Concurrency Control Algorithm, Recovery Algorithm (Java/Python)	4	LO1
III	a) Design of a distributed database for a real life application - Fragmentation, Query Processing b) Simulation of Recovery methods.	4	LO 4
IV	**Advanced Database Models** Case study based assignments for Temporal, Mobile or Spatial databases	4	LO 3
V	**Data Warehouse Construction** a) Real life Problem to be defined for Warehouse Design b) Construction of star schema c) ETL Operations.	6	LO 4
VI	**OLAP Exercise** a) Construction of Cubes b) OLAP Operations, OLAP Queries	4	LO 6

Text Books:

1. Elmasri and Navathe, “Fundamentals of Database Systems”, 6th Edition, PEARSON Education.
2. Theraja Reema, “Data Warehousing”, Oxford University Press, 2009.
3. Data Warehousing, Data Mining, & OLAP by Alex Berson McGraw Hill.

References:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom “Database System Implementation”, Pearson Ltd. 1/ e
2. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e Pearson Ltd

3. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling", 3rd Edition. Wiley India.

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL504	IOT (Mini Project) Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL504	IOT (Mini Project) Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try to:

1. Address the real world problems and find the required solution.
2. Design the problem solution as per the requirement analysis done.
3. Study the basic concepts of programming/ hardware/ emulator for Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.
4. Fabricate and implement the mini project intended solution for project based learning.
5. Build and test the mini project successfully.
6. Improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do survey for different application using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc topics for the mini project.

4. Each group will identify the Hardware and software requirement for their mini project problem statement.

5. Prototype/Design your own circuit board using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.

6. Installation, configure and manage your Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc board/kit.

7. Work with operating system and do coding to for input devices on board.

8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.

9. Create and interface using Web to publish or remotely access the data on Internet.

10. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.

11. Each group may present their work in various project competitions and paper presentations.

12. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Massimo Banzi,"Getting Started with Arduino",O'reilly, 2nd edition
2. Simon Monk," Raspberry Pi Cookbok", O'reilly
3. Raspberry Pi User Guide

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL505	Business Communication and Ethics	2	2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL505	Business Communication and Ethics	--	--	--	--	50	--	--	50

***** Batch wise practical's

Pre-requisite

- Communication Skills

Course Objective: Students will try:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Course Outcomes: Students will learn to:

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module	Detailed Contents	Hrs.
01	**Report Writing**	**05**
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
02	**Technical Writing**	**03**
2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	**Introduction to Interpersonal Skills**	**08**
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	**Meetings and Documentation**	**02**
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	**Introduction to Corporate Ethics**	**02**
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
06	**Employment Skills**	**06**

6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		26

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

1. **Term Work:**
2. Term work shall consist of all assignments from the list. The distribution of marks for term
3. work shall be as follows:
4. Book Report……..(10) Marks
5. Assignments …… (10) Marks
6. Project Report Presentation…….. (15) Marks
7. Group Discussion…… (10) Marks
8. Attendance ……(05) Marks
9. **TOTAL: ……(50) Marks**

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

References

1. Fred Luthans, *"Organizational Behavior"*, McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business"*, McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication"*, McGraw Hill

4. Wallace and Masters, *"Personal Development for Life and Work"*, Thomson Learning, 12th edition
5. Heta Murphy, *"Effective Business Communication"*, Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing"*, Tata McGraw-Hill Education
7. Ghosh, B. N., *"Managing Soft Skills for Personality Development"*, Tata McGraw Hill. Lehman,
8. Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.
10. Dr. Alex, K., "Soft Skills", S Chand and Company
11. Subramaniam, R., "Professional Ethics" Oxford University Press.
12. Robbins Stephens P., "Organizational Behavior", Pearson Education
13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To learn mathematical background for analysis of algorithm
2. To learn various advanced data structures.
3. To understand the concept of designing an algorithm.
4. To learn dynamic programming and greedy method.
5. To understand the concept of pattern matching
6. To learn advanced tree and graph applications.

Course Outcomes:

1. Students will be able to choose appropriate advanced data structure for given problem.
2. Students will be able to calculate complexity.
3. Students will be able to select appropriate design techniques to solve real world problems.
4. Students will able to apply the dynamic programming technique to solve the problems.
5. Students will be able to apply the greedy programming technique to solve the problems.
6. Students will be able to select a proper pattern matching algorithm for given problem.

Prerequisite: Knowledge Any Programming Language, Data structures and Analysis

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Data structures and analysis	02	--
I	Introduction	Introduction • Introduction to advanced data structures: • Introduction/Fundamentals of the analysis of algorithms o Recurrences: ▪ The substitution method ▪ Recursive tree method ▪ Masters method o Probabilistic analysis o Amortized analysis o Randomized algorithms o Mathematical aspects and analysis of algorithms	10	CO1 CO2
II	Advanced Data Structures	• Introduction • AVL tree • Huffman algorithm • B/B+ tree • 2-3 tree operations • Red-Black Trees • tries • Heap operations • Implementation of priority queue using heap • Topological sort Analysis of All problems	11	CO1 CO2 CO3
III	Divide and Conquer	• Introduction • Binary search • Finding the minimum and maximum • Merge sort • Quick sort • Strassen's matrix multiplication Analysis of All problems	7	CO2 CO3
IV	Greedy algorithms	• Introduction • Knapsack problem • Job sequencing with deadlines • Minimum cost spanning trees	8	CO2 CO3

		○ Kruskal's algorithm ○ Prim's algorithm • Optimal storage on tapes • Optimal merge pattern • Subset cover problem • Container loading problem Analysis of All problems		CO5
V	Dynamic algorithms And NP-Hard and NP-Complete	Introduction Dynamic algorithms • All pair shortest path • 0/1 knapsack • Travelling salesman problem • Coin Changing Problem • Matrix Chain Multiplication • Flow shop scheduling • Optimal binary search tree (OBST) • Analysis of All problems • Introduction to NP-Hard And NP-Complete Problems	8	CO2 CO3 CO4
VI	String Matching	• introduction • The naïve string matching algorithm • Rabin Karp algorithm • Knuth-Morris-Pratt algorithm (KMP) • Longest common subsequence(LCS) • Analysis of All problems • Genetic algorithms	6	CO2 CO3 CO6

Text Books:

1. Introduction to ALGORITHMS, Cormen, Leiserson, Rivest, Stein, PHI.
2. Algorithms: Design and Analysis, Harsh Bhasin, OXFORD.
3. Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4. C and Data structures, Deshpande, Kakde, Dreamtech Press.

Reference Books:

1. Data Structures and Algorithms in C++, Goodritch, Tamassia, Mount, WILEY.
2. Data Structures using C, Reema Thareja, OXFORD.
3. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5012	Image Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5012	Image Processing	20	20	20	80	--	--	100

Course Objectives: The course will help the students to get familiar with

1. Fundamental concepts of a digital image processing system.
2. Concepts of image enhancement techniques.
3. Various Image Transforms.
4. Compression techniques and Morphological concepts
5. Various segmentation techniques, and object descriptors.
6. Color models and various applications of image processing.

Course Outcomes: Students should be able to:

1. Remember the fundamental concepts of image processing.
2. Explain different Image enhancement techniques
3. Understand and review image transforms
4. Analyze the basic algorithms used for image processing &image compression with morphological image processing.
5. Contrast Image Segmentation and Representation
6. Design & Synthesize Color image processing and its real world applications.

Prerequisite: Mathematics and Statistics.

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	As images are two dimensional signals, the single dimensional Digital Signal Processing fundamentals.	02	

I	Introduction to digital image processing system	Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels.	07	CO 1
II	Image enhancement	Intensity Transformations and Spatial Filtering, Histogram processing, Filtering in Frequency Domain	09	CO 2
III	Image transforms	Discrete Fourier transform - Properties of two dimensional DFT, DCT, DST, Walsh, Hadamard, Haar Transform and their properties.	07	CO 3
IV	Image compression and morphological image processing	Fundamentals of compression, Basic compression Methods, Huffman Coding, Arithmetic Coding , LZW Coding , Run-Length Coding , Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding , Predictive Coding. Image morphology, Opening & Closing, Hit or Miss Transform, Basic Morphological Algorithms	11	CO 4
V	Image segmentation and representation	The detection of discontinuities - Point, Line and Edge detections , Hough Transform, Thresholding Region based segmentation Chain codes, Polygon approximation, Shape numbers, Fourier descriptors, statistical Moments.	08	CO 5

VI	Color Image Processing and Applications	Color Fundamentals and Models, Pseudocolor Image Processing, Smoothing and Sharpening, Image Segmentation Based on Color. Biometric Authentication, Digital watermarking, Content Base Image Retrieval. Vector quantization	08	CO 6

Text Books:

1. Rafael C. Gonzalez and Richard E.woods, "Digital Image Processing", Addition - Wesley Publishing Company, New Delhi, Third Edition, 2007.
2. William K. Pratt, "Digital Image Processing", John Wiley, NJ, Fourth Edition 2007.

Reference Books:

1. Sid Ahmed M.A., "Image Processing Theory, Algorithm and Architectures", McGraw-Hill, 1995.
2. Kenneth R Castleman, "Digital Image Processing", Prentice Hall, New Delhi, 1996.
3. Anil.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd., New Delhi, 1995.
4. S. Sridhar, " Digital Image Processing", second Edition, Oxford university press, New Delhi, 2016.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar " Digital Image Processing", McGraw-Hill, 2016

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5013	E-Commerce & E-Business	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5013	E-Commerce	20	20	20	80	--	--	100

Course Objectives: Students will try to :

1. Understand concept of Ecommerce and its types.
2. Be familiarized with technologies for Ecommerce.
3. Understand different types of Online Payment systems.
4. Understand Selling and marketing on web.
5. Be familiarized with concept of E-business and E-business Models.
6. Understand various E-business Strategies.

Course Outcomes: Students will be able to:

1. Define and differentiate various types of E-commerce.
2. Describe Hardware and Software Technologies for E-commerce.
3. Explain payment systems for E -commerce.
4. Describe the process of Selling and Marketing on web.
5. Define and Describe E-business and its Models.
6. Discuss various E-business Strategies.

Prerequisite: Internet Technologies, Internet Security, Middleware technologies, web services

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Internet Technologies, Internet Security, Middleware technologies, web services	02	
I	Introduction to E	E –commerce :Definition of e commerce , different types of E-commerce ,Examples	04	CO1

	–commerce	of E- commerce, E-commerce trade cycle , advantages and disadvantages of E-commerce , Traditional commerce Vs E - commerce		
II	Overview of Hardware and Software Technologies for Ecommerce	Overview of Client side programming (Dream weaver , Front page) Hardware and , Server side Programming (PHP) , Database Software connectivity , session tracking, middleware technologies for ecommerce perspective and security aspects with respect to e commerce, integration of web services	08	CO2
III	Payment System for Ecommerce	Traditional payment model , Characteristics of payment, Online Payment Basics, Payment Cards, Electronic Cash, Electronic Wallets, Stored-Value Cards, SET Protocol for credit card payment, Internet Technologies and the Banking Industry	10	CO3
IV	Selling and Marketing on Web	Selling on the Web: Revenue Models and Building a Web Presence: Revenue Models, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising on the Web, E-Mail Marketing, Technology-Enabled Customer Relationship Management, Creating and Maintaining Brands on the Web Online Auctions, Virtual Communities, and Web Portals	10	CO4
V	E business :- Introduction to e business and Developing E-business models	Definition of e- business , Characteristics , elements of e business , e business roles , Impact of e business , challenges of e business , difference between e business and e commerce , E-business structure, Evolution of E –business and stages , E – business models , Characteristics of Internet based software and e business solutions	10	CO5
VI	E business strategies	Strategic planning process, SCM , CRM , ERP , procurement	08	CO6

Text Books:

1 E -Commerce Fundamentals and application (Henry Chan) Wiley publication
2. Electronics Commerce (Gary Schneider) Thomson Course technology
3.E –Business , Parag Kulkarni , Sunita Jahirabadkar, Pradip Chande , Oxford Higher Education , Oxford University Press
4. E –business and E –commerce Management , Dave Chaffey , Pearson , 3rd edition
5. E commerce by Laudon

References:

1. E-Commerce Strategies, Technology and applications (David Whitley) Tata McGrawHill
2. Introduction to E-commerce Elias Awad

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5014	IT Enabled Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5014	IT Enabled Services	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of IT enabled services and challenges for the same.
2. To understand strategic IT planning for industries.
3. To develop enterprise IT architecture for Information technology.
4. To encourage the use of Information Technology so as to enable students to improve their skills, knowledge and job prospects and enable them to obtain employment in sunrise industries.
5. To develop the ability to integrate various resources for optimization in the industry as well as for strategic utilization of IT enabled services and functions.
6. To develop competence in global sourcing: strategy and management to gain a perspective on the global services sourcing landscape: past, present, and future.

Course Outcomes: Students will be able to:

1. Describe the importance of IT enabled services and challenges.
2. Identify strategic IT planning for software development.
3. Recognize enterprise IT architecture for Information technology.
4. Use of Information Technology so as to enable them for job in sunrise industries.
5. Illustrate various IT web services for betterment of knowledge.
6. Use their skills to find out various current IT trends in ITES.

Prerequisite: Internet Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Information Technology and Project Management, Web Engineering and Technology.	02	
I	Business strategy: challenges and opportunities for IT	Business Strategy: Challenges and Opportunities in the Globalized, Interconnected, Convergent World, Establish Principles before Practice, IT Strategy, Application Strategy, Technology Strategy for IT, IT Management Strategy, Developing IT Strategy for Competitive Advantage, Stages of IT Strategy Development and Implementation, Challenges of IT and Business Strategy Alignment, Inhibitors of Business and IT Strategy Alignment, Three-D Framework for Business and IT Strategy Alignment.	09	CO1
II	Strategic IT planning	Business Implications for IT Strategic and Planning, Strategic IT Planning Motivations, SITP Process: Prevalent Planning Approaches, Difficulties in Developing and Executing SITP, Best Practices for Achieving Good SITP, SITP Approaches-Prevalent Researches.	09	CO2
III	Enterprise IT architecture	Defining EITA, Contents of a Typical Enterprise IT Architecture, Standard for Enterprise IT Architecture, Technology Management strategy Framework, Prevalent Technology Reference Architectures Framework and Standards, Program Management, Benefits of PMO, Desired Qualities of a Program Office Manager, Maturity of PMO, Implementation of PMO Strategy, Measuring PMO Performance, Success Factors for PMO, Project Scope Management, PMO Dashboard and Reporting.	08	CO3

IV	IT service management strategy	Information Technology Infrastructure Library (ITIL), ITIL Overview, ITIL Service Support Processes, Incident Management, Problem Management, Service Delivery, Service Level Management, Financial Management, Capacity Management, IT Service Continuity Management (ITSCM), Availability Management, Imperatives for Outsourcing, IT Management Layers, Variants of Outsourcing, Business Process Outsourcing, In sourcing.	08	CO4
V	IT enabled web services	Overview of basic features of PHP: arrays, functions and state management, working with PHP forms, More advanced PHP, OOP's concept in PHP, Portable database supported with different, exception handling, concepts of UDDI, WSDL, SOAP.	08	CO5
VI	Current trends in ITES	Current Employment in the IT and ITES industry: Newly emerging area and requirement of IT enabled service sector. Industry Oriented Human Resource Requirement: Outlook of the IT and ITES Industry. Barriers to Trade in ITES Role of International Bodies (WTO & UNCTAD) in facilitating Trade in ITEST/ITES, experiences and Case studies of ITES-call centers, ERP, google.	08	CO6

Text Books:

1. Sanjiva Shankar Dubey, " IT strategy and Management", PHI.
2. K. Venkatesh, " Marketing of Information Technology",TMH.
3. Steve Suehring, Timconverse, Joyoe Park , "PHP 6 and MySQL Bible", Wiley.

References:

1. Shiro Uesugi, “IT Enabled Services”, Springer; 2013 edition, 2013.
2. Sanjiva Shankar Dubey, “IT Services Business Management: Concepts, Processes and Practices”, PHI, 2012.
3. Nikhil Treebhoohu, “Promoting IT Enabled Services”, Addison-Wesley, 2013.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITDLO5015	Computer Graphics & Virtual Reality	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5015	Computer Graphics & Virtual Reality	20	20	20	80	----	--	100

Course Objectives: Students will try:

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To learn the basic principles of 3-dimensional computer graphics.
3. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
5. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
6. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Course Outcomes: Students will be able to:

1. To list the basic concepts used in computer graphics.
2. To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
3. To describe the importance of viewing and projections.
4. To define the fundamentals of animation, virtual reality and its related technologies.
5. To understand a typical graphics pipeline
6. To design an application with the principles of virtual reality

Prerequisite: Basic Mathematics

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge of Mathematics	2	
I.	Introduction to Computer graphics and Output primitives	**Introduction**: Display Devices, Bitmap and Vector based graphics, Overview of Coordinate System. **Scan Conversion** of**:** point, line using Digital differential analyzer & Bresenham's algorithm, circle using midpoint approach, **Curve Generation**: Bezier and B-Spline curves. **Introduction to fractals**: generation procedure, classification, dimension and Koch Curve.	7	CO1
II.	Area Filling, Transformations (2D and 3D)	**Area filling**: Inside/Outside Test, Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fill algorithm. **Basic Geometrical 2D Transformations:** Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation and Composite transformation. **Three Dimensional transformations:** Translation, Scaling, Rotations, Composite.	8	CO1 CO2
III.	Viewing (2D and 3D) Projection and Clipping	**Viewing**: Introduction, Viewing Pipeline, View Coordinate reference frame, Window to viewport transformation. **Three-Dimensional Viewing:** 3D Pipeline, Viewing transformation, **Projections**: Parallel (Oblique and orthographic), Perspective (one Point) **Clipping**: Point clipping, Line clipping**:** Cohen Sutherland Algorithm, Liang Barsky algorithms, Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton. Text Clipping.	10	CO1 CO2 CO3

IV.	Introduction To Animation	**Animation**: Key Frame Animation, Animation Sequence, Motion Control Methods, **Morphing**, **Warping**- Mesh Warping.	4	CO1 CO2 CO4 CO5
V.	Introduction to Virtual Reality	**Virtual Reality:** Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception. Classical Components of VR System, Types of VR Systems, Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Input Devices, Graphical Display, Sound displays, and Haptic Feedback. Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL rendering pipeline. **Applications** of Virtual Reality.	9	CO1 CO2 CO4 CO6
VI.	VR Modeling and Programming	**Geometric Modeling**: Virtual Object Shape, Object Visual Appearance. **Kinematics Modeling**: Object Position, Transformation Invariants, Object Hierarchies, **Physical Modeling**: Collision Detection, Surface Deformation, Force Computation. **Behavior Modeling**. Programming through **VRML/X3D**: Defining and Using Nodes and Shapes, VRML Browsers, **Java 3D, OpenCV** for augmented reality	12	CO1 CO2 CO4 CO6

Text Books

1 Donald Hearn and M. Pauline Baker, “Computer Graphics”, Pearson Education.
2 R. K Maurya, “Computer Graphics with Virtual Reality”, Wiley India.

Reference Books

1. Grigore Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley.
2. Steven Harrington, “Computer Graphics”, McGraw Hill.
3. Rogers, “Procedural Elements of Computer Graphics”, Tata McGraw Hill.
4. Vince, “Virtual Reality Systems”, Pearson Education.
5. F.S. Hill, Stephen M. Kelley , “Computer Graphics using Open GL” Prentice Hall
6. Samyak Datta , “Learning OpenCV 3 Application Development”, Packt

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

T. E. Information Technology (Semester-VI)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC601	Software Engineering with Project Management	4	-	-	4	-	-	4
ITC602	Data Mining and Business Intelligence	4	-	-	4	-	-	4
ITC603	Cloud Computing & Services	4	-	-	4	-	-	4
ITC604	Wireless Networks	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -II	4	-	-	4	-	-	4
ITL601	Software Design Lab	-	2	-	-	1	-	1
ITL602	Business Intelligence Lab	-	2	-	-	1	-	1
ITL603	Cloud Service Design Lab	-	2	-	-	1	-	1
ITL604	Sensor Network Lab	-	2	-	-	1	-	1
ITM605	Mini-project	-	4	-	-	2	-	2
	Total	**20**	**12**	-	**20**	**6**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC601	Software Engineering with Project Management	20	20	20	80	3	-	-	-	100
ITC602	Data Mining and Business Intelligence	20	20	20	80	3	-	-	-	100
ITC603	Cloud Computing & Services	20	20	20	80	3	-	-	-	100
ITC604	Wireless Networks	20	20	20	80	3	-	-	-	100
ITDLO-II	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
ITL601	Software Design Lab	-	-	-	-	-	25	25	--	50
ITL602	Business Intelligence Lab	-	-	-	-	-	25	25	--	50
ITL603	Cloud Service Design Lab	-	-	-	-	-	25	25	--	50
ITL604	Sensor Network Lab	-	-	-	-	-	25	25	--	50
ITM605	Mini-Project	-	-	-	-	-	25	25	--	50
Total		100	100	100	400	-	125	125	--	750

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VI. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	Department Level Optional Course (DLO)
Semester VI	
ITDLO6021	Advance Internet Programming
ITDLO6022	Software Architecture
ITDLO6023	Digital Forensics
ITDLO6024	Multimedia Systems
ITDLO6025	Green IT

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC601	Software Engineering with Project Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC601	Software Engineering with Project Management	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand the nature of software development and software life cycle process models, agile software development, SCRUM and other agile practices.
2. To Explain methods of capturing, specifying, visualizing and analyzing software requirements.
3. To understand concepts and principles of software design and user-centric approach and principles of effective user interfaces.
4. To know basics of testing and understanding concept of software quality assurance and software configuration management process.
5. To understand need of project management and project management life cycle.
6. To understand project scheduling concept and risk management associated to various type of projects.

Course Outcomes: Students will be able to:

1. Define various software application domains and remember different process model used in software development.
2. Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
3. Convert the requirements model into the design model and demonstrate use of software and user-interface design principles.
4. Distinguish among SCM and SQA and can classify different testing strategies and tactics and compare them.
5. Justify role of SDLC in Software Project Development and they can evaluate importance of Software Engineering in PLC.
6. Generate project schedule and can construct, design and develop network diagram for different type of Projects. They can also organize different activities of project as per Risk impact factor.

Prerequisite: Programming and Networking.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Nature of Software, Software Definition, Software Characteristics, Software Application Domains	02	
I	The Software Process	Generic view of Process, Prescriptive Models: Waterfall Model, Incremental-RAD Model, Evolutionary Process Model-Prototyping, Spiral and Concurrent Development Model, Specialized Models: Component based, Aspect Oriented Development, Agile Methodology, Scrum and Extreme Programming	07	CO1
II	Requirements Engineering and Cost Estimation	Requirement, Types of Requirements, Requirement gathering, Requirement Engineering Task, Identifying Stakeholders, Multiple viewpoints, SRS (Software Requirement Specification) Project Estimation, LOC based, FP based and Use case based estimation.	07	CO1 CO2
III	Analysis and Design Engineering	Introduction of Analysis elements, Scenario based, Flow based, behavior and class based Design Concepts and Principles, Architecture Design, Component Level Design, System Level Design, User Interface Design.	09	CO1 CO2 CO3
IV	Quality & Configuration Management	Need for Testing, Testing Tactics, Testing strategies, McCall's Quality Factor, Software Configuration Management, SCM Process	07	CO4
V	IT Project Management	Introduction, 4 P's, W5HH Principle, Need for Project Management, Project Life cycle and ITPM, Project Feasibility, RFP, PMBOK Knowledge areas, Business Case, Project Planning, Project Charter and Project Scope.	10	CO5

VI	Project Scheduling and Risk Management	WBS, Developing the Project Schedule, Network Diagrams (AON, AOA), CPM and PERT, Gantt Chart, Risk Identification, Risk Projection and RMMM	10	CO1 CO2 CO3 CO4 CO6

Text Books:

1. Roger S Pressman "Software Engineering : A Practitioner's Approach" 7th Edition Mcgraw-Hill ISBN:0073375977
2. Jack T. Marchewka, "Information Technology Project Management" 4th Edition ,Wiley India

References:

1. "Software Engineering : A Precise Approach" Pankaj Jalote , Wiley India
2. Ian Sommerville " Software Engineering" 9th edition Pearson Education SBN-13: 978-0- 13-703515-1, ISBN-10: 0-13-703515-2
3. John M. Nicholas, Project Management for Business and Technology, 3rd edition, Pearson Education.
4. Software Project management by Bob Hughes, Mike Cotterell , Rajib Mall

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC602	Data Mining and Business Intelligence	04		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC602	Data Mining and Business Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods of evaluation.
4. To impart knowledge of tools used for data mining
5. To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.
6. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.

Course Outcomes: Student will be able to:

1. Demonstrate an understanding of the importance of data mining and the principles of business intelligence
2. Organize and Prepare the data needed for data mining using pre preprocessing techniques
3. Perform exploratory analysis of the data to be used for mining.
4. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.
5. Define and apply metrics to measure the performance of various data mining algorithms.
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Database Management System, Advanced Data Management Technology.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Knowledge of databases, and Date warehousing, OLAP	02	--
I	Introduction to Data Mining	What is Data Mining; Kind of patterns to be mined; Technologies used; Major issues in Data Mining	03	CO1
II	Data Exploration and Data Preprocessing	Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity. Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	09	CO2 CO3
III	Classification	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes‟ Classifier. Prediction: Structure of regression models; Simple linear regression, Multiple linear regression. Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation.	09	CO4 CO5
IV	Clustering	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K-Mediods; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based.	10	CO4 CO5
V	Frequent Pattern	Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and	10	CO4

	Mining	Association Rules; Frequent Pattern Mining, Efficient and Scalable Frequent Itemset Mining Methods, The Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemsets; Mining Frequent itemsets using vertical data formats; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules; From Association Mining to Correlation Analysis, lift, ; Introduction to Constraint-Based Association Mining.		CO5
VI	Business Intelligence	What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance CRM etc.	09	CO6

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
3. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis ,Wiley India Publications.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, 2nd Edition, Wiley India.

References:

1. Michael Berry and Gordon Linoff “Data Mining Techniques”, 2nd Edition Wiley Publications.
2. Michael Berry and Gordon Linoff “Mastering Data Mining- Art & science of CRM”, Wiley Student Edition.
3. Vikram Pudi & Radha Krishna, “Data Mining”, Oxford Higher Education.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC603	Cloud Computing & Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC603	Cloud Computing & Services	20	20	20	80	--	--	100

Course Objectives: Students will try to learn:

1. Basics of cloud computing.
2. Key concepts of virtualization.
3. Different Cloud Computing services
4. Cloud Implementation, Programming and Mobile cloud computing
5. Key components of Amazon Web Services
6. Cloud Backup and solutions

Course Outcomes: Students should be able to:

1. Define Cloud Computing and memorize the different Cloud service and deployment models
2. Describe importance of virtualization along with their technologies.
3. Use and Examine different cloud computing services
4. Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing
5. Describe the key components of Amazon web Service
6. Design & develop backup strategies for cloud data based on features.

Prerequisite Subjects: Computer Network, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	OSI Layers, Basics of OS.	02	--
I	Introduction	Defining Cloud Computing, Cloud and other similar configurations, Components of Cloud	06	CO1

		Computing, Cloud types: NIST and Cloud Cube Models, Cloud Deployment Models and Service Models, Cloud computing architecture, Advantages and Disadvantages of Cloud Computing.		
II	Virtualization	Virtualization: Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors, Taxonomy of virtualization, Implementation Levels of Virtualization, Virtualization of CPU, Memory and I/O Devices , Virtualization and Cloud Computing, Pros and Cons of virtualization, Technology Examples: KVM, Xen, Vmware and HyperV	10	CO2
III	Cloud Computing Services	Exploring Cloud Computing Services: SPI Model: Software as a service, Platform as a service, and Infrastructure as a service. Anything as a service or Everything as a service (XaaS): Security as a Service, Identity management as a Service, Database as a Service, Storage as a Service, Collaboration as a Service, Compliance as a Service, Monitoring as a Service, Communication as a Service, Network as a Service, Disaster recovery as a service, Analytics as a Service, Backup as a Service.	09	CO1 CO2 CO3
IV	Cloud Implementation, Programming and Mobile Cloud Computing	Open Stack Cloud Architecture: Feature of Open stack, Components of Open stack, mode of operations. Programming support for Google apps engine-GFS, Bigtables, Chubby, Google APIs. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile	09	CO1 CO2 CO3 CO4

		cloud computing		
V	Exploring the Components of Amazon Web Services	AWS cloud computing Platform, a) Elastic Compute Cloud(EC2): Compute Basics, Instance types, Life cycle of instances. b) Simple Storage Service (S3): Basics and Operations, Features, Amazon Glacier, Glacier vs S3. c) Elastic Block Storage (EBS):Basics and Types of EBS Volumes d)Amazon Virtual Private Cloud (Amazon VPC): Subnets, Route tables, Elastic IP Addresses (EIP), Elastic Network Interfaces (ENIs) & Security groups & ACL. e) Exploring Elastic Load Balancing (ELB): Basics, Types of load balancers, Configuring Elastic Load Balancing, Basics of Cloud Watch & Auto Scaling.	11	CO1 CO2 CO3 CO4 CO5
VI	Cloud Backup & Solutions	Cloud Backup Solutions and their features, Cloud data management interface (CDMI), Cloud Storage gateways (CSG), Comparison between different cloud platforms: Amazon web services & Open stack (Based on Type of deployment, Services supported and their components).	05	CO1 CO2 CO3 CO4 CO5 CO6

Text Books:

1. Barrie Sosinsky ,"Cloud Computing Bible",Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing Black Book", Dreamtech Press.
3. Joe Baron et.al ,"AWS certified solution Architect", Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Thomas Erl,Robert Cope,Amin naserpour,"Cloud Computing Design Patterns",Pearson Publication.
2. Judith Hurwitz ,"Cloud Computing for Dummies" , Wiley Publication.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC604	Wireless Network	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC604	Wireless Network	20	20	20	80	--	--	100

Course Objectives: Students will try to:

1 Understand the fundamentals of wireless networks.
2 Learn and analyze the different wireless technologies.
3 Evaluate Ad-hoc networks and wireless sensor networks.
4 Understand and evaluate emerging wireless technologies and standards
5 Understand design considerations for wireless networks
6 Learn and analyze and evaluate the security threats and related security standards

Course Outcomes: Students will be able to:

1. Explain the basic concepts of wireless network and wireless generations.
2. Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc
3. Appraise the importance of Ad-hoc networks such as MANET and VANET and Wireless Sensor networks
4. Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
5. Explain the design considerations for deploying the wireless network infrastructure.
6. Differentiate and support the security measures, standards. Services and layer wise security considerations.

Prerequisite: Computer Networks.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Modulation and Demodulation Techniques, PSTN	02	
I	Fundamentals Wireless Communication	Fundamentals of Wireless Communication, Advantages, limitations and application, wireless media, Infrared Modulation Techniques, DSSS and FHSS, Frequency Spectrum: Radio and Infrared; Wireless generations: 1G: Cellular,2G: Mobile Radio,3G: UMTS- Security related Encryption Algorithm,4G	07	CO1
II	Evolution of Wireless Technologies	Multiple Access Technique: TDMA, FDMA, CSMA, CDMA Wireless Technologies: GSM, GPRS, EDGE,CDMA,LTE, UMTS	10	CO1 CO2
III	Types of Wireless Networks	Ad-hoc: MANET & VANET, Application, Advantage and limitations; Wireless Sensor Network: Application, advantages and limitations	09	CO1 CO3
IV	Emerging Wireless Technologies and standards	WLL , WLAN- 802.11 (Wi-Fi), WPAN- 802.15.1/3/4 (Bluetooth, Zigbee), WMAN-802.16a (Wi-max) , Wi-max and LTE /3GPP comparison, Mi-fi, Ly-fi,	10	CO1 CO2 CO4
V	Wireless Network Design Considerations	Wireless technology, Cisco Unified Wireless Network, Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers	07	CO1 CO2 CO3 CO4 CO5
VI	Wireless Network Security	The need, attacks, security serviced, WEP, Mobile IP, VPN(PPTP, LLTP, IPSec), Network Layer Security, Transport Layer Security, Email Security: PGP, S/ MIME, Internet Firewalls for Trusted System	07	CO1 CO2 CO3 CO6

Text Books:

1. Cellular Communications: A Comprehensive and Pratical Guide, Nishith Tripathi, Jeffery H Reed, Wiley
2. Wireless Mobile Internet Security, 2nd Edition, Man, Young Rhee, Wiley- IEEE press
3. Designing for Cisco Internetwork Solutions (DESGN), 2nd Edition, CCDA, Diane Teare, cisco Press.

References:

1. Introduction to Digital mobile communication, 2nd Edition, Yoshihiko Akaiwa
2."Wireless Communications and networks", William Stallings, Pearson / Prentice Hall
3. Wireless communication and networking, Vijay Garg

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL601	Software Design Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL601	Software Design Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try to:

1 Learn basic concepts of UML.
2 Master the vocabulary, rules, and idioms of the UML and learn how to model it effectively.
3 Understand how to apply the UML to solve a number of common modeling problems.
4 Model the systems, from concept to executable artifact, using object-oriented techniques.
5 Apply the knowledge of Software engineering and project management.
6 Understand the software development process using tool.

Course Outcomes: Students will be able to:

1. Sketch a Modeling with UML.
2. Deploy Structural Modeling.
3. Deploy Behavioral Modeling.
4. Deploy Architectural Modeling.
5. Examine estimation about schedule and cost for project development.
6. Select project development tool.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	**Software**
PC i3 or above.	IBM Rational Rose Modeler, Dia, StarUML (Any One) Orange Scrum, Xampp , GitHub

Guidelines

1. Students should take one case study as a mini project work which is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must be able to identify Object oriented Technologies, Basic expression of Classes, Attributes and operations.
4. Students must develop a Conceptual Model of the UML for above case study.
5. Students should define Classes, Relationships, Class Diagrams, Advanced Classes and Relationship, Object Diagrams for above case study.
6. Students should define Use Cases, Use case Diagrams, Activity Diagrams, Interaction Diagrams, State Chart Diagrams for above case study.
7. Students should define Components, Deployment, Collaborations, Component Diagrams, Deployment Diagrams for above case study
8. Students should define SRS, WBS, Network Diagram, Gantt Chart, Cost Estimation Techniques
9. Demonstration it using Scrum Tool
10. Each group may present their work in various project competitions and paper presentations.
11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. "The Unified Modeling Language User Guide" by Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Publication,ISBN 978-81-7758-372-4
2. Jack T. Marchewka, Information Technology Project Management, 4th edition, Wiley India, 2009.

References:

1. UML – Tutorial "www.tutorialspoints.com/uml/"
2. "An Introduction to Object-Oriented Analysis: Objects and UML in plain English" by Davis William Brown, Wiley, Second Edition
3. "Fundamentals of Object-Oriented Design in UML", Meilir Page-Jones, Pearson Education
4. UML in 24 Hours
5. UML Basics— an Introduction to the Unified Modeling Language – IBM "www.ibm.com › Learn › Rational"

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Case Study and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL602	Business Intelligence lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL602	Business Intelligence Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods, and tools.
4. To learn how to gather and analyze large sets of data to gain useful business understanding.
5. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.
6. To identify and compare the performance of business.

Lab Outcomes: Students should be able to:

1. Identify sources of Data for mining and perform data exploration
2. Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files.
3. Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open source tools like WEKA
4. Implement various data mining algorithms from scratch using languages like Python/ Java etc.
5. Evaluate and compare performance of some available BI packages
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	Software
PC i3 or above.	Open source data mining and BI tools like WEKA, Rapid Miner, Pentaho.

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
1 & II	2 tutorials a) Solving exercises in Data Exploration b) Solving exercises in Data preprocessing	04	LO 1 LO 2
III	Using open source tools Implement a) Classifiers b) Clustering Algorithms c) Association Mining Algorithms	06	LO 3
IV	a) Implementation of any one classifier using languages like JAVA/ python/R b) Implementation of any one clustering algorithm using languages like JAVA/ python c) Implementation of any one association mining algorithm using languages like JAVA/ python	06	LO 4
V	Detailed case study of any one BI tool (open source tools like Pentaho can be used) (paper Assignment)	04	LO 5
VI	**Business Intelligence Mini Project**: Each group assigned one new case study for this; A BI report must be prepared outlining the following steps: a)Problem definition, Identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA site, UCI Machine Learning Repository, KDD site, KDD Cup etc. c) Implement the data mining algorithm of choice	06	LO 6

	d) Interpret and visualize the results e) Provide clearly the BI decision that is to be taken as a result of mining.		

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, 1st Edition, Wiley India.

References:

1. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
2. WEKA, RapidMiner Pentaho resources from the Web.

Term Work:
Term Work shall consist of at least 10 to 12 practical’s based on the below list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL603	Cloud Service Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL603	Cloud Service Design Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students to get familiar with:

1. Key concepts of virtualization & different types of Hypervisors used in virtualization along with implementation
2. Concept of On demand Application Delivery like SaaS using Ulteo
3. Open source cloud implementation and administration using Open Stack
4. Various Cloud services provided by Amazon Web Services
5. Programming on Platform as a Service cloud
6. Implementation of Storage as a service using Own Cloud.

Lab Outcomes: Students should be able to:

1. Define & implement Virtualization using different types of Hypervisors
2. Describe steps to perform on demand Application delivery using Ulteo .
3. Examine the installation and configuration of Open stack cloud
4. Analyze and understand the functioning of different components involved in Amazon web services cloud platform.
5. Describe the functioning of Platform as a Service
6. Design & Synthesize Storage as a service using own Cloud

Prerequisite Subjects: Computer Network, Operating System, Java Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
a)Hardware Configuration for server 1.Intel or AMD Multi Core processors (like i3/i5/i7/Quad core/Octa core) with Intel VT-X or AMD-V support	**a) Software Requirements for Server** 1.Server OS for Physical Sever like CentOS /Fedora/Ubuntu/ Redhat Server 2.Pre-configured OpenSSH	1. Internet Connection for each PC with at least 2 MBPS bandwidth and LAN bandwidth of 1 GBPS.

2. 6 GB RAM 3. 500 GB Harddisk 4. Gigabit Ethernet (GbE) network interface card (NIC) **b)Hardware Configuration for Cloud Client** PC/Laptop/Smart phone/Thin Client or Any device which has built-in Wifi, Ethernet or data connection facility.	3.Xen Server DVD 4.Ulteo DVD **a) Software Requirements for Clients** 1. JDK 1.8 or higher & .NET Framework 4 2. Netbeans or Eclipse IDEs 3. OpenSSH client or putty 4.Vmware Workstation, 5.Oracle Virtualbox 6. Built-in web browser.	

Suggested List of Experiments

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Virtualization	1. Creating and running virtual machines on Hosted Hypervisors like KVM Type 1 ,Vmware Workstation,Oracle Virtualbox 2. Creating and running virtual machines on Bare-Metal Hypervisors Type 0 like Xen,Vmware ESXI or HyperV	06	LO1
II	On demand Application Delivery and Virtual Desktop infrastructure	Installation and Configuration of Ulteo to demonstrate on demand Application delivery over web browser to explore SaaS Environment.	04	LO2
III	Open source cloud implementation and administration	To demonstrate installation and Configuration of Open stack Private cloud.	04	LO3
IV	Amazon Web Services	Like auto scaling, elastic load balancing, virtual private computing & Networking. Security service provided by Amazon web services. Accessing AWS using	06	LO4

		web services API provided by Amazon.		
V	Platform as a Service	To Demonstrate Platform as a Service using Googleapp Engine/IBM BlueMix/tSuru	04	LO5
VI	Storage as a Service	Explore Storage as a service using own Cloud for remote file access using web interfaces. S3 storage and glacier storage and understand the storage LC management provided by AWS.	02	LO6

Text Books:

1. Barrie Sosinsky ,"Cloud Computing Bible",Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr.Deven Shah, "Cloud Computing Black Book", Dreamtech Press.
3. Joe Baron et.al ,"AWS certified solution Architect", Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Learn to Master Cloud Computing by Star EduSolutions
2. Kai Hwang,"Distributed and Cloud Computing",MK Publication
3. Thomas Erl,Robert Cope,Amin naserpour,"Cloud Computing Design Patterns",Pearson Publication.
4. Judith Hurwitz ,"Cloud Computing for Dummies" , Wiley Publication.

Web Resources:

1. http://fosshelp.blogspot.in
2. https://aws.amazon.com/
3. https://docs.openstack.org/
4. https://owncloud.org/
5. https://appengine.google.com

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the below list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL604	Sensor Network Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of twoTests					
ITL604	Sensor Network Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do survey for different application using different types of sensors for their mini project.

4. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.

5. Design your own circuit board using multiple sensors etc.

6. Installation, configure and manage your sensors in such away so that they can communicate with each other.

7. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.

8. Create and interface using Mobile/Web to publish or remotely access the data on Internet.

9. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.

10. Each group may present their work in various project competitions and paper presentations.

11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
2. Contiki Cooja User Guide.

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
2. A comparative review of wireless sensor network mote technologies, IEEE paper 2009

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM605	Mini-Project	--	04	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM605	Mini-Project	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students

2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.

3. Department has to allocate half day for the project work in VI semester, 1 day in VII semester and 2 day in VIII semester every week.

4. To encourage project based learning in the curriculum students may identify their technical domain area in semester VI and can perform the Mini-project in the VI semester or students may do literature survey

5. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.

6. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.

7. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.

8. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.

9. Teams must analyze all the results obtained by comparing with other standard techniques.

10. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

11. The team will finally propose a plan for project work to be continued in the final year.

12. Semester VII to carry out the project good quality project and all these project part

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.

2. Each team will prepare a report that will summarize the results of the literature survey and the project proposal. The list of papers surveyed must be clearly documented.

3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.

4. Oral exam will be conduct on the project done by the students.

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Mini Project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6021	Advance Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6021	Advance Internet Programming	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To get familiar with the concept of Search Engine Basics.
2. To Understand Search Engine Optimization Techniques.
3. To Learn Web Service Essentials.
4. To gain knowledge of Rich Internet Application Technologies.
5. To be familiarized with Web Analytics 2.0
6. To explore Web 3.0 and Semantic web standards.

Course Outcomes: Students will be able to:

1. Determine SEO Objectives and Develop SEO plan prior to Site Development.
2. Explain Search Engine Optimization Techniques and Develop Keyword Generation.
3. Describe different Web Services Standards.
4. Develop Rich Internet Application using proper choice of Framework.
5. Apply multiple quantitative and qualitative methods for web analytics 2.0.
6. Explain Web 3.0 and Semantic web standards

Prerequisite: Basics of Internet Programming – HTML5, CSS3, XML.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to HTML 5 & CSS3 basics, XML basics	02	
I	Search Engine Basics	Search Engine Basics Algorithm based Ranking Systems – Determining Searcher Intent and Delivering Relevant, Fresh Content, Analyzing Ranking Factors, Using Advanced Search Techniques, Vertical Search Techniques, Country Specific search engines. Determining SEO Objective and Finding Your Site's Audience – Setting SEO Goals and Objective Developing SEO plans Prior to Site Development, SEO for Raw traffic ; E-commerce Sales; Mindshare/Branding; Direct Marketing; Reputation Management; Ideological Influence	09	CO1
II	Search Engine Optimization	Getting started SEO: Defining Your Site's Information Architecture, Auditing an Existing Site to identify SEO Problems, Identifying Current Server Statistic Software and Gaining Access – Determining Top competitors, Benchmarking Current Indexing Status, Current Rankings, Benchmarking Current Traffic Source and Volumes, Conduct SEO/Website SWOT analysis. Keyword Generation – Creating Pages – Website Structure- Creating Content-Creating Communities- building Links-Using Google Analytics-Social Media Optimization-Creating Pay-per-click Campaigns- Optimizing PPC Campaigns through Quality Score optimization - Tracking Results and Measuring Success.	09	CO1 CO2
III	Web Services	Web Services: Introduction to Web Services, XML, XSL, XSLT, WSDL, SOAP, UDDI, Transaction, Business Process Execution Language for web Services, WS-Security and web service security specification, WS-Reliable Messaging, WS-Policy, WS-Attachments. REST-ful web services, Resource Oriented Architecture, Comparison of REST, SOA, SOAP.	08	CO1 CO2 CO3
IV	Rich Internet Application	**Introduction to AJAX**, Blogs, Wikis, RSS feeds **Working with Java Script Object Notation (JSON)**, Implement JSON on server side,	08	CO4

		Implementing Security and Accessibility in AJAX Applications: Secure AJAX application, Accessible Rich Internet Applications **Developing RIA using AJAX Techniques:** CSS, HTML, DOM, XMLHTTPRequest, JavaScript, PHP, AJAX as REST Client **Introduction to Open Source Frameworks and CMS for RIA:** Django, Drupal, Joomla introduction and comparison.		
V	Web Analytics 2.0	Introduction to Web Analytics 2.0 1: State of the Analytics Union, State of the Industry, Rethinking Web Analytics: Meet Web Analytics 2.0, Optimal Strategy for Choosing Your Web Analytics Soul Mate. The Awesome World of Clickstream Analysis: Metrics. The Key to Glory: Measuring Success. Failing Faster: Unleashing the Power of Testing and Experimentation.	08	CO4 CO5
VI	Web 3.0 and Semantic Web	**Web 3.0 and Semantic Web**: Challenges, Components, Semantic Web Stack: RDF, RDF Schema (RDFS), Simple Knowledge Organization System (SKOS), SPARQL as RDF query language, N-Triples as a format for storing and transmitting data, Turtle (Terse RDF Triple Language), Web Ontology Language (OWL) a family of knowledge representation languages, Rule Interchange Format (RIF), a framework of web rule language dialects supporting rule interchange on the Web	08	CO4 CO5 CO6

Text Books:

1. The Art of SEO O'Reilly Publication
2. Web Services Essentials by Ethan Cerami O'Reilly Media
3. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, by Avinash Kaushik, ISBN: 978-0-470-52939-3, wiley publication.
4. "Semantic Web Technologies: Trends and Research in Ontology-based Systems", by John Davies, Rudi Studer, and Paul Warren John, Wiley & Son'
5. Advance Internet Technology by Dr. Deven Shah Dreamtech.

References:

1. RESTful Web Services, By Leonard Richardson, Sam Ruby, O'Reilly Media
2. Rich Internet Application AJAX and Beyond WROX press
3. Handbook of Semantic Web Technologies, by John Domingue, Dieter Fensel, Springer Reference
4. Tim O'Reilly, What is Web 2.0? : Design Patterns and Business Models for the Next Generation of Software, O'REILLY

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO6022	Software Architecture	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6022	Software Architecture	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of architecture in building effective, efficient, competitive software product.
2. To understand principal design decisions governing the system.
3. To understand role of architecture in software engineering
4. To understand designing application from architectural perspective
5. To understand different notations used for capturing design decisions.
6. To understand different functional and non-functional properties of complex software systems.

Course Outcomes Students will be able to:

1. Students will cite knowledge of various approaches to document a software system (Remembering)
2. Students will be able to describe functional and non-functional requirements (Understanding)
3. Students will be able to use proper architecture for software (Applying)
4. Students will be able to categorize different components used in the software system (Analyzing)
5. Students will be able to choose from different architectural styles (Evaluating)
6. Students will be able to improve quality of software by selecting proper architecture (Creating)

Prerequisite: Programming Language, UML

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Power of analogy: Architecture of the building, limitations of analogy, The reorientation of software engineering,	02	CO1
I	Introduction to Software Architecture and Software Product Life Cycle	Evolution of Software Development, Fundamentals of Software Engineering, Elements of Software Architecture. Management View, Software Engineering View, Engineering Design View, Architectural View,	07	CO1 CO2
II	Architectural Design Process and Introduction to Software Design	Understanding the problem, Identifying design elements and their relationship, Evaluating the Architecture, Transforming the Architecture, Problems in Software Architectural Design, Function form and Fabrication, The scope of Design, Psychology and Philosophy of Design, General Methodology of Design	09	CO1 CO2 CO3
III	Complexity, Modularity, Models and Knowledge Representation	Complexity, Modularity, What are Models, What are Models used for, What roles do Models Play, Modeling the Problem and Solution Domain, Views,	09	CO1 CO4
IV	Architecture Representation and Architectural Design Principles	Goals of Architecture Representation, Foundation of Architectural Representation, Architectural Description Language, Architectural Level of Design, Architecting with Design Operators, Functional Design Strategies.	09	CO4
V	Architectural Styles, Patterns and Meta models	Defining Architectural Patterns and Style, Common Architectural Styles, Understanding Metamodels, Applying Reference Models, Fundamental Metamodel for describing Software Component	08	CO4 CO5
VI	Architectural Description and Architectural	Standardizing Architectural Description, Creating an Architectural Description, Applying	08	CO1

	Framework, Architecture Quality	Architectural Description, Software Architecture Framework, 4+1 View Model of Architecture, Reference Model for Open Distributed Processing, Importance of Assessing Software Quality, How to improve Quality. DevOps practice and Architecture.		CO6

Text Books:

1. The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
2. Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.

References:

1. Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson.
2. DevOps A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6023	Digital Forensics	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6023	Digital Forensics	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber crime
2. To explore practical knowledge about ethical hacking Methodology.
3. To learn the importance of evidence handling and storage for various devices
4. To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyzed the ways that exploits in securities.
5. To investigate attacks, IDS .technical exploits and router attacks and “Trap and Trace” computer networks.
6. To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Outcomes: Student will able to:

1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences .
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection .
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis
6. List the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools .

Prerequisite: Cryptography and Security, Computer Networks

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Cryptography and Security ,Computer Networks	2	
I	Introduction to Cyber Crime and Ethical Hacking	**Introduction of Cybercrime**: Types of cybercrime ,categories of cybercrime , Computers' roles in crimes, Prevention from Cyber crime, Hackers, Crackers, Phreakers **Ethical Hacking** :Difference between Hacking and Ethical hacking : Steps of Ethical Hacking, Exploring some tools for ethical hacking: reconnaisance tools, scanning tools	6	CO1
II	Introduction to Digital Forensics and Digital Evidences	**Digital Forensic** ,Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, **Digital Evidences** : Types and characteristics and challenges for Evidence Handling	6	CO2
III	Computer Security Incident Response Methodology	**Introduction to Computer Security Incident** Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, **IR Process** – Initial Response, Investigation, Remediation, Tracking of Significant ,Investigative Information, Reporting **Pre Incident Preparation,** Incident Detection and Characterization. **Live Data Collection** : Live Data Collection on Microsoft Windows Systems: Live Data	11	CO3

		Collection on Unix-Based Systems		
IV	Forensic Duplication and Disk Analysis, and Investigation	**Forensic Duplication** Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools **Disk and File System Analysis:** Media Analysis Concepts, File System Abstraction Model The Sleuth Kit : Installing the Sleuth Kit , Sleuth Kit Tools Partitioning and Disk Layouts : Partition Identification and Recovery, Redundant Array of Inexpensive Disks Special Containers : Virtual Machine Disk Images , Forensic Containers Hashing, Carving : Foremost , Forensic Imaging : Deleted Data , File Slack , dd , dcfldd , dc3dd **Data Analysis** Analysis Methodology Investigating Windows systems , Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis	11	CO4
V	Network Forensics	Technical Exploits and Password Cracking , Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks , Analyzing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools	9	CO5
VI	Forensic Investigation	**Report** :Goals of Report, Layout of an		

	Report and Forensic Tools	Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report . **Computer Forensic Tools** : need and types of computer forensic tools, task performed by computer forensic tools . Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence	7	CO6

Text Books:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.
2. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic : The fascinating world of Digital Evidences " Wiley India Pvt Ltd 2017.
3. Cory Altheide, Harlan Carvey "Digital forensics with open source tools "Syngress Publishing, Inc. 2011.
4. Chris McNab, Network Security Assessment, By O'Reily.

References:

1. Clint P Garrison "Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
2. Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations" . Cengage Learning, 2014
3. Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.
4. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6024	Multimedia Systems	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6024	Multimedia Systems	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To learn and understand technical aspect of Multimedia Systems.
2. To understand the standards available for different audio, video and text applications.
3. To Design and develop various Multimedia Systems applicable in real time.
4. To learn various multimedia authoring systems.
5. To understand various networking aspects used for multimedia applications.
6. To develop multimedia application and analyze the performance of the same.

Course Outcomes: Students will be able to:

1. Developed understanding of technical aspect of Multimedia Systems.
2. Understand various file formats for audio, video and text media.
3. Develop various Multimedia Systems applicable in real time.
4. Design interactive multimedia software.
5. Apply various networking protocols for multimedia applications.
6. To evaluate multimedia application for its optimum performance.

Prerequisite: Knowledge of computer graphics, computer networking and database systems.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of database, computer networks and computer graphics.	2	--
I	Multimedia Systems Design: An Introduction	Multimedia Elements. Multimedia Systems Architecture, Evolving Technologies for Multimedia Systems, Defining Objects For	9	CO1

		Multimedia Systems. Multimedia Data Interface Standards. The Need for Data Compression. Multimedia applications including digital libraries, system software , streaming videos and its applications.		
II	Compression and Decompression Data and File Format Standards	Types of Compression. Image Compression Schemes. Video Compression. Audio Compression. Rich-Text Format. TIFF File Format. Resource Interchange File Format (RIFF), MIDI File Format. JPEG DIB File Format for Still and Motion Images. JPEG Still Image. AVI video File Format. MPEG Standards.	10	CO1 CO2
III	Multimedia Application Design	Multimedia Application Classes. Types of Multimedia Systems. Virtual Reality Design. Components of Multimedia Systems. Multimedia database issues and solutions. Organizing Multimedia Databases.	8	CO1 CO2 CO3
IV	Multimedia Authoring, User Interface and	Multimedia Authoring Systems. Hypermedia Application Design Considerations. User Interface Design. Information Access. Object Display/Playback Issues	7	CO4
V	Distributed Multimedia Systems	Components of a Distributed Multimedia System. Distributed Client-Server Operation. Middleware in Distributed Workgroup Computing. Multiserver Network Topologies. Distributed Multimedia Databases. Managing Distributed Objects. Application Workflow Design Issues. Distributed Application Design Issues	8	CO4 CO5
VI	System Design: Methodology and Considerations.	Fundamental Design Issues. Determining Enterprise Requirements. Examining Current Architecture and Feasibility. Performance Analysis. Designing for Performance Multimedia System Design. System Extensibility. Multimedia Systems Design Example.	8	CO5 CO6

Text Books:

1. **Prabhat K. Andleigh, Kiran Thakrar** "Multimedia Systems Design" 1/e, Pearson , ISBN 978-93-325-4938-8
2. Fundamentals of Multimedia by Ze-Nian Li& Mark.S.Drew
3. Introduction to Multimedia Communication, Application, Middleware, Networking by K.R.Roa, Zoran S,Bojkovic & Dragorad A. Milovanovic.

References:

1. Organization of Multimedia Resources: Principles and Practice of Information Retrieval by Mary A. Burke
2. Multimedia Systems Design by Prabhat K.Andleigh/ Kiran Thakrar

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6025	Green IT	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6025	Green IT	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand what Green IT is and How it can help improve environmental Sustainability
2. To understand the principles and practices of Green IT.
3. To understand how Green IT is adopted or deployed in enterprises.
4. To understand how data centres, cloud computing, storage systems, software and networks can be made greener.
5. To measure the Maturity of Sustainable ICT world.
6. To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes: Students will be able to:

1. Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement
2. Identify IT Infrastructure Management and Green Data Centre Metrics for software development
3. Recognize Objectives of Green Network Protocols for Data communication.
4. Use Green IT Strategies and metrics for ICT development.
5. Illustrate various green IT services and its roles.
6. Use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.

Prerequisite: Environmental Studies

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy , Green IT: Burden or Opportunity? **Hardware:** Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. **Software:** Introduction, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power.	9	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics	9	CO1 CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards.	9	CO1 CO3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT.	8	CO1 CO4

V	Green it services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	9	CO1 CO4 CO5
VI	Managing and regulating green it	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centres, Social Movements and Greenpeace.	6	CO1 CO5 CO6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT,WILEY 1st Edition-2013
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach , Elsevier 2015
3. Reinhold, Carol Baroudi, and Jeffrey HillGreen IT for Dummies, Wiley 2009

References:

1. Mark O'Neil , Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2.Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

AC 11.5.2017

Item No. 4.180

UNIVERSITYOFMUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Information Technology

Second Year with Effect from **AY 2017-18**

Third Year with Effect from **AY 2018-19**

Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Preamble

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.
Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.
Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.
The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.
I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.
I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Outcome for graduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

Chairman (Ad-hoc Board Information Technology)
University of Mumbai)

B. E. Information Technology (Semester-VII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC701	Enterprise Network Design	4	-	-	4	-	-	4
ITC702	Infrastructure Security	4	-	-	4	-	-	4
ITC703	Artificial Intelligence	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO-I	Institute Level Optional Course-I	3	-	-	3	-	-	3
ITL701	Network Design Lab	-	2	-	-	1		1
ITL702	Advanced Security Lab	-	2	-	-	1		1
ITL703	Intelligence System Lab	-	2	-		1		1
ITL704	Android Apps Development Lab	-	2			1		1
ITM705	Project-I	-	6/8			3	-	3
	Total	**19**	**14**	-	**19**	**7**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC701	Enterprise Network Design	20	20	20	80	3	-		-	100
ITC702	Infrastructure Security	20	20	20	80	3	-		-	100
ITC703	Artificial Intelligence	20	20	20	80	3	-		-	100
ITDLO-II	Department Level Optional Course -III	20	20	20	80	3	-		-	100
ILO-I	Institute Level Optional Course-I	20	20	20	80	3	--		-	100
ITL701	Network Design Lab	-	-	-	-	-	25	25	--	50
ITL702	Advanced Security Lab	-	-	-	-	-	25	25	--	50
ITL703	Intelligence System Lab	--	-	-	-	--	25	25	--	50
ITL704	Android Apps Development Lab						25	25	--	25
ITM705	Project-I	-	-	-	-	-	50	25	--	75
Total		100	100	100	400		150	125	--	750

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VII, which is

not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VII			
ITDLO7031	Storage Area Networks	ILO7011	Product Lifecycle Management
ITDLO7032	Mobile Application Development	ILO7012	Reliability Engineering
ITDLO7033	High Performance Computing	ILO7013	Management Information System
ITDLO7034	Software Testing and Quality Assurance	ILO7014	Design of Experiments
ITDLO7035	Soft Computing	ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC701	Enterprise Network Design	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC701	Enterprise Network Design	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To be familiarized with the methodologies and approaches of the network design for an enterprise network.
2. To understand the network hierarchy and use modular approach to network design for an enterprise network.
3. To understand the campus design and data center design considerations for designing an enterprise campus.
4. To study Enterprise Edge WAN Technologies and design a WAN using them
5. Designing an IP addressing plan and selecting a Route protocol for an enterprise network.
6. To design enterprise network for given user requirements in an application.

Course Outcomes: Student should be able to:

1. Understand the customer requirements and Apply a Methodology to Network Design
2. Structure and Modularize the Network
3. Design Basic Campus and Data Center Network.
4. Design Remote Connectivity
5. Design IP Addressing and Select suitable Routing Protocols for the Network
6. Compare Openflow controllers and switches with other enterprise networks.

Pre-requisite: Computer Networks

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1. OSI Reference Model and TCP/IP Protocol Suite 2. Routing IP Addresses 3. Internetworking Devices	02	
I	Applying a Methodology to Network Design:	The Cisco Service Oriented Network Architecture, Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites, Using the Top-Down Approach to Network Design, The Design Implementation Process.	08	CO1, CO6
II	Structuring and Modularizing the Network:	Network Hierarchy, Using a Modular Approach to Network Design, *Services Within Modular Networks, Network Management Protocols and Features*	09	CO2, CO6
III	Designing Basic Campus and Data Center Networks	Campus Design Considerations, Enterprise Campus Design, Enterprise Data Center Design Considerations	09	CO3, CO6
IV	Designing Remote Connectivity	Enterprise Edge WAN Technologies, WAN Design, Using WAN Technologies, Enterprise Edge WAN and MAN Architecture, Selecting Enterprise Edge Components, Enterprise Branch and Teleworker Design.	09	CO4, CO6
V	Designing IP Addressing in the Network & Selecting Routing Protocols	Designing an IP Addressing Plan, Introduction to IPv6, Routing Protocol Features, Routing Protocols for the Enterprise, Routing Protocol Deployment, *Route* Redistribution, Route Filtering, Redistributing and Filtering with BGP, Route Summarization	10	CO5
VI	Software Defined	Understanding SDN and Open Flow : SDN – SDN Building		CO6

	Network	Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , POX and NOX, Open Flow in Cloud Computing, Case study: how SDN changed Traditional Enterprise network Design	05	

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.
3. CCDA Cisco official Guide
4. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky

References:

1. Top-Down Network Design (Networking Technology) 3rd Edition, Priscilla Oppenheimer ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, Shaun Hummel

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC702	Infrastructure Security	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC702	Infrastructure Security	20	20	20	80	--	--	100

Course Objectives: Students will try :

1. To understand underlying principles of infrastructure security
2. To explore software vulnerabilities, attacks and protection mechanisms
   To learn security aspects of wireless network infrastructure and protocols
3. To investigate web server vulnerabilities and their countermeasures
4. To develop policies for security management and mitigate security related risks in the organization
5. To Learn the different attacks on Open Web Applications and Web services.
6. To Learn the different security policies.

Course Outcomes: Students will be able to:

1. Understand the concept of vulnerabilities, attacks and protection mechanisms
2. Analyze and evaluate software vulnerabilities and attacks on databases and operating systems
3. Explain the need for security protocols in the context of wireless communication
4. Understand and explain various security solutions for Web and Cloud infrastructure
5. Understand, and evaluate different attacks on Open Web Applications and Web services
6. Design appropriate security policies to protect infrastructure components

Prerequisite: Computer Networks, Cryptography and Network Security

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction	Cyber-attacks, Vulnerabilities, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC,MAC, RBAC, ABAC, BIBA, Bell La Padula), Authentication and Access Control Services- RADIUS, TACACS, and TACACS+	6	CO1

II	Software Security	**Software Vulnerabilities:** Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits **Operating System Security:** Memory and Address Protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security **Database Security:** Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security	12	CO2
III	Wireless Security	Mobile Device Security- Security Threats, Device Security, GSM, UMTS and 4G Security, IEEE 802.11xWireless LAN Security, VPN Security, Wireless Intrusion Detection System (WIDS)	9	CO3
IV	Cloud Security	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth	8	CO4
V	Web Security	Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, DNS Attacks, Web Service Security, Secure Electronic Transaction, Email Attacks, Web Server Security as per OWASP, Firewalls, Penetration Testing	12	CO4, CO5
VI	Information Security and Risk Management	Security Policies, Business Continuity Plan, Risk Analysis, Incident Management, Legal System and Cybercrime, Ethical Issues in Security Management.	5	CO6

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wiley

Reference Books:

1. Web Application Hackers Handbook by Wiley.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. CCNA Security Study Guide, Tim Boyle, Wiley
4. Introduction to Computer Security, Matt Bishop, Pearson.
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O'Riely

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC703	Artificial Intelligence	04 Hr/Week		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC703	Artificial Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
3. To review the different stages of development of the AI field from human like behavior to Rational Agents.
4. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
5. To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. that play an important role in AI programs.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

Course Outcomes: Students will be able to:

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing to problems leading to understanding of cognitive computing. .

Prerequisite: Programming, Data Structures.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisites**	Knowledge of any programming language, Data structures.	**2**	**--**
I	Introduction to Intelligent Systems and Intelligent Agents	Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent.	07	CO 1 CO 2
II	Search Techniques	**Uninformed Search**: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. **Informed Search:** Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*, **Constraint Satisfaction Programming**: Crypto Arithmetic, Map Coloring, N-Queens. **Adversarial Search:** Game Playing, Min-Max Search, Alpha Beta Pruning	11	**CO 2** **CO 3**
III	Knowledge and Reasoning	A Knowledge Based Agent, Overview of Propositional Logic, First Order Predicate Logic, Inference in First Order Predicate Logic: Forward and Backward Chaining, Resolution.	10	**CO 4**
IV	Planning	Introduction to Planning, Planning with State Space Search, Partial Ordered planning, Hierarchical Planning, Conditional Planning.	06	**CO 4**
V	Uncertain Knowledge and Reasoning	Uncertainly, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks, Simple Inference in Belief Networks.	06	**CO 5**
VI	Natural Language	Language Models, Natural Language for Communication:	10	**CO 6**

	Processing	Syntactic Analysis, Augmented Grammars and Semantic Interpretation, Machine Translation. **Overview of Cognitive Computing:** Foundation of Cognitive Computing, List of Design Principles for Cognitive Systems, Natural Language Processing in Support of a Cognitive System **(First three chapters from Text book 3)**		

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition
3. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Lugar, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
2. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
5. John Kelly , Steve Hamm, Smart Machines - IBM′s Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL701	Network Design Lab	--	2	--	--	2	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral	Practical & Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL701	Network Design Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To be familiarized with the requirements of an enterprise and address its major design areas
2. To recognize the hierarchical network model for the enterprise
3. Identify the networking devices and their configurations required for the design and also prepare a bill of materials
4. Propose a design for the Server Farm of an enterprise network and discuss up gradations if needed.
5. Provide suitable IP addressing plan and best possible routing protocol for an enterprise network.
6. Construct a suitable design for an enterprise network and test it using a tool.

Lab Outcomes: Students will be able to:

1. Understand the requirements of an enterprise and outline its major design areas
2. Identify functional areas to construct high level modules for enterprise architecture and analyze them.
3. Identify the networking devices, prepare a bill of materials and configure the devices as per the Core, Acess and Distribution layers
4. Design the Server Farm for an enterprise network and discuss up gradations if needed.
5. Identify and select the technology for Remote site Connectivity**,** suitable IP addressing plan and routing protocol for an enterprise network.
6. Test and monitor the enterprise network using a tool

Prerequisite: Computer Networks.

Guidelines

1. The case study of College Campus Network must be designed as a mini project work which is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the requirements of a College campus enterprise network.
4. The students must outline the major design areas of a College campus enterprise network.
5. The students must identify the functional areas and construct high level modules for the College campus enterprise architecture.
6. The students must analyze the existing College campus enterprise network and propose up gradations to existing infrastructure.
7. The students must identify the network devices required and their locations to design a College campus enterprise network.
8. The students must configure the network devices required as per the Core Layer, Access Layer and Distribution Layer.
9. The students must Design the Server Farm for enterprise network using a configuration tool and also discuss if any other improvement is required.
10. The students must Prepare a bill of materials of all the networking devices. Develop a Request for Proposal-RFP for the enterprise network
11. The students must identify the technology for Remote Site connectivity and evaluate it as per the application requirements of the college campus enterprise network.
12. Propose a suitable IP addressing plan for the enterprise network.
13. Determine a suitable routing protocol for the enterprise network.
14. Create and Test the designed college campus enterprise network using a tool.
15. Use Nagios tool for enterprise infrastructure monitoring tool
16. Each group may present their work in various project competitions and paper presentations.
17. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
2. Designing and Supporting Computer Networks, CCNA Discovery Learning Guide (Cisco Systems Networking Academy Program) Paperback – 2008, Kenneth Stewart , Aubrey Adams, Allan Reid , Jim Lorenz.

References:

1. 1. Top-Down Network Design (Networking Technology) 3rd Edition, Priscilla Oppenheimer ,Cisco Press Book
2. Network Planning and Design Guide Paperback – 2000, Shaun Hummel

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITL702	Advance Security Lab	--	02	-	--	01	-	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL702	Advance Security Lab	--	--	--	--	25	--	25	50

Lab Objective: Students will try to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Lab Outcome: Students will able to:

1. Implement and analyze program and database vulnerabilities Buffer overflow and SQL Injection.
2. Explore and analyze different security tools to secure mobile devices, web browser, wireless network and router
3. Explore reconnaissance, attack and forensics tools in Kali Linux
4. Learn security of system using personal firewall installation
5. Understand AAA using RADUIS
6. Understand AAA using TACACS

Prerequisite: Computer Networks, Cryptography and Network Security.

Hardware	**Software**
PC i3 or above configuration.	Kali Linux, Java, Snort, Kismet, Metasploit, Wireshark, Droidcrypt

Detail Syllabus:

Sr. No	Description	Hours	CO mapping
1	Exploring Kali Linux and the inbuilt tools for reconnaissance and ethical hacking.	2	LO3
2	Implementation and analysis of SQL injection Attack	4	LO1
3	Implementation of Buffer overflow attack and its analysis using Splint, Cppcheck etc.	2	LO1
4	Setting up personal Firewall using Iptables	2	LO4
5	Exploring wireless security tools like Kismet, NetStumbler etc.	2	LO2
6	Performing a penetration testing using Metasploit	2	LO3
7	Exploring Router security, access lists using packet tracer	2	LO2
8	Exploring VPN security using Packet tracer	2	LO2
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+	2	LO5

10	Install and use a security app on an Android mobile (e.g. Droidcrypt)	2	LO2
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data	2	LO3
12	Configuration of mod Security, core rule set on apache server.	2	LO2

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, TIm Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL703	Intelligence System Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL703	Intelligence System Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try:

1. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems
2. To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques.
3. To make students understand various AI methods like searching and game playing and how to apply them to solve real applications
4. To explain to students the basic issues of knowledge representation and Logic so as to build inference engines
5. To impart a basic understanding of some of the more advanced topics of AI such as planning.
6. To understand Bayes networks, natural language processing and introduce concept of cognitive computing.

Course Outcomes: Students will be able to:

1. Design the building blocks of an Intelligent Agent using PEAS representation .
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
4. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
5. Formulate and solve problems with uncertain information using Bayesian approaches.
6. Apply concept Natural Language processing and cognitive computing for creation of domain specific ChatBots.

Hardware	**Software**
PC i3 or above configuration.	Java Python

Detailed syllabus:

Module No.	Detailed Content	Hours	LO Mapping
1	Tutorial exercise for a) Design of Intelligent System using PEAS. b) Problem Definition with State Space Representation	2	LO 1, LO 2
11	Implementation of Uninformed and Informed Search Algorithms.	6	LO 2
111	Implementation of CSP and Game playing algorithms .	4	LO 3
1V	a) Assignment on Predicate Logic, for forward and backward reasoning and resolution. b) Design of a Planning system using STRIPS.	4	LO 4
V	Implementation of Bayes' Belief Network.	2	LO 5
VI	**Mini project** Construction of a domain specific ChatBot using Natural Language Processing techniques. (Applications can include : Medical Diagnosis, Personal Shopping Assistant, Travel Agent , Trouble shooting etc.)	8	LO6

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.

2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley India

References:

1. George Lugar, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.

2. John Kelly , Steve Hamm, Smart Machines - IBM′s Watson and the Era of Cognitive Computing, Columbia Business School Publishing

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment + Mini-Project) + 5 Marks (Attendance) **Oral Exam:** An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL704	Android Apps Development Lab		2			1		1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of twoTests					
ITL704	Android Apps Development Lab	--	--	--	--	25	--	25	50

Hardware	**Software**
PC i3 or above configuration.	Java Android SDK

Lab Objectives: Students will try:

1. To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment.
2. To learn designing of User Interface and Layouts for Android App.
3. To learn how to use intents to broadcast data within and between Applications.
4. To use Content providers and Handle Databases using SQLite.
5. To introduce Android APIs for Camera and Location Based Service.
6. To discuss various security issues with Android Platform.

Lab Outcomes: Students will be able to:

1. Experiment on Integrated Development Environment for Android Application Development.
2. Design and Implement User Interfaces and Layouts of Android App.
3. Use Intents for activity and broadcasting data in Android App.
4. Design and Implement Database Application and Content Providers.
5. Experiment with Camera and Location Based service.
6. Develop Android App with Security features.

Prerequisite: Java Programming, Internet Programming**.**

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do survey for different application which they can create Apps using Android.

4. Students will do Installation, configuration of Android Studio & to create AVD and also try for Cross platform Integrated Development Environment (Any Open Source Tool).

5. Students will try to Design and implement following points in their Mini Project (Android Apps)

    a. Widget box for Android phone.

    b. Use Layouts

    c. Use Intents

    d. Use Activity

    e. Use SQLite

    f. Use Camera

    g. Use Location API

    h. Generate APK file

6. Each group along with the concerned faculty shall identify a potential problem statement for Apps development, on which the study and implementation is to be conducted.

7. Each group may present their work in various project competitions and paper presentations.

8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1.Professional Android 4 Application Development by wrox publication
2.Android Cookbook by o'reilly
3. Beginning Android Development Wrox Press

References:

1. Android Application Development For Dummies, 2nd Edition by MichaelBurton, DonnFelker
2. Android Security –attack and defenses, AbhishekDubey and AnmolMisra by CRC Press

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM705	Project-I	--	06	--	--	3	--	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM705	Project-I	--	--	--	--	50	--	25	75

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.

6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.

7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.

8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.

9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.

10. Students will do testing and analyze in Sem VIII

11. Teams must analyze all the results obtained by comparing with other standard techniques.

12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.

2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.

3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.

4. Oral exam will be conduct on the project done by the students.

Term Work:
Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 50 Marks (Total marks) = 45 Marks (Project-I) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-I and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7031	Storage Area Network	04	--	--	04	--	01	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7031	Storage Area Network	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Understand the need for Storage Area Network and Data protection to satisfy the information explosion requirements
2. Study storage technologies: SAN, NAS, IP storage etc., which will bridge the gap between the emerging trends in industry and academics.
3. To get an insight of Storage area network architecture, protocols and its infrastructure.
4. To study and discuss the applications of SAN to fulfill the needs of the storage management in the heterogeneous environment..
5. Study and understand the management of Storage area Networks.
6. To understand and analyze case studies on the storage area network technology

Course Outcomes: Students will able to:

1. Students will analyze the limitations of the client-server architecture and evaluate the need for data protection and storage centric architectures such as Intelligent storage system..
2. Students will understand, interpret and examine various SAN technologies.
3. Students will describe and sketch the SAN architecture and its uses.
4. Students will classify the applications as per their requirements and select relevant SAN solutions.
5. Students will understand and evaluate different SAN management strategies to fulfill business continuity requirements.
6. Students will design case studies on NAS, SAN and SAN/ NAS

Prerequisite: Computer Networks, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Networking Protocols, File system and Memory management	02	
I	Introduction to Storage System	Introduction: Storage oriented architecture, Storage Systems, Data center Infrastructure, Challenges in managing information, Information life cycle; Basics of Storage System: Components of Storage System, Disk Drive components and Performance, Components of Host; Data Protection: Raid Components and types, RAID technologies and RAID levels, RAID impact on disk performance; Intelligent Storage System" Components of ISS, Storage Provisioning and types of ISS	09	CO1
II	Network Attached Storage	Storage on Network: NAS hardware and software architecture, NAS connectivity, NAS as a Storage System; NAS Hardware devices; NAS software components; NAS connectivity options: NAS connectivity hardware and Software Architecture.	07	CO2
III	Storage Area Networks	Architecture Overview: Creating Network for storage; Hardware devices: Fibre Channel Switch, Host Bus Adaptors, Putting the Storage in SANs, Fabric Operation from a hardware perspective, SAN hardware considerations ; Software Components: The switch's operating system, device drivers, the supporting components, considerations for SAN software ; Configuration options for SANs: Connecting into the data center, the evolving network and device connections, SAN configuration guidelines	10	CO3

IV	Applications-Putting it together	Defining the I/O workload: Storage planning and capacity planning, the definition and characterization of workloads, the business application, I/O content and workloads, Considerations for I/O workloads in storage networking ; Applying SAN solution: SAN workload characterization, applying SAN to OLTP workloads, transactional workloads; Applying NAS solution: NAS workload characterization, applying NAS to departmental workloads, enterprise web workloads and specialized workloads; Considerations when integrating SN and NAS: Differences and similarities, the need to integrate, future storage connectivity and integration	10	CO4
V	Management	Planning business continuity: Defining the environment, the role of storage networking in business continuity, storage design and implementation of the business continuity planning ; Managing availability: Availability Metrics, Implementing the plan ; Maintaining Serviceability: Tracking the configurations, Investigating the changes and closing the loop on serviceability; Capacity Planning: Storage Analysis, developing and implementing plan for storage, Modelling performance and capacity requirements ; Security considerations: Overview of Information security, Security methods, Storage Security challenges, FC SAN security, NAS security	09	CO5
VI	Case studies	Case studies on NAS, SAN, SAN/NAS	05	CO6

Text Books:

1. Storage Networks: The Complete Reference. Spalding, Robert ,Tata McGraw-Hill Education, 2003
2. “Storage Network Management and Retrieval”, Vaishali Khairnar, Nilima Dongre. Wiley

References:

1. Richard Barker, Paul Massiglia, “Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs”, Wiley India
2. Ulf Troppens,Wolfgang Muller-Friedt,Rainer Wolafka, “Storage Networks Explained” Wiley Publication
3. G. Somasundaram, Alok Shrivastava, “Information Storage and Management”, EMC Education services”, Wiley Publication

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITDLO7032	Mobile Application Development	04	-	-	04	-	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7032	Mobile Application Development	20	20	20	80	-	-	--	100

Course Objectives: Students will try:

1. To introduce Android platform and its architecture.
2. To learn activity creation and Android UI designing.
3. To be familiarized with Intent, Broadcast receivers and Internet services.
4. To work with SQLite Database and content providers.
5. To integrate multimedia, camera and Location based services in Android Application.
6. To explore Mobile security issues.

Course Outcomes: Students will be able to:

1. Describe Android platform, Architecture and features.
2. Design User Interface and develop activity for Android App.
3. Use Intent , Broadcast receivers and Internet services in Android App.
4. Design and implement Database Application and Content providers.
5. Use multimedia, camera and Location based services in Android App.
6. Discuss various security issues in Android platform.

Prerequisite: Internet Programming, Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of HTML5,CSS3 & XML	02	-
I	Introduction to Android and Architecture of	Introduction of Android platform, Android features ,Android Marketplace, Evolution of Android OS, Android	07	CO1

	Android	Application Architecture, Developing for Android, Developing for Mobile and Embedded Devices, Android Development Tools		
II	Applications, Activities and Building User Interface	Application: Application Manifest File,Externalizing Resources,Android Application Lifecycle and Android Application Class. Android Activity: Creating activities, Activity lifecycle and Android Activity classes. User Interface:Fundamental Android UI Design, Layouts, Fragments, Designing UI with views, Creating new views, widget toolbox, Adapters.	09	CO2
III	Intents, Broad cast receiver and Internet Resources	Introducing Intents, Linking Activities Using intents , Calling Built-in Applications Using intents , Displaying notifications, Creating Intent Filters and Broadcast Receivers,Downloading and Parsing Internet Resources,Using the Download Manager,Internet Services, Connecting to Google App Engine, Downloading Data Without Draining the Battery	09	CO3
IV	Data Persistence and Content Providers	Introducing Android Databases,Introducing SQLite, Content Values and Cursors,Working with SQLite Databases,Parsing an XMLdocument ,Parsing JSON data . Creating Content Providers, Using Content Providers,Adding Search to Your Application,Native Android Content Providers	09	CO4
V	Audio, Video ,Camera, Maps, Geocoding and Location Based services	Playing Audio and Video,Manipulating Raw Audio,Using Audio , Using the Camera for Taking Pictures,Recording Video,Using Media Effects ,Adding Media to the Media Store. Using Location-Based Services ,Using the Emulator with Location-Based Services,Selecting a Location Provider,Finding Your Current Location, Location Updates,Proximity Alerts,Geocoder, Map-Based Activities,Displaying Maps	08	CO5
VI	Securing and Publishing Android Application	Android Security Model,Android's Manifest Permissions,Mobile Security Issues,Recent Android Attacks,Pen Testing Android. Preparing for Publishing, Deploying	08	CO6

		APK Files		

Text Books:

1. Professional Android 4 Application Development,Retomeier, by wrox publication,
2. Android Security –attack and defenses, AbhishekDubey and AnmolMisra by CRC Press
3. Beginning Android Application Development, Wei-meng lee, by wrox publication

References:

1. Android Application Development For Dummies, 2nd Edition by Michael Burton, DonnFelker
2. Android Cookbook by o'reilly

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO7033	High Performance Computing	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7033	High Performance Computing	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1. Learn the concepts of parallel processing as it pertains to high-performance computing.
2. Learn to design parallel programs on high performance computing.
3. Discuss issues of parallel programming.
4. Learn the concepts of message passing paradigm using open source APIs.
5. Learn different open source tools.
6. Learn the concepts of Multi-core processor.

Course Outcomes: Students will be able to:

1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.
6. Design algorithms suited for Multicore processor and GPU systems using OpenMP and CUDA

Prerequisite: Computer Organization

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO mapping
1	Introduction	Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation), Parallel Architectures: Interconnection network, Processor Array, Multiprocessor	7	CO1
2	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	7	CO2
3	Parallel Algorithm Design	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Basic Communication operations: Broadcast and Reduction Communication types	12	CO3
4	Performance Measures	Performance Measures : Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks	5	CO4
5	Fundamental Design Issues in HPC	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations,	12	CO5

		One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication, Introduction to OpenMP,		
6	General Purpose Graphics Processing Unit(GPGPU)	CUDA enabled GPGPU, GPGPU architecture, GPGPU programming using CUDA, Introduction to CUDA Programming	9	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing", Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill, Second Edition, 2010.
3. Edward Kandrot and Jason Sanders, "CUDA by Example – An Introduction to General Purpose GPU Programming", Addison-Wesley Professional ©, 2010.
4. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

Reference Books:

1. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing: Technology, Architecture, Programming", McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, "High- Performance Computing: Paradigm and Infrastructure" Wiley, 2006.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7034	Software Testing and Quality Assurance	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7034	Software Testing and Quality Assurance	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1 Basic software debugging methods.
2 White box testing methods and techniques.
3 Black Box testing methods and techniques.
4 Designing test plans.
5 Different testing tools (familiar with open source tools)
6 Quality Assurance models.

Course Outcomes: Students will be able to:

1. Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.
2. Implement various test processes for quality improvement
3. Design test planning.
4. Manage the test process
5. Apply the software testing techniques in commercial environment
6. Use practical knowledge of a variety of ways to test software and an understanding of some of the trade-offs between testing techniques.

Prerequisite: Software Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Software Engineering Concepts**	02	--
I	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high level design, Verification of low level design, validation.	09	CO1
II	Testing Techniques	Dynamic Testing: Black Box testing: boundary value analysis, equivalence class testing, state table based testing, cause-effect graphing based testing, error guessing. White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, regression testing produces quality software, regression testability, objectives of regression testing, regression testing types, define problem, regression testing techniques.	08	CO2 CO3
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification. Software Metrics: need, definition and classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow	08	CO4

		matrix used for testing, function point and test point analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization its type , techniques and measuring effectiveness.		
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc.	09	CO1 CO5
V	Testing for specialized environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing	08	CO2 CO3
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO 9126 quality characteristics, ISO9000:2000, Software quality management	06	CO6

Text Books :

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication

References :

1. Effective Methods for Software Testing , third edition by Willam E. Perry, Wiley Publication

2. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , Dreamtech press

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO7035	Soft Computing	04	--	01	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO7035	Soft Computing	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To familiarize with soft computing concepts.
2. To introduce the fuzzy logic concepts, fuzzy principles and relations.
3. To Basics of ANN and Learning Algorithms.
4. Ann as function approximation.
5. Genetic Algorithm and its applications to soft computing.
6. Hybrid system usage, application and optimization.

Course Outcomes: Students will be able to:

1. List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2. Explain the concepts and meta-cognitive of soft computing.
3. Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4. Outline facts to identify process/procedures to handle real world problems using soft computing.
5. Evaluate various techniques of soft computing to defend the best working solutions.
6. Design hybrid system to revise the principles of soft computing in various applications.

Prerequisite: NIL

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Probability and Statistics, C++/Java/ Matlab	02	

		programming.		
I	Fuzzy Set Theory	Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Fuzzy composition Fuzzification and Defuzzification: Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification methods	06	CO1 CO2
II	Fuzzy Rules, Reasoning, and Inference System	Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.	06	CO1 CO2
III	Neural Network-I	Introduction: What is a Neural network? Fundamental Concepts, Basic Models of Artificial Neural Networks, Arificial Intelligence and Neural Networks, McCulloch-Pitts Neuron Learning: Error-Correction Learning, Memory based Learning, Hebbian learning, Competitive Learning, Boltzmann Learning Perceprton: Perceprton Learning Rule, Perceptron Learning Algorithm, Perceprton Convergence Theorem, Perceptron learning and Non-separable sets.	09	CO1 CO2
IV	Neural Networks -II	Back propaggation: Multilayered Network Architecture, Back porpagation Algorithm, Practical Consideration in impin Implementing the Back propagation Algorithm. Back propagation and XOR problem. Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-center-Off-surround Networks, Building blocks of Adaptive Resonance, Substrate of resonance, Structural details of the resonance Model, Adaptive Resonance Theory I (ART I), Neurophysiological Evidence for ART Mechanism Character Recognition: Introduction, General Algorithm Architecture for Character Recognition: Binarization, Preprocessing, Filters, Smoothing, Skew Detection and Correction, Slant Correction, Character Normalization, Thinning, Segmentation, Multilingual OCR by Rule-Based Approach and ANN	10	CO3 CO6

		Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network: Inputs, Outputs, Identification Results of Multilingual OCR		
V	Genetic Algorithm	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?, A Simple Genetic Algorithm Genetic Algorithms at Work—a Simulation by hand, Grist for the Search Mill—Important Similarities, Similarity Templates (Schemata), Learning the Lingo. Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited, The Two-armed and й-armed Bandit Problem, How Many Schemata Are Processed Usefully? The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyperplanes, Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work? Mapping Objective Functions to Fitness Form, Fitness Scaling, Codings, A Multiparameter, Mapped, Fixed-Point Coding, Discretization, Constraints. Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges, Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph Results of Handwriting Recognition: Effect of Genetic Algorithms, Distance Optimization, Style Optimization	10	CO1 CO3 CO6
VI	Hybrid Computing	Introduction, Neuro-Fuzzy Hybrid Systems, Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFS Architecture, Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network, Advantages of Neuro-Genetic Hybrids, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids	09	CO4 CO6

Text Books:

1. . S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007, ISBN: 10: 81-265-1075-7.
2. J.-S. R. Jang, C. –T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence, PHI Learning Private Limited-2014
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004/2007
4. Simon Haykin, Neural Networks A Comprehensive Foundation, Second Edition, Pearson Education-2004
5. David E. Goldberg, Genetic Algorithms, in search, optimization and Machine Learning, Pearson

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing, CRC Press, Taylor & Francis Group, 2010.
2. Genetic Algorithms and Genetic Programming Modern Concepts and Practical Applications © 2009 Michael Affenzeller, Stephan Winkler, Stefan Wagner, and Andreas Beham, CRC Press
3. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO7011	Product Life Cycle Management	03

Course Objectives: Students will try :

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to :

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:**Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**ProductDesign:**Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:**For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques,	05

	Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
05	**Integration of Environmental Aspects in Product Design:**Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:**Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper.Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07

05	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts,	05

	Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyber line** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of	06

	casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO7018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10

04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure toimplications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to…

1. Demonstrateunderstanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	07

4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	**10**
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based onapproximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington

9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150
10. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

B. E. Information Technology (Semester-VIII)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC801	Big Data Analytics	4	-	-	4	-	-	4
ITC802	Internet of Everything	4	-	-	4	-	-	4
ITDLO-IV	Department Level Optional Course-IV	4	-	-	4	-	-	4
ILO-II	Institute Level Optional Course-II	3	-	-	3	-	-	3
ITL801	Big Data Lab	-	2	-	-	1		1
ITL802	Internet of Everything Lab		2			1		1
ITL803	DevOps Lab	-	2	-	-	1		1
ITL804	R Programming Lab	-	2	-		1		1
ITM805	Project-II	-	16			8	-	8
	Total	**15**	**24**	-	**15**	**12**	-	**27**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in				
		Test 1	Test 2	Avg.						
ITC801	Big Data Analytics	20	20	20	80	3	-	-	-	100
ITC802	Internet of Everything	20	20	20	80	3	-	-	-	100
ITDLO-IV	Department Level Optional Course-IV	20	20	20	80	3	-	-	-	100
ILO-II	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
ITL801	Big Data Lab						25	25	-	50
ITL802	Internet of Everything Lab	-	-	-	-	-	25	25		50
ITL803	DevOps Lab	-	-	-	-	-	25	--	25	50
ITL804	R Programming Lab	-	-	-	-	-	25	--	25	50
ITM805	Project-II						100	50	--	150
Total		80	80	80	320	--	200	100	50	750

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VIII. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester VIII, which is

not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester VIII			
ITDLO8041	User Interaction Design	ILO8021	Project Management
ITDLO8042	Information Retrieval Systems	ILO8022	Finance Management
ITDLO8043	Knowledge Management	ILO8023	Entrepreneurship Development and Management
ITDLO8044	Robotics	ILO8024	Human Resource Management
ITDLO8045	Enterprise Resource Planning	ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC801	Big Data Analytics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC801	Big Data Analytics	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To introduce to the students several types of big data like social media, web graphs and data streams.
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes: Student will be able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
5. Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.
6. Design and implement successful Recommendation engines for enterprises.

Prerequisites: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisites**	Data Mining, database Systems, Algorithms	02	--
I	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	03	CO 1
II	Introduction to Big Data Frameworks: Hadoop, NOSQL	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; **Overview of** : Apache Spark, Pig, Hive, Hbase, Sqoop **What is NoSQL?** NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, **Mongo DB**	10	CO 2
III	MapReduce Paradigm	**MapReduce:** The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. **Algorithms Using MapReduce:** Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step . **Illustrating** use of MapReduce with use of real life databases and applications.	09	CO 3
IV	Mining Big Data Streams	**The Stream Data Model:** A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. **Sampling Data in a Stream :** Sampling Techniques. **Filtering Streams:** The Bloom Filter	07	CO 5

		Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . **Counting Ones in a Window:** The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm.		
V	Big Data Mining Algorithms	**Frequent Pattern Mining** : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and MapReduce. **Clustering Algorithms:** CURE Algorithm. Canopy Clustering, Clustering with MapReduce **Classification Algorithms:** Parallel Decision trees, Overview SVM classifiers, Parallel SVM, K-Nearest Neighbor classifications for Big Data, One Nearest Neighbour.	10	CO 4
VI	Big Data Analytics Applications	**Link Analysis** : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. **Mining Social- Network Graphs** : Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map-Reduce. **Recommendation Engine**s: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	11	CO 4 CO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, ”Big Data Analytics”, Wiley Publications,
2. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press.
3. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
4. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
5. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC802	Internet of Everything	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC802	Internet of Everything	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To learn the concepts of IOT.
2. To identify the different technology.
3. To learn different applications in IOT.
4. To learn different protocols used in IOT.
5. To learn the concepts of smart city development in IOT.
6. To learn how to analysis the data in IOT.

Course Outcomes: Student will be able to:

1. Apply the concepts of IOT.
2. Identify the different technology.
3. Apply IOT to different applications.
4. Analysis and evaluate protocols used in IOT.
5. Design and develop smart city in IOT.
6. Analysis and evaluate the data received through sensors in IOT.

Prerequisites: IOT Lab, Sensor Lab, Wireless Network.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisites**	What are sensors, Sensor family, Architecture of single node sensor?	02	--
I	Introduction	Introduction, History of IOT, Objects in IOT, Identifier in the IOT, Technologies in IOT	03	CO 1
II	RFID Technology	Introduction, principle of RFID, components of RFID system: RFID tag, Reader, RFID middleware,	8	CO 2

		Issues etc.		
III	RFID Applications	Introduction, concepts and technology: RFID, transponder, RFID architecture, RFID applications i.e. logistics and supply chain, production, monitoring and maintenance, product safety, quality and information, access control and tracking and tracing of individuals, payment, loyalty, household etc. Hardware, Hardware issues, protocols: pure aloha, slotted aloha, frame slotted aloha, tree protocols, tree splitting algorithms, binary search algorithms, bitwise arbitration protocols. Main query tree protocols.	09	CO2 CO 3
IV	Wireless Sensor Networks	History and context, Node, connecting nodes, networking nodes, securing communication, standards and Fora. Networking and the Internet - IP Addressing, Protocols - MQTT, CoAP, REST Transferring data	09	CO2 CO3 CO4
V	Mobility and Settings.	Introduction, localization, mobility management, localization and handover management, technology considerations, performance evaluation, simulation setup, performance results. Identification of IOT (data formats. IPV6, identifiers and locators, tag etc.)	10	CO4 CO5
VI	Data Analytics for IoE	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study - Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.	11	CO5 CO6

Text Books:

1 Internet of Things connecting objects to the web, by Hakima Chaouchi, Wiley.
2. Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti.

Reference Books:

1 The Internet of Things (MIT Press) by Samuel Greengard.
2 The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).
3 RFID and the Internet of Things, by Herve chabanne, Wiley

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL801	Big Data Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL801	Big Data Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the tools required to manage and analyze big data like Hadoop, NoSql
2. To impart knowledge of Map reduce paradigm to solve complex problems Map-Reduce.
3. To introduce several new algorithms for big data mining like classification, clustering and finding frequent patterns.
4. To introduce to the students several types of big data like social media, web graphs and data streams.
5. To identify various sources of Big data
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Lab Outcomes: Students will be able to:

1. Demonstrate capability to use Big Data Frameworks like Hadoop
2. Program applications using tools like Hive, pig, , NO SQL and MongoDB for Big data Applications
3. Construct scalable algorithms for large Datasets using Map Reduce techniques
4. Implement algorithms for Clustering, Classifying and finding associations in Big Data
5. Design and implement algorithms to analyze Big data like streams, Web Graphs and Social Media data and construct recommendation systems.
6. Apply the knowledge of Big Data gained to fully develop a BDA applications for real life applications.

Prerequisite: Java, Python

Requirement

Hardware	Software
PC i3 or above, 8 GB RAM	Virtual Machine, Hadoop Frame work, NOSQL and MongoDb Compilers

Detailed syllabus:

Module	Detailed Content	Hours 2hrs	LO Mapping
1	Assignment on Study of Hadoop ecosystem	02	LO 1
2	Programming exercises on Hadoop Using Hive, Pig, Hbase Sqoop NOSQL, MongoDB	04	LO 2
3	Implementing simple algorithms in Map-Reduce Matrix multiplication, Aggregates, joins, sorting, searching etc.	04	LO3
4	Implementing Algorithms using MapReduce (Any 2) • Implementing Frequent Item set Mining • Implementing Clustering algorithms • Implementing Classification Algorithms	06	LO 4
5	Big Data Applications (Any 2) • Implementing Analytics on data streams • Implementing Social Network Analysis Algorithms • Implementing Web Graph Algorithms • Implementing recommendation Engines	05	LO 5
6	**Mini Project**: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining d) Recommendation Engines (list of datsets also given in the text book)	05	LO 5 LO 6

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, ”Big Data Analytics”, Wiley Publications,
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
4. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage, Addison Wesley

Term Work:
Term Work shall consist of at least 10 to 12 practical’s based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL802	Internet of Everything Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL802	Internet of Everything Lab	--	--	--	--	25	--	25	50

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Hard disk	1. Ubuntu or Linux Desktop OS 2. VMware 3. Cooja contiki or any open source software 4. Cupcarbon	1. Internet Connection

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.

4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students must understand the

a. Concept

b. Importance

c. Interdisciplinary

d. Challenges

e. Various applications/smart objects

f. Major Players/Industry, Standards.

4. The students must understand the IoT Architecture:

a. Node Structure: Sensing, Processing, Communication, Powering

b. Networking: Topologies, Layer/Stack architecture

c. Communication Technologies: Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Discuss data rate, range, power, computations/bandwidth, QoS

d. Smartness - Signal Processing/Analytics: Impact on Power/Energy savings, dynamic networks, simple case studies

e. IoT Fabricator: Introduction to Embedded electronics, fabricating electronics, Communication Network requirements, Data processing challenges – recreation, IP/security, Challenges

f. Hands-on in IoT: Projects based on some Hardware (Raspberry pi, Arduino, Intel, IITH Mote, Smartphones), Software (Contiki, TinyOS, Android), IoT Fabricator etc. can be used.

5. The students may do will visit different websites to identify their IOT topic for the mini project.

6. The students may do survey for different application using different types of sensors for their mini project.

7. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.

8. Design your own circuit board using multiple sensors etc.

9. Installation, configure and manage your sensors in such away so that they can communicate with each other.

10. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.

11. Each group will identify the Hardware and software requirement for their mini project problem statement.

12. Create and interface using Mobile/Web to publish or remotely access the data on Internet.

13. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.

14. Each group may present their work in various project competitions and paper presentations.

15. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
4. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga

References:

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, Daniel Minoli John Wiley & Sons
3. Contiki Cooja User Guide.
4. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
5. Recent research/white papers

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL803	DevOps Lab	--	2	--	--	--	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL803	DevOps Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To understand the concept of DevOps with associated technologies and methodologies.
2. To be familiarized with Jenkins, which is used to build & test software Applications & Continuous integration in Devops environment.
3. To understand different Version Control tools like GIT, CVS or Mercurial
4. To understand Docker to build, ship and run containerized images
5. To use Docker to deploy and manage Software applications running on Container.
6. To be familiarized with concept of Software Configuration Management & provisioning using tools like Puppet,Chef, Ansible or Saltstack.

Lab Outcomes: Students will be able to:

1. Remember the importance of DevOps tools used in software development life cycle
2. Understand the importance of Jenkins to Build, Deploy and Test Software Applications
3. Examine the different Version Control strategies
4. Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker
5. Summarize the importance of Software Configuration Management in DevOps
6. Synthesize the provisioning using Chef/Puppet/Ansible or Saltstack.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration	1. Windows or Linux Desktop OS for Client machines	1. Internet Connection for each PC with at least 2 MBPS

1. Intel Core i3/i5/i7 Processor with Intel VT-X support 2. 4 GB RAM 3. 500 GB Harddisk 4. Gigabit Ethernet (GbE) network interface card (NIC)	2. CentOS/Fedora/Ubuntu/Redhat Server OS for One Server 3. JDK 1.8 or higher 4. Netbeans or Eclipse 5. OpenSSH	bandwidth.

Prerequisite Subjects: Operating System, Virtualization, Cloud Computing, Java and Web Programming, and Software Engineering.

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	To Understand the Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications.	02	--
I	Build & Test Applications with Continuous Integration	To Install and Configure Jenkins to test, and deploy Java or Web Applications using Netbeans or eclipse.	04	LO 1 LO2
II	Version Control	To Perform Version Control on websites/ Softwares using different Version control tools like RCS/ CVS/GIT/Mercurial (Any two)	04	LO 1 LO 3
III	Virtualization & Containerization	To Install and Configure Docker for creating Containers of different Operating System Images	04	LO 1 LO 4
IV	Virtualization & Containerization	To Build, deploy and manage web or Java application on Docker	04	LO 1 LO 4
V	Software Configuration Management	To install and configure Software Configuration Management using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 5

VI	Provisioning	To Perform Software Configuration Management and provisioning using Chef/Puppet/Ansible or Saltstack.	04	LO 1 LO 6

Text Books:

1. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
2. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", Addison-Wesley-Pearson Publication.
3. John Ferguson Smart,"Jenkins, The Definitive Guide", O'Reilly Publication.
4. Learn to Master DevOps by Star EduSolutions.

References:

1. Sanjeev Sharma and Bernie Coyne,"DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers",Apress Publication.
3. Joakim Verona, "Practical DevOps",Pack publication

Term Work:
Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL804	R Programming Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of two Tests					
ITL804	R Programming Lab	--	--	--	--	25	25	--	50

Lab Objectives: Students will try:

1. To provide an overview of a new language R used for data science.
2. To introduce students to the R programming environment and related eco-system and thus provide them with an in-demand skill-set, in both the research and business environments
3. To introduce the extended R ecosystem of libraries and packages
4. To demonstrate usage of as standard Programming Language.
5. To familiarize students with how various statistics like mean median etc. can be collected for data exploration in R
6. To enable students to use R to conduct analytics on large real life datasets.

Lab Outcomes: students will be able to:

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages
3. Extract data from files and other sources and perform various data manipulation tasks on them.
4. Code statistical functions in R.
5. Use R Graphics and Tables to visualize results of various statistical operations on data .
6. Apply the knowledge of R gained to data Analytics for real life applications.

SOFTWARE requirements:

1. The R statistical software program. Available from: https://www.r-project.org/

2. RStudio an Integrated Development Environment (IDE) for R. Available from: https://www.rstudio.com/

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
0	**Prerequisites -** Any programming Language like Java Python. Basic statistics. Data Mining Algorithms	--	--
I	**Introduction:** Installing R on personal machines. installing R and RStudio. • The basic functionality of R will be demonstrated, Variable types in R. Numeric variables, strings and factors. • Accessing the help system. Retrieving R packages. • Basic data types and operations: numbers, characters and composites. • Data entry and exporting data	02	**LO 1, LO 2, LO 3**
II	**Data structures**: vectors, matrices, lists and data frames.	04	**LO1, LO 3**
III	**R as a programming language**: • Grouping, loops and conditional execution, Functions **Exploratory data analysis** • Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot	04	**LO 1, LO 4**
IV	**Graphics in R** • Graphics and tables • Working with larger datasets • Building tables with aggregate • Introduction to ggplot2 graphics	06	**LO 3**
V	**Regression and correlation** • Simple regression and correlation, Multiple regression • Tabular data and analysis of Categorical data	02	**LO 4**
VI	**R for Data Science (Mini Project)** Implementing a mini project using any data mining or big data analytics algorithm in R • Extracting data from a large Dataset • Exploratory analysis • Using Mining algorithm • Visualizations and interpretation of results	06	**LO 5, LO 6**

Text Books:

1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf (Online Resources)
2. R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
3. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
4. R Programming For Dummies by Joris Meys Andrie de Vries, Wiley Publications

References:

1. Hands-On Programming with R by Grolemund, O Reilly Publications
2. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.
3. R for Data Science Learning Dan Toomey December 2014 Packt Publishing Limited

Term Work:
Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM805	Project-II	--	16	--	--	8	--	8

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM805	Project-II	--	--	--	--	100	--	50	150

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate 1 day in VII semester and 2 day in VIII semester every week.
4. Students will do literature survey in Sem VI or Sem VII.
5. Students will do design, implementation and coding in Sem VII.
6. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.
7. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) embers as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Students will do testing and analyze in Sem VIII
11. Teams must analyze all the results obtained by comparing with other standard techniques.
12. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and implementation and coding as project proposal in SEM VII. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.
4. Oral exam will be conduct on the project done by the students.

Term Work:

Term Work shall consist of full Project-I on above guidelines/syllabus.

Term Work Marks: 100 Marks (Total marks) = 95 Marks (Project-II) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Project-II and Presentation.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8041	User Interaction Design	04	--	--	04	--	--	04

Course code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8041	User Interaction Design	20	20	20	80	--	--	--	100

Course Objectives: Students will try to:

1 To stress the importance of good interface design.
2 To understand the importance of human psychology as well as social and emotional aspect in designing good interfaces.
3 To learn the techniques of data gathering, establishing requirements, analysis and data interpretation.
4 To learn the techniques for prototyping and evaluating user experiences.
5 To understand interaction design process.
6 To bring out the creativity in each student – build innovative applications that are usable, effective and efficient for intended users.

Course Outcomes:

1. Students will be able to identify and criticize bad features of interface designs.
2. Students will be able to predict good features of interface designs.
3. Students will be able to illustrate and analyze user needs and formulate user design specifications.
4. Students will be able to interpret and evaluate the data collected during the process.
5. Students will be able to evaluate designs based on theoretical frameworks and methodological approaches.
6. Students will be able to produce/show better techniques to improve the user interaction design interfaces.

Prerequisite: Web technologies, Software Engineering, Experiences in designing interfaces for applications and web sites. Basic Knowledge of designing tools and languages like HTML , Java etc.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering concepts and any programming Language	02	--
I	Introduction to Interaction Design	Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience	**09**	**CO1,CO 2**
II	Understanding and Conceptualizing Interaction Cognitive aspects and Social, Emotional Interaction	Understanding the Problem Space and Conceptualizing Design, Conceptual Model, Interface Types Cognitive aspects, Social Interaction and the Emerging Social Phenomena, Emotions and the User Experience, Expressive and Frustrating Interfaces, Persuasive Technologies	**09**	**CO2,CO 3**
III	Data Gathering, Establishing Requirements, Analysis, Interpretation and Presentation	Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis	**09**	**CO4**
IV	Process of Interaction Design, Prototyping, Construction,	Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies	**09**	**CO4**
V	Design rules and Industry standards	Design principles, Principles to support Usability, Standards and Guidelines, Golden rules and Heuristics, ISO/IEC standards	**08**	**CO5**
VI	Evaluation Techniques and Framework	The Why, What, Where and When of Evaluation, Types of Evaluation, case studies, DECIDE Framework, Usability Testing, conducting	**06**	**CO5,CO 6**

		experiments, Field studies, Heuristic Evaluation and walkthroughs, Predictive models.		

Text Books:

1. *Interaction Design*, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. *Human Computer Interaction, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale*
3. Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
4. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.

References:

1. The UX Book, by Rex Hartson and Pardha S Pyla.
2. Donald A. Norman, "The design of everyday things", Basic books.
3. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8042	Information Retrieval System	04	--	--	04	--	--	04

Course Code	CourseName	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of twoTests					
ITDLO8042	Information Retrieval System	20	20	20	80	--	--	--	100

Course Objectives: students will try:

1. To learn the fundamentals of information retrieval system.
2. To classify various Information retrieval models.
3. To demonstrate the query processing techniques and operations
4. To compare the relevance of query languages for text and multimedia data
5. To evaluate the significance of various indexing and searching techniques for information retrieval.
6. To develop a effective user interface for information retrieval.

Course Outcomes:

1. Students will define and describe the objectives the basic concepts of Information retrieval system.
2. Students will evaluate the taxonomy of different information retrieval models.
3. Students will solve and process text and multimedia retrieval queries and their operations
4. Students will evaluate text processing techniques and operations in information retrieval system.
5. Students will demonstrate and evaluate various indexing and searching techniques.
6. Student will design the user interface for an information retrieval system.

Prerequisite: Data structures and algorithms

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment (Prerequisite syllabus should not be considered for paper setting) Indexing and searching Algorithms	02	
I	Introduction	Motivation, Basic Concepts, The retrieval Process, Information System: Components, parts and types on information system; Definition and objectives on information retrieval system	05	CO1
II	IR Models	Modeling: Taxonomy of Information Retrieval Models, Retrieval: Adhoc and filtering, Formal Characteristics of IR models, Classic Information Retrieval, Alternative Set Theoretic models, Probabilistic Models, Structured text retrieval Models, models for Browsing; Multimedia IR models: Data Modeling	09	CO2
III	Query Processing and Operations	Query Languages: Keyword based Querying, Pattern Matching, Structural Queries, Query Protocols; Query Operations: User relevance feedback, Automatic local analysis, Automatic global analysis, Multimedia IR Query Languages	10	CO3
IV	Text Processing	Text and Multimedia languages and properties: Metadata, Markup Languages, Multimedia; Text Operations: Document Preprocessing, Document Clustering, Text Compression, Comparing Text Comparison Technique	10	CO4
V	Indexing and Searching	Inverted files, Other indices for text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression; Multimedia IR: Indexing and Searching:- Spatial Access Methods, A Generic Multimedia indexing approach, One-	11	CO5

		dimensional time series, Two dimensional color images, Automatic Feature extraction; Searching Web: Challenges, Characterizing the web, Search Engines. Browsing, Meta searches, Searching needle in haystack, Searching using Hyperlinks		
VI	User interface and visualization	Human Computer interaction, the information access process, starting points, query specifications, context, using relevance judgments, interface support for the search process	05	CO6

Text Books:

1.Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley
2. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher
3. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India

References:

1. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
2. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8043	Knowledge Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8043	Knowledge Management	20	20	20	80	--	--	--	100

Course Objectives:

1 Establish a foundation of key terms and concepts, historical events and contributions, organizational benefits, and guiding principles on which to build greater understanding of knowledge management

2 Appreciate the role and use of knowledge for individuals, as well as organizations and institutions.

3 Increase information and understanding about knowledge transfer using low- and high technology strategies

4 Explore the future of knowledge management and its influence on our jobs, communities, and society

Course Outcomes: After completion of the course the learner will be able to

1) Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
2) Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems
3) Evaluate the impact of technology including telecommunications, networks, and Internet/intranet role in managing knowledge.
4) Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy Ponder KM's current and future impact on individuals, organizations and society at large

Prerequisite: An introductory course in IT/ IS

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Meaning of data, information, knowledge and expertise Meaning of epistemology, Types of Knowledge - Subjective & Objective views of knowledge, procedural Vs. Declarative, tacit Vs. explicit, general Vs. specific.	**3**
I	Introduction to Knowledge Management	What is Knowledge? Types of expertise – associational, motor skill,¬ theoretical Characteristics of knowledge – explicitness, codifiability, teachability, specificity Reservoirs of knowledge, Meaning of Knowledge Management, Forces Driving Organizational issues in KM, KM Systems & their role Relevance of KM in today's dynamic & complex environment Future of Knowledge Management	**5**
II	Knowledge management system life cycle	Challenges in Building KM Systems – Conventional versus KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture.	**8**
III	KM Solutions for capture, sharing & applications	KM Processes, KM Systems, Mechanisms & Technologies Knowledge Capturing Techniques: Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory Grid- Concept Mapping –Blackboarding, Nominal Group Technique, Delphi method,	**9**
IV	Knowledge codification	Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing – Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation.	**9**
V	Knowledge transfer and sharing	Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.	**9**

VI	KM Impact	Dimensions of KM Impact – People, Processes, Products & Organizational Performance Factors influencing impact – universalistic & contingency views Assessment of KM Impact – Qualitative & quantitative measures Identification of appropriate KM solutions, Ethical Legal and Managerial Issues	**9**

Text Books:

1. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies . Prentice Hall. ISBN: 0-13-109931-0.
2. Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13-034820-1
3. Donald Hislop, Knowledge Management in Organizations, Oxford 2nd Edition. Ian Watson (2002).
4. Shelda Debowski, Knowledge Management, Wiley India Edition.

References:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.
2. Stuart Barnes (Ed.) (2002). Knowledge Management Systems Theory and Practice. Thomson Learning.
3. Kimiz Dalkir, Knowledge Management in Theory and Practice, Elsevier, Butterworth Hinemann.
4. Applying Knowledge Management: Techniques for Building Corporate Memories. Morgan Kaufmann. ISBN: 1558607609.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8044	Robotics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8044	Robotics	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. Learn the basic concepts of Robots.
2. Learn the concepts of Kinematics of Robotics.
3. Learn the concepts of Motions, velocities and dynamic analysis of force.
4. Learn the concepts of Motion planning.
5. Learn the concepts of Trajectory Planning
6. Learn the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Course Outcomes: Student will be able to:

1. Apply the basic concepts of Robots.
2. Apply and evaluate the concepts of Kinematics of Robotics.
3. Apply the Motions, velocities and dynamic analysis of force.
4. Apply and evaluate Motion planning.
5. Apply the concepts of Trajectory Planning
6. Apply the concepts of Potential Functions, Visibility Graphs and Coverage Planning

Prerequisites: Basic of Electrical Engineering.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisites**	Basics of Electrical Engineering	02	--
I	Fundamentals	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate	04	CO1

		frames, workspace, applications		
II	Kinematics of Robotics	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	11	CO2
III	Motions, velocities and dynamic analysis of force	Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian. Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames	09	CO3
IV	Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	08	CO5
V	Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	04	CO4
VI	Potential Functions, Visibility Graphs and Coverage Planning	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods. Cell Decomposition, Localization and Mapping	14	CO6

Text Books:

1. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion –Theory, Algorithms and Implementations”, Prentice-Hall of India

References:

1. Mark W. Spong & M. Vidyasagar, “Robot Dynamics & Control”, Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition, 2013.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO8045	Enterprise Resource Planning	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITDLO8045	Enterprise Resource Planning	20	20	20	80	--	--	--	100

Course Objectives: Students will try:

1. To learn the basic concepts of ERP.
2. To learn different technologies used in ERP.
3. To learn the concepts of ERP Manufacturing Perspective and ERP Modules.
4. To learn what are the benefits of ERP
5. To study and understand the ERP life cycle.
6. To learn the different tools used in ERP.

Course Outcomes: Student will be able to:

1. Understand the basic concepts of ERP.
2. Identify different technologies used in ERP.
3. Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules.
4. Discuss the benefits of ERP
5. Understand and implement the ERP life cycle.
6. Apply different tools used in ERP.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basics of software.	02	--
I	Introduction to ERP	Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model	04	CO1

II	ERP Technologies	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System	06	CO2
III	ERP Manufacturing Perspective and ERP Modules	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP – Distributed Requirement Planning, PDM - Product Data Management. Finance, Plant Maintenance, Quality Management, Materials Management.	10	CO3
IV	Benefits of ERP	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability	08	CO4
V	ERP Life cycle	Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode).	06	CO5
VI	E-Commerce to E-business	E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techo enterprise, New generation e-business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications. Enterprise resource planning the E-business Backbone Enterprise architecture, planning, ERP usage in Real world, ERP Implementation, Future of ERP applications, memo to CEO ,E-Procurement, E- Governance, Developing the E-Business Design.	16	CO6

		JD Edwards-Enterprise One. Microsoft Dynamics-CRM Module.		

Text Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

References:

1. Guide to Planning ERP Application, Annetta Clewwto and Dane Franklin, McGRaw-Hill, 1997
2. The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
3. E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Credits
ILO8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting,	8

	engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	
06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	10

	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8023	Enterpreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and	6

	stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data	**08**

	j. Preparation of Research Report	
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:**Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement	07

	Patent databases: Important websites, Searching international databases	

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business-** Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06

3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000

6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

PG- Electronics and Telecommunication Engineering

Sr. No.	Subject Code	Subject Name	Count
1	ETC102	Optical Communication Network, Laboratory I - Optical Communication Network	2
2	ETC103, ETL102	Modern Digital Signal Processing Applications, Laboratory II - Modern Digital Signal Processing Applications	2
3	ETC202, ETL201	Wireless Adhoc and Sensor Networks, Laboratory III – Wireless Adhoc and Sensor Networks	2
4	ETC203,ETL202	RF and Microwave Engineering, Laboratory IV – RF and Microwave Engineering	2
5	ETC203	RF and Microwave Engineering	1
6	ETS301	Special Topic Seminar	1
7	ETD301	Dissertation I	1
8	ETD401	Dissertation II	1
		Total	12

AC-14/7/2016
Item No.4.27

UNIVERSITY OF MUMBAI

Revised Syllabus for the

Master of Engineering (M.E.) Electronics and Telecommunication Engineering

(As per Choice Based Credit & Grading System with effect from the academic year 2016–2017)

From Co-ordinator's Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education, since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Choice Based Credit and Grading System will be implemented for First year Master of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Master of Engineering in the academic year 2017-2018.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble:

The curriculum in higher education is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The engineering education in India is expanding in manifolds and the main challenge is the quality of education. All stakeholders are very much concerned about it. The curriculum of Electronics & Telecommunication in Mumbai University is no exception. In keeping with the demands of the changing times, it contains innovative features. The exposure to the latest technology and tools used all over the world is given by properly selecting the subjects. It is designed in such a way to incorporate the requirements of various industries. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of post-graduation. So the curriculum must be refined and updated to ensure that the defined objectives and outcomes are achieved.

I, as Chairman Ad-hoc Board of Studies in Electronics and Telecommunication Engineering, University of Mumbai, happy to state here that, the heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational objectives as listed below.

Objectives:

1. To produce Electronics & Telecommunication engineers, having strong theoretical foundation, good design experience and exposure to research and development.
2. To produce researcher who have clear thinking, articulation and interest to carry out theoretical and/or applied research resulting in significant advancement in the field of specialization.
3. To develop an ability to identify, formulate and solve electronics and telecommunication engineering problems in the latest technology.
4. To develop the ability among students to synthesize data and technical concepts from applications to product design.

These are the suggested and expected main objectives, individual affiliated institutes may add further in the list. I believe that the small step taken in the right direction will definitely help in providing quality education to the stake holders.

This book of curricula is the culmination of large number of faculty members and supporting staff. It also reflects the creative contribution of hundreds of teachers – both serving and retired. I sincerely hope that the faculty and students of Electronics and Telecommunication in Mumbai University will take full advantage of dynamic features of curriculum and make teaching-learning process a truly sublime experience for all.

At the end I must extend my gratitude to all experts and colleagues who contributed to make curriculum competent at par with latest technological development in the field of Electronics & Telecommunication Engineering.

Dr. Uttam D. Kolekar
Chairman, Ad-hoc Board of Studies in Electronics and Telecommunication Engineering

Program Structure for M.E. (Electronics & Telecommunication)

(w.e.f. A.Y. 2016-2017) Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours/week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETC101	Statistical Signal Processing	04	--	--	04	--	--	04
ETC102	Optical Communication Network	04	--	--	04	--	--	04
ETC103	Modern Digital Signal Processing Applications	04	--	--	04	--	--	04
ETDLO101X	Department Level Optional Course-1	04	--	--	04	--	--	04
ILO101X	Institute Level Optional Course-1	03	--	--	03	--	--	03
ETL101	Laboratory I - Optical Communication Network	--	02	--	--	01	--	01
ETL102	Laboratory II - Modern Digital Signal Processing Applications	--	02	--	--	01	--	01
Total		**19**	**04**	**--**	**19**	**02**	**--**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem.Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ETC101	Statistical Signal Processing	20	20	20	80	03	--	--	100
ETC102	Optical Communication Network	20	20	20	80	03	--	--	100
ETC103	Modern Digital Signal Processing Applications	20	20	20	80	03	--	--	100
ETDLO101X	Department Level Optional Course-I	20	20	20	80	03	--	--	100
ILO101X	Institute Level Optional Course-I	20	20	20	80	03	--	--	100
ETL101	Laboratory I - Optical Communication Network	--	--	--	--	--	25	25	50
ETL102	Laboratory II –Modern Digital Signal Processing Applications	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**	**--**	50	**50**	**600**

Subject Code	Department Level Optional Course I	Subject Code	Institute Level Optional Course I
ETDLO1011	Next Generation Networks	ILO1011	Product Life cycle Management
ETDLO1012	Advanced Antenna Design	ILO1012	Reliability Engineering
ETDLO1013	Image Analysis using Machine learning	ILO1013	Management Information System
ETDLO1014	Embedded Communication Systems Design	ILO1014	Design of Experiments
		ILO1015	Operations Research
		ILO1016	Cyber Security and Laws
		ILO1017	Disaster Management & Mitigation Measures
		ILO1018	Energy Audit and Management

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours/week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETC201	Modern Digital Communication	04	--	--	04	--	--	04
ETC202	Wireless Adhoc and Sensor Networks	04	--	--	04	--	--	04
ETC203	RF and Microwave Engineering	04	--	--	04	--	--	04
ETDLO202X	Department Level Optional Course II	04	--	--	04	--	--	04
ILO202X	Institute Level Optional Course II	03	--	--	03	--	--	03
ETL201	Laboratory III – Wireless Adhoc and Sensor Networks	--	02	--	--	01	--	01
ETL202	Laboratory IV – RF and Microwave Engineering	--	02	--	--	01		01
Total		**19**	**04**	**--**	**19**	**02**	**--**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem.Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ETC201	Modern Digital Communications	20	20	20	80	03	--	--	100
ETC202	Wireless Adhoc and Sensor Networks	20	20	20	80	03	--	--	100
ETC203	RF and Microwave and Engineering	20	20	20	80	03	--	--	100
ETDLO202X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ILO202X	Institute Level Optional Course- II	20	20	20	80	03	--	--	100
ETL201	Laboratory III - Wireless Adhoc and Sensor Networks	--	--	--	--	--	25	25	50
ETL202	Laboratory IV - RF and Microwave Engineering	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**	--	**50**	**50**	**600**

Subject Code	Department Level Optional Course II	Subject Code	Institute Level Optional Course II
ETDLO2021	Satellite Networking	ILO2021	Project Management
ETDLO2022	Network and Cyber Security	ILO2022	Finance Management
ETDLO2023	Remote Sensing	ILO2023	Entrepreneurship Development and Management
ETDLO2024	Error Control Coding	ILO2024	Human Resource Management
		ILO2025	Professional Ethics and CSR
		ILO2026	Research Methodology
		ILO2027	IPR and Patenting
		ILO2028	Digital Business Management
		ILO2029	Environmental Management

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours/week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETS301	Special Topic Seminar	--	06	--	--	03	--	03
ETD301	Dissertation I	--	24	--	--	12	--	12
Total		**--**	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Pract. / Oral	Total
		Test1	Test 2	Avg.				
ETS301	Special Topic Seminar	**--**	**--**	**--**	--	50	50	100
ETD301	Dissertation I	**--**	**--**	**--**	--	100	--	100
Total		**--**	**--**	**--**	**--**	**150**	**50**	**200**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours/week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ETD401	Dissertation II	--	30	--	--	15	--	15
Total		**--**	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Pract. / Oral	Total
		Test1	Test 2	Avg.				
ETD401	Dissertation II	**--**	**--**	**--**	--	100	100	200
Total		**--**	**--**	**--**	**--**	**100**	**100**	**200**

Note:

- In case of Seminar (ETS301), 01 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation I (ETD301) and Dissertation II (ETD401), 02 Hour / week / student should be considered for the calculation of load of a teacher

Subject Code	Subject Name	Credits
ETC101	**Statistical Signal Processing**	**04**

Course Pre-requisite:

- Matrix theory
- Fundamentals of probability
- Signals and systems

Course Objectives:

The aim of this course is to provide knowledge of statistical techniques necessary to explain and explore the important applications in signal processing and telecommunication.

Course Outcome:

Learner will be able to:

- Understand basics of linear algebra in communication engineering.
- Apply appropriate statistical tools for handling design and analysis of systems that involve randomness.
- Analyze random processes for LTI systems and estimation theory.
- Evaluate role of probability models in engineering design.

Module	Detailed Content	Hours
1	**Linear Algebra** • Signal spaces, metric spaces, vector spaces, norms and normed vector spaces, inner-product spaces, orthogonality, orthogonal subspaces, linear transformations: range and null space, orthogonalization of vectors, representation and approximation in vector spaces, matrix representation of least squares, geometry of linear equations, four fundamental subspaces of linear operator, properties of matrix inverses, results on matrix rank, pseudo inverses, matrix condition number, singular value decomposition(SVD), pseudoinverse and the SVD.	12
2	**Review of Random Variables and Processes** • Random variables, distribution and density function, functions of random variables, sums of independent random variables, central limit theorem, discrete time stochastic process, stationarity, random signal variability, time averages, ergodicity, autocorrelation function of a real WSS process and its properties, cross-correlation function, frequency domain description of stationary process, general correlation matrices, correlation matrices from random process, correlation matrices of stationary process.	08
3	**Analysis and processing of random signals** • Linear time invariant system with WSS process as an input: stationarity of the output, auto-correlation and power-spectral density of the output; examples with white-noise as input; linear	04

	shift-invariant discrete-time system with WSS sequence as input, examples of random processes: white noise process and white noise sequence; Gaussian process.	
4	**Whitening and Innovations Representation** • Transformations using eigen-decomposition, transformations using triangular decomposition, generation of real valued random vectors with given second-order moments, discrete Karhunen-Loève transform and its application, optimal reduced-basis representation, periodic random sequences.	08
5	**Principles of Estimation Theory** • Estimation in signal processing, the mathematical estimation problem, assessing estimator performance, unbiased and consistent estimators, confidence interval, efficient estimator, minimum variance unbiased estimation, existence of minimum variance unbiased estimator, estimator accuracy considerations, Cramer-Rao lower bound(CRLB) theorem, computation of CRLB for different examples, general CRLB for signals in white-Gaussian noise, vector parameter CRLB.	10
6	**The Kalman Filter** • The state space signal model, Kalman filter I: The Bayes approach, Kalman filter II: innovations approach, Estimation using the innovations process, innovations for processes with state space models. Discrete-time Kalman filter.	06

Textbooks and References:

1. Todd K. Moon and Wynn C. Stirling, "*Mathematical Methods and Algorithms for Signal Processing*", Pearson Education, Inc., 2000.
2. Dimitris. G. Manolakis, Vinay Ingale, and Stephen M. Kogon, "*Statistical and Adaptive Signal Processing*", Artech House, Inc., 2005.
3. Peyton Z. Peebles, "*Probability, Random Variables and Random Signal Principles*", Mc-Graw Hill, 2000.
4. Steven M. Kay, "*Fundamentals of Statistical Signal Processing: Estimation Theory* Vol 1, Prentice Hall, Englewood Cliffs, NJ, 2010.
5. Alberto Leon-Garcia, "*Probability and Random Processes for Electrical Engineering*", Pearson Education, 2007.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETC102	**Optical Communication Network**	**04**

Course Pre-requisite:

- Wave theory and Propagation
- Analog Communication
- Digital Communication

Course Objectives:

To teach students:

- The issues related to signal degradation due to Linear Impairments
- System impairments due to nonlinear effect in fiber.
- System optimization by controlling dispersion and Nonlinear Effects.
- High data rate WDM optical Transport Networks.

Course Outcome:

The course enables the students to:

- Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
- Identify the issues related to signal degradation due to multiplexing.
- Identify working principle of various components of all optical network.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.

Module	Detailed Content	Hours
1	**A Review of Optical Fibers** • Introduction • Signal Degradation • Fiber dispersion • Multimode fiber • Single mode fiber • Dispersion Management • Dispersion compensating Fibers	06
2	**Non Linear Optics** • General Overview of Nonlinearities • Effective area and length • Stimulated Raman Scattering • Stimulated Brillouin Scattering • Self Phase modulation • Cross –Phase modulation	12

	• Four wave mixing and its mitigation • Applications of Nonlinear Effects • Solitons properties of Solitons, Properties of Solitons, Loss managed Soliton ,Dispersion managed Soliton, Optical Switching, Parametric amplification	
3	**Optical Network Components** • Sources: Quantum well lasers, Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers • Detectors: Resonant cavity enhancement (RCE) Photo Detector, Material requirement for RCEPD, Wavelength selectivity, High speed comparison of conventional and RCEPD, RCE Schottky Photodiode, RCE Avalanche Photodiode • Optical Amplifiers: Optical Pumping, Erbium Doped Amplifier, Semiconductor Laser Amplifier, Raman Amplifier, • Integrated Optics: Directional couplers and Photonic Switch, Optical Modulators • WDM network components: WADM, Optical Crossconnects	12
4	**Introduction to Optical Network** • Overview of generations of optical Networks • SONET& SDH: Multiplexing hierarchy, Multiplexing structure – Functional components, Problem detection, Virtual tributaries & containers • Optical Transport Network: Hierarchy, Frame structure, Multiplexing	06
5	**WDM Network Design** • Cost Trade-offs: A detailed Ring Network example • LTD and RWA Problems • Routing and Wavelength assignment • Dimensioning wavelength networks • Statistical wavelength routing networks- First passage model, Blocking model • Maximum load dimensioning models- offline lightpath request, online RWA in Rings	06
6	**Deployment Consideration** • Architectural choices for next generation transport Network • Designing the transmission Layer using SDM,TDM and WDM • Unidirectional versus bidirectional WDM Systems- Long haul networks case study, Long Haul Undersea Networks • Metro Networks, Metro Ring Case study	06

Textbooks and References:

1. "*Optical Fiber Communications*"-Gerd Keiser-Fourth Edition-TATA McGRAW
2. "*Optical Fiber Communications Principles and Practice*"-John.M.Senior-Pearson Education HILL
3. "*Fiber Optics Communication System*"-G.P.Agarwal-Wiley Publications
4. "*Fiber Optics Communications*"- Harold Kolimbris-Pearson Education
5. "*Opto-Electronics, an introduction*"-Wilson and Hawkes,Prentice Hall
6. "*Nonlinear Fiber Optics*" G.P.Agarwal-Academic Press
7. " *Applications of Nonlinear Optics*", Academic press-G.P. Agarwal
8. "*Optical Networks, A Practical Perspective*", Third edition- Rajiv Ramaswami, Kumar N. Sivarajan, Elsevier
9. *"Optical Networks, Third generation Transport Systems*",by Uyless Black, Pearson
10. "*Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink*" by Le Nguyen Binh, CRC Press, 2010

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETC103	**Modern Digital Signal Processing Applications**	**04**

Course Pre-requisite:

- Signals & Systems
- Discrete Time Signal Processing

Course Objectives:

The aim of this course is to provide in-depth treatment on methods and techniques in

- Power spectrum estimation, Adaptive filtering, Wavelet transforms.
- Applications of Signal Processing to real world problems

Course Outcome:

Learners will be able to:

- Implement adaptive filters for a given application; study and apply the techniques of power spectrum estimation and wavelet theory for various applications.
- Apply Signal processing tools to biomedical signal processing and musical sound processing.

Module	Detailed Content	Hours
1	**Spectrum Estimation** • Non- Parametric methods of Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, Non-parametric Methods for Periodogram estimation: Bartlett, Welch and Blackman and Tukey methods. • Parametric Methods of Power Spectrum Estimation: AR, MA & ARMA models for power spectrum estimation. Yule-Walker method for the AR model parameter	08
2	**Introduction to Adaptive systems** • Introduction, Characteristics, Examples of Adaptive systems, Applications. The adaptive system -linear combiner- Description, Weight vectors, desired response performance function- Gradient and mean square error.	06
3	**Adaptive Signal Processing and Applications** • FIR Adaptive filters - Adaptive Direct Form FIR Filters based on steepest descent method -Widrow Hoff LMS Adaptive algorithm. Adaptive Direct Form FIR Filters-RLS Algorithms. • Applications: Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation.	08
4	**Wavelet Theory** • Fourier Transform and its Limitations – Short Time Fourier Transform – Introduction to time frequency analysis- Continuous Wavelet Transform – Discrete Time Wavelet Transform- Multi-resolution analysis– Haar Wavelet –	10

	Daubechies Wavelet, Filter bank theory. • Application of wavelet theory to signal denoising, speckle removal, and signal compression.	
5	**Application of Digital Signal Processing to Biomedical Signal Processing** • Detection of fetal heartbeats during labor- Fetal ECG, ECG preprocessing, QRS template, QRS detection methods, performance measure for QRS detection. • Adaptive removal of ocular artefacts from human EEGs- Methods for removal and control of ocular artefacts, online Ocular Artefacts Removal (OAR) algorithm and system, hardware for online OAR system, system testing and experimental results.	08
6	**Application of Digital Signal Processing in Musical Sound Processing** • Musical sound processing - Time domain operations- single echo filter, multiple echo filter, Reverberation, Flanging, Chorus generator, Frequency domain operations-Analog filters, First order digital filters and Equalizers, Second order digital filters and Equalizers.	08

Textbooks and References:

Textbooks:

1. John G. Proakis and Dimitris G. Manolakis, "*Digital Signal Processing*", PHI, 2005.
2. Bernard Widrow and Samuel D.Strearns, "*Adaptive Signal Processing*", Pearson Edu Asia 2002.
3. S. M. Kay, *Modern Spectrum Estimation Theory and Application*", PHI.
4. K. P. Soman, K.I. Ramchandran and N. G. Reshmi, "*Insight into Wavelets: From theory to practice*, Third Edition PHI, 2010.
5. Raghuveer. M. Rao and Ajit S.Bopardikar, "*Wavelet Transforms -Introduction to theory and applications*, Pearson Education, Asia, 2000.
6. Rangaraj M. Rangayyan, "*Biomedical Signal Analysis- A Case Study Approach*", Wiley 2002.
7. Willis J. Tompkins, *Biomedical Digital Signal Processing*, PHI, 1999
8. Sen M Kuo, Bob H Lee and W Tian, "*Real Time Signal processing: Fundamentals, Implementations and Applications*" Springer, Wiley Publishers, Third Edition 2013.
9. S. K. Mitra, "*Digital Signal Processing*", TMH, 2001
10. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing, A Practical Approach*", Pearson Education, 2008.

Reference Books:

1. Simon Haykin, "*Adaptive Filter Theory*", Pearson Edu, 2013
2. D. C. Reddy, *Biomedical Signal Processing Principles and Techniques*, Tata Mc Graw-Hill, 2005
3. A. H. Sayed, "*Adaptive filters*", Wiley Student Edition, 2010
4. S. Thomas Alexander, *Adaptive signal processing-Theory and Applications*, Springer – Verlag.
5. I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.
6. Mark Kahrs, Karlheinz Brandenburg, "*Applications of Digital Signal Processing to Audio and Acoustics*", Kluwer Academic Publishers, 2002
7. Mallat, Stéphane. "*A wavelet tour of signal processing*." Academic press, Third Ed. 2008.
8. Torrence, Christopher, and Gilbert P. Compo, "*A practical guide to wavelet analysis*." Bulletin of the American Meteorological society Jan. 1998
9. Burrus, C. Sidney, Ramesh A. Gopinath, and Haitao Guo. "*Introduction to wavelets and wavelet transforms*." Prentice Hall Inc. 1997
10. Paul S. Addison, "*The illustrated wavelet transform handbook: introductory theory and applications in science, engineering, medicine and finance*." CRC press, 2002

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO1011	**Next Generation Networks**	**04**

Course Pre-requisite:

- Computer Networks
- Wireless Networks
- Mobile Communication

Course Objectives:

The aim of this course is

- To relate the paradigm shift from circuit switched network to packet switched network.
- To apply the advancement in networks field.
- To examine new technologies in telecommunication.
- To appraise the NGN Standards

Course Outcome:

Learners will be able to:

- Relate and compare the core differences between traditional and new telecommunication technologies.
- Analyze, implement and apply the components of NGN architecture with NGN standards.

Module	Detailed Content	Hours
1	**Next Generation Technologies, Networks and Services** • Introduction, • Next Generation (NG) Technologies, • Wire line NG Technologies, • FTTP, Long-Haul Managed Ethernet.	08
2	**Wireless NG Technologies** • Long Term Evolution (LTE), • Enhanced HSPA Evolution Data Optimized (EVDO), Ultra Mobile Broadband (UMB), • SDR and cognitive radio • IoT, VOIP, IPTV, Quality of Services, Quality of Experiences in NGN.	10
3	**Next Generation Multiservice Technology Overview** • MPLS &QoS, MPLS services and components, overview of VPN, layer2 VPN, layer 3 VPN	06
4	**ITU NGN Standards and Architectures** • Main drivers to Next Generation Networks – NGN , ITU NGN standards • All-IP network concept for NGN , • NGN control architectures and protocols(TISPAN),Numbering, naming and addressing for all NGN	08

5	**Control and Signalling Protocols for NGN** (SIP, Diameter) • NGN security(AAA, identity management) , • Service convergence • Fixed-Mobile Convergence (FMC) in NGN, • IP Multimedia Subsystem (IMS) for NGN	08
6	**Transition to NGN and Future Evolution** • Migration of PSTN networks to NGN , • Transition of IP networks to NGN, • IPv6, NGN Evolution.	08

Textbooks and References:

Textbooks:

1. *Wireless communication and Networking*-Vijay Garg, ELSEVIER Inc.
2. Next Generation Telecommunications Network, Parliament office of Science and Technology (Postnote). Dec 2007, No. 296 Ref. www.parliament.uk.

Reference Books

1. ITU Manual
2. *Next Generation Telecommunications Networks, Services, and Management* by Thomas Plevyak, VeliSahin, ISBN: 978-0-470-57528-4 , Wiley-IEEE Press
3. *Next Generation Wireless Systems and Networks:* Hsiao – Hwa Chen, Mohsen Guizani – Wiley
4. *IP-Based Next-Generation Wireless Networks: Systems, Architectures, and Protocols*- Jyh- Cheng Chenand Tao Zhang- Wiley

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO1012	**Advanced Antenna Design**	**04**

Course Pre-requisite:

- Wave Theory and Propagation
- RF and Antenna

Course Objectives:

The aim of this course is

- To provide state-of-art knowledge in microstrip antennas,
- To explain various methodologies presently prevalent for design of microstrip antennas
- To enable students to make design decisions in microstrip antennas

Course Outcome:

Learners will be able to:

- Design and analyze microstrip antennas,
- Correlate the fundamental design of antenna to advanced communication applications

Module	Detailed Content	Hours
1	**Review of Antennas** • Antenna parameters • Infinitesimal dipole antenna • Half wave dipole antenna	04
2	**Microstrip Antennas** • Introduction, Rectangular patch and Circular patch design • Quality factor, Bandwidth, Efficiency, Input impedance, and Coupling • Analytical models for MSAs transmission line models, cavity model, Multimode network model.	08
3	**Circular Polarization Technique** • Dual-Feed circularly polarized MSAs, Square MSA with two feeds, Effect of amplitude and phase imbalance, Square MSA with four feeds, CMSA with multiple feeds • Single-feed circularly polarized MSA, Diagonally fed nearly square MSA, Square MSA with modified edges, Square MSA with modified corners, Square MSA with a diagonal slot. • Broadband circularly polarized MSA, Dual-feed planar multiresonator MSA, Stacked MSA for circular polarization, Aperture coupled circularly polarized MSA, Sequentially rotated MSA.	10
4	**Planar Monopole Antennas** • Introduction, Planar Rectangular and Square Monopole	10

	Antennas, RMSA Suspended in Air with Orthogonal Ground Plane, Calculation of the Lower Frequency of the Planar Monopole Antennas. • Effect of Various Parameters of Planar Rectangular Monopole (RM) Antennas, Radiation Pattern of RM Antennas • Various Planar RMs with Equal Areas, Planar Circular Monopole Antennas.	
5	**Broadband and Compact Microstrip Antennas** • Mechanism of Parasitic Coupling for Broad BW, Gap-Coupled RMSAs, Radiating-Edge Gap-Coupled RMSAs, Multilayer Broadband MSA, Design Examples. • Compact Shorted RMSAs, Partially Shorted RMSAs, Effect of Dimensions of RMSAs with a Single Shorting Post, Effect of the Position of the Single Shorting Post	08
6	**Next generation Antennas** • Introduction to smart antennas, smart Antenna configurations-switched beam antennas and adaptive antenna approach, Smart Antennas' Benefits and draw backs, Antenna Beam forming, Architecture of Smart antenna system. • Metamaterial Antennas: Introduction, Negative Refractive Index (NRI) Metamaterials, Metamaterial Antennas Based on NRI concepts. • Applications of Smart Antennas: Smart antennas for Code Division Multiple Access Systems, Smart antennas for automatic radio frequency identification readers, Mutual coupling reduction techniques in MIMO.	08

Textbooks and References:

1. *Antenna Theory*- C. A. Balanis- Wiley and sons
2. *Antennas* – John. D. Krauss- TMH ed.
3. *Microstrip Antenna Design Handbook* - Ramesh Garg- Artech House.
4. *Handbook of Microstrip Antennas* - James R. James, Peter S. Hall-IEE Electromagnetic wave series.
5. *Broadband Microstrip antennas* – Girish Kumar and K.P. Ray, Artech House
6. *Smart Antennas for Wireless Communications with MATLAB*: Frank Gross, McGRAW Hill.
7. *Handbook on Advancements in Smart Antenna Technologies for Wireless Networks*-Chen Sun, Jun Cheng and Takashi Ohira, Information science reference, New York.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO1013	**Image Analysis using Machine learning**	**04**

Course Pre-requisite:

- Image and Video processing

Course Objectives:

The aim of this course is

- To provide exposure to students in gaining knowledge on concepts and understanding of Image Analysis.
- To give necessary knowledge of digital image analysis for further research within the area and to be able to use digital image analysis within other research areas such as computer graphics, image coding, video coding and industrial image processing problems.
- To prepare the student for further studies in e.g. computer vision, multispectral image analysis and statistical image analysis.

Course Outcome:

Learners will be able to:

- Demonstrate good capability to independently identify problems which can be solved with methods from image analysis, and be able to choose an appropriate method.
- Independently apply basic methods in image processing to problems which are relevant in industrial applications or research.
- Explain the solution to a problem in image analysis in a well structured manner and with clear logic.

Module	Detailed Content	Hours
1	**Introduction to Image Processing** • Basic mathematical concepts: Image transforms, Discrete Fourier Transform, Fast Fourier Transform. • Image enhancement: Grey level transforms, filtering. Extraction of special features: Filtering, edge and corner detection. Image Segmentation and mathematical morphology.	08
2	**Image Representation** • Boundary Representation: Chain Code, Polygonal Approximations, Signatures, Bending Energy, Statistical Moments, Region Representation • Boundary Descriptions: Simple Descriptor, Shape Number, Fourier Descriptor, Run-length Code, Projection, Concavity Tree. • Component Labelling: Component counting, Recursive	06

	Algorithm, Sequential Algorithm.	
3	**Feature Extraction** • Histogram (or Brightness) Features, Shape Features, Spatial Moment, Central Moment, Topological Features, Geometrical Features, Transform Features, Texture Features, Syntactic and Structural Features	08
4	**Evaluating Hypotheses** • Estimating Hypothesis Accuracy, Basics of Sampling Theory, Deriving confidence intervals, difference in error of two hypotheses, Comparing Learning Algorithms.	06
5	**Learning Algorithms** • Decision Tree Learning : Building Single and Multiple Decision Trees Selecting the Decision Tree to be Built, Obtaining Prules from Decision Trees, Missing Attribute Values, Classifying with Relabelled Nodes, Error Rates on Recall Sets, Pruning Decision Trees, Issues in decision tree learning. • Bayes Learning : Bayes Theorem and concept learning, Bayesian Belief Networks, Naive Bayes with Binary Attributes, Performance of Bayes Classifier • Instance Based Leaning : K-nearest neighbour learning, case based learning, radial basis functions • Deep Learning Algorithm : Deep Networks, Deep Belief Networks, Convolutional Networks,	08
6	**Image Classification** Image Classification using • Neural network: Issues in neural network learning, perceptrons, multilayer network & Back propagation Algorithm. • Fuzzy Systems: Fuzzy logic, Fuzzification, Fuzzy inference, fuzzy rule based system, defuzzification • Support Vector Machine : Linear Classifiers, Classifier Margin, Solving the Optimization Problem, Hard Margin and Soft Margin, Linear and Non Linear SVMs, Kernel functions, • Genetic Algorithms : Genetic operators, genetic programming, models of evolution & learning, parallelizing genetic algorithm	12

Textbooks and References:

Textbooks:

1. Mitchell, Tom. *Machine Learning*. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
2. Haykin, Simon S. Neural Networks and Learning Machines, 3rd edition Pearson 2008.
3. Sonka, Milan. Hlavac Vaclav. Boyle Roger. *Image Processing, Analysis and Machine Vision*, New Delhi: Thomson Learning, 2001. ISBN: 9812400613.
4. Rajasekaran S, Vijaylakshmi Pai G.A. Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Application. New Delhi, Prentice Hall of India.
5. Valluru, Sudarshan K. Rao Nageswara T., Introduction to Neural Networks, Fuzzy Logic & Genetic algorithms, Jaico Publishing House 2010.

Reference Books:

1. Bishop, Christopher. *Pattern recognition and machine learning*, Springer Verlag, 2006.
2. Shinghal Rajjan, Pattern Recognition Techniques and Applications. New Delhi Oxford University Press, 2011. ISBN 9780195676853.
3. Richards John, Jia Xiuping, *Remote Sensing Digital Image Analysis*, Springer 2006. ISBN : 9783540251286

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO1014	**Embedded Communication System Design**	**04**

Course Pre-requisite:

- Microcontrollers and Programming language

Course Objectives:

The aim of this course is

- To impart the concepts and architecture of embedded systems and to make the students capable of designing embedded systems product.
- To achieve this, system design, architecture and programming of industry popular ARM Cortex is covered in detail.

Course Outcome:

Learners will be able to:

- Understand the embedded concepts and architecture of embedded systems
- Understand the architecture and programming of ARM Cortex microcontroller
- Understand the open source RTOS and their usage
- Able to design an embedded systems application
- Able to usage of the development and debugging tools

Module	Detailed Content	Hours
1	**Overview of Product Design** • Need, design challenges, product survey, specifications of product need of hardware and software, partitioning of the design into its software and hardware components, iteration and refinement of the partitioning.	06
2	**Software and Hardware** • Tradeoffs, custom single-purpose processors, general-purpose processors, memory, interfacing, design technology-hardware design, cost reduction, re-engineering, optimization, maintenance, validation and development, prototyping, turnkey product design.	06
3	**Embedded Systems and ARM Architecture** • Embedded concepts, architecture of embedded systems, ARM architecture, Cortex-M3 basics, exceptions, instruction sets, NVIC, interrupt behavior, Cortex-M3/M4 programming, memory protection unit and other Cortex-M3 features, STM32xxx ARM Cortex M3/M4 microcontroller memory and peripherals, development & debugging tools.	12
4	**Communication and Security** • Embedded systems security and secured hardware structures. Communications security in embedded systems. Embedded systems time constraints.	04

5	**Multi core Architecture** • Multi-Core architecture for embedded systems, Programming models for Multi-Core, Embedded Multi-Core processing for networking.	04
6	**Open Source RTOS** • Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matric in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparative study. • Interfacing Modules: Sensor and actuator interface, data transfer and control, GPS, GSM, Bluetooth, Zigbee module interfacing with data processing and communication. IoT overview, IoT supported hardware platforms.	16

Textbooks and References:

1. *The Definitive Guide to the ARM Cortex-M3,* Joseph Yiu, Second Edition, Elsevier Inc. 2010.
2. Andrew N Sloss, Dominic Symes, Chris Wright, *"ARM System Developer's Guide - Designing and Optimizing System Software",* 2006, Elsevier.
3. *Communicating Embedded Systems: Networks Applications,* Francine Krief (Editor) February 2010, Wiley-ISTE
4. Frank Vahid and Tony Givargis, *"Embedded System Design: A Unified Hardware/Software Introduction",* John Wiley publication
5. P Marwedel, *"Embedded System Design",* Springer publication
6. Christopher Hallinan, *"Embedded Linux Primer: A Practical Real-World Approach",* Second Edition, Pearson Education Publication

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ILO1011	**Product Life Cycle management**	**03**

Course Pre-requisite:

- Microcontrollers and Programming language

Course Objectives:

The aim of this course is

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Course Outcome:

Learners will be able to:

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Content	Hours
1	**Introduction to Product Lifecycle Management (PLM)** • Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies** • Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM.	10
2	**Product Design** • Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering	09

	and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
3	**Product Data Management** • Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
4	**Virtual Product Development Tools** • For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
5	**Integration of Environmental Aspects in Product Design** • Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
6	**Life Cycle Assessment and Life Cycle Cost Analysis** • Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Textbooks and References:

1. John Stark, "*Product Lifecycle Management: Paradigm for 21st Century Product Realisation*", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "*Product Design for the environment-A life cycle approach*", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "*Product Life Cycle Management*", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "*Product Lifecycle Management: Driving the next generation of lean thinking*", Tata McGraw Hill, 2006, ISBN: 0070636265

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Some guidelines for setting the question paper. Minimum 80% syllabus

Examination: syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO1012	**Reliability Engineering**	**03**

Course Objectives:
The aim of this course is

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Course Outcome:
Learners will be able to:

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Content	Hours
1	**Probability theory** • Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions** • Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion** • Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
2	**Reliability Concepts** • Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis** • Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models** • Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08

3	**System Reliability** • System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
4	**Reliability Improvement** • Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. • System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
5	**Maintainability and Availability** • System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. • Availability – qualitative aspects.	05
6	**Failure Mode, Effects and Criticality Analysis** • Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Textbooks and References:

1. L.S. Srinath, "*Reliability Engineering*", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "*Reliability and Maintainability Engineering*", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "*Engineering Reliability*", John Wiley & Sons, 1980.
4. P.D.T. Conor, "*Practical Reliability Engg*.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "*Reliability in Engineering Design*", John Wiley & Sons.
6. Murray R. Spiegel, "*Probability and Statistics*", Tata McGraw-Hill Publishing Co. Ltd.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question

2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO1013	**Management Information System**	**03**

Course Objectives:
The aim of this course is

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Course Outcome:
Learners will be able to:

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Content	Hours
1	**Introduction To Information Systems (IS)** • Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	04
2	**Data and Knowledge Management** • Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. **Business intelligence (BI)** • Managers and Decision Making, BI for Data analysis and Presenting Results	07
3	**Ethical issues and Privacy** • Information Security, Threat to IS, and Security Controls	07
4	**Social Computing (SC)** • Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	07
5	**Computer Networks:** • Wired and Wireless technology, Pervasive computing, Cloud computing model.	06

6	**Information System within Organization** • Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. • Acquiring Information Systems and Applications: Various System development life cycle models.	08

Textbooks and References:

1. Kelly Rainer, Brad Prince, *Management Information Systems*, Wiley
2. K.C. Laudon and J.P. Laudon, *Management Information Systems: Managing the Digital Firm*, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, *Managing Information Systems: Strategy and Organization*, Prentice Hall, 2008

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs and Analysis**	07

	3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	
04	**Two-Level Fractional Factorial Designs and Analysis** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	**Conducting Tests** 5.1 Testing Logistics 5.2 Statistical aspects of conducting tests 5.3 Characteristics of good and bad data sets 5.4 Example experiments 5.5 Attribute Vs Variable data sets	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Phillip J Ross, "Taguchi Technique for Quality Engineering," McGrawHill
7. Madhav S Phadke, " Quality Engineering using Robust Design," Prentice Hall

Subject Code	Subject Name	Credits
ILO1015	**Operations Research**	**03**

Course Objectives:
The aim of this course is

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.

Course Outcome:
Learners will be able to:

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
  Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Content	Hours
1	**Introduction to Operations Research** • Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming** • Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem** • Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem** • Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	14

	Integer Programming Problem • Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
2	**Queuing models** • Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
3	**Simulation** • Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
4	**Dynamic programming** • Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
5	**Game Theory** • Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
6	**Inventory Models** • Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Textbooks and References:

1. Taha, H.A. "*Operations Research - An Introduction*", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "*Operations Research: Principles and Practice*", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "*Introduction to Operations Research*", Tata McGraw Hill, 2002.
4. *Operations Research*, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. *Operations Research*, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO1016	**Cyber Security and Laws**	**03**

Course Objectives:
The aim of this course is

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Course Outcome:
Learners will be able to:

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Module	Detailed Content	Hours
1	**Introduction to Cybercrime** • Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	04
2	**Cyber offenses & Cybercrime** • How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in • Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	09
3	**Tools and Methods Used in Cyberline** • Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	06
4	**The Concept of Cyberspace** • E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in	08

	Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	
5	**Indian IT Act.** • Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	06
6	**Information Security Standard compliances** • SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06

Textbooks and References:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi.
2. *The Indian Cyber Law* by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. *The Information technology Act*, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. *Cyber Law & Cyber Crimes* By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO1017	**Disaster management and Mitigation Measures**	**03**

Course Objectives:
The aim of this course is

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Course Outcome:
Learners will be able to:

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Content	Hours
1	**Introduction** • Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
2	**Natural Disaster and Manmade disasters:** • Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion • Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
3	**Disaster Management, Policy and Administration** • Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. • Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster	06

	management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
4	**Institutional Framework for Disaster Management in India:** • Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. • Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
5	**Financing Relief Measures:** • Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. • International relief aid agencies and their role in extreme events.	09
6	**Preventive and Mitigation Measures:** • Pre-disaster, during disaster and post-disaster measures in some events in general • Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication • Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. • Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Textbooks and References:

1. '*Disaster Management*' by Harsh K.Gupta, Universities Press Publications.
2. '*Disaster Management: An Appraisal of Institutional Mechanisms in India*' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. '*Introduction to International Disaster Management*' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. '*Disaster Management Handbook'* by Jack Pinkowski, CRC Press Taylor and Francis group.
5. '*Disaster management & rehabilitation'* by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. '*Natural Hazards and Disaster Management*, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. *Concepts and Techniques of GIS* –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO1018	**Energy Audit and Management**	**03**

Course Objectives:
The aim of this course is

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcome:
Learners will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Content	Hours
1	**Energy Scenario** • Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
2	**Energy Audit Principles** • Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. • Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
3	**Energy Management and Energy Conservation in Electrical**	10

	System • Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** • Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
4	**Energy Management and Energy Conservation in Thermal Systems:** • Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. • General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
5	**Energy Performance Assessment** • On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
6	**Energy conservation in Buildings** • Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Textbooks and References:

1. *Handbook of Electrical Installation Practice*, Geofry Stokes, Blackwell Science
2. *Designing with light: Lighting Handbook*, By Anil Valia, Lighting System
3. *Energy Management Handbook*, By W.C. Turner, John Wiley and Sons
4. *Handbook on Energy Audits and Management*, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. *Energy Management Principles*, C.B.Smith, Pergamon Press
6. *Energy Conservation Guidebook*, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. *Handbook of Energy Audits*, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ETL101	**Laboratory-I - Optical Communication Network**	**01**

Sr. No.	Title of Experiment
1	Performance analysis of optical link in presence of group velocity dispersion
2	Designing of dispersion compensating Fiber
3	Performance Analysis of Optical Link with Different Sources
4	Performance Analysis of Optical Link with Different Detectors
5	Performance analysis of Optical Link upto 40 Gbps
6	Performance Analysis of Soliton Communication System
7	Effect of cross phase modulation on WDM system
8	Mitigation of Four wave mixing by NZ-DSF fiber.
9	Performance Analysis of Optical Amplifier
10	Performance Analysis of DWDM System

- Out of 10 Experiments any 8 experiments have to be performed.

Assessment

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners. (Examiners will be from PG recognized teachers)

Subject Code	Subject Name	Credits
ETL102	**Laboratory-II - Modern Digital Signal Processing Applications**	**01**

Sr. No.	Title of Experiment
1	Demonstrate the application of Periodogram and Spectrogram
2	Pre-processing of ECG signal
3	Wavelet analysis for denoising
4	Wavelet transform for audio signal compression
5	Simulation of adaptive filtering
6	Generation of Chorus and flanging effects for voice record
7	Implementation of equalizers
8	Simulated generation of ECG signal and isolation of QRS complex
9	Analysis of EEG signals

- Out of 9 Experiments any 8 Experiments have to be performed.

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners. (Examiners will be from PG recognized teachers)

Subject Code	Subject Name	Credits
ETC201	**Modern Digital Communication**	**04**

Course Pre-requisite:

- Digital communication
- Random Signal Analysis

Course Objectives:

The aim of this course is to let the students obtain

- Fundamentals of modern communication system
- Ability to analyze and design digital communication systems

Course Outcome:

Learners will be able to:

- Explain and implement different source coding techniques
- Analyze waveform receivers for coherent and non-coherent communication
- Describe and design of band-limited channels
- Evaluate the detection and estimation of signals in the presence of noise.
- Explain the characteristics of fading channels.

Module	Detailed Content	Hours
1	**Source Coding** • Average ,mutual information & entropy • Coding for discrete sources • The Lempel algorithm(LZ-77,LZ-78,LZW) • Coding for analog sources -Temporal waveform coding • Spatial waveform coding	09
2	**Coherent Communication with Waveforms** • Binary cross-correlation receivers • Matched filter receivers • M-ary waveform receivers • Time-sampling approach • Karhunen-Loeve(K-L) Expansion approach • Whitening approach • Real and complex signal models • Effect of Data Imperfect Carrier Synchronization • Effect of Data Imperfect bit synchronization	08
3	**Non Coherent Communication with Waveforms** • Non Coherent receivers in random phase channels • Optimum M-FSK receivers • Non coherent receivers in random amplitude and phase channels	08

	• Optimum receivers in Rayleigh channels • Optimum receivers in Rician channels	
4	**Signal Design for Channel and Equalization** • Design of band limited signals with controlled ISI • Symbol by symbol sub optimum detection • Introduction to linear equalizer • Means square error (MSE) criterion • Iterative equalization and decoding • Introduction to adaptive equalization • The LMS Algorithm	09
5	**Optimum Detection and Estimation** • Noise vector in signal space • Bayes detection of received signal • Decision region & minimum error probability • Optimum detection of several special comm. signals	07
6	**Fading Channels** • Small scale multipath propagation • Parameters of mobile multipath channels • Types of small scale fading • Rayleigh and Rician distribution	07

Textbooks and References:

1. *Digital Communication* by John G.Proakis, 3rd Edition McGraw –Hill International Editions.
2. *Digital Communication Techniques Signal Design & Detection* by Marvin K. Simon, Sami M Hindei, William C Lindesy, PHI Learning Private Limited.
3. *Digital Communications, Fundamental & Application* by Bernard Sklar, Pabitra Kumar Ray, 2nd Edition , Pearson Publication
4. *Wireless communication principles and practice* by Theodore S. Rappaport, 2nd Edition , Pearson Publication

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETC202	**Wireless Adhoc and Sensor Networks**	**04**

Course Pre-requisite:

- Computer Networks
- Wireless Networks

Course Objectives:

The aim of this course is to let the students

- To understand the Wireless adhoc and sensor Network.
- To understand the major challenges and designing issues in designing wireless sensor and adhoc networks.
- To understand various MAC and routing protocols in wireless sensor and adhoc networks.
- To Understand Heterogeneous network architecture including MANET, WLAN, Cellular Networks.

Course Outcome:

Learners will be able to:

- Understand and explain the concept of adhoc and sensor networks and their applications.
- Set up and evaluate performance of various protocols in wireless sensor and adhoc networks.
- Understand TCP performance over adhoc network.
- Understand integration of MANET, cellular Network and WLAN.

Module	Detailed Content	Hours
1	**Introduction to MANET and Wireless Sensor Network** • Challenges and Applications of MANET, Design issues and application of sensor Network, Sensing and Communication Range, Energy and Clustering of sensors, Wireless mesh Network, Architecture and Challenging technologies.	08
2	**Routing in Adhoc Networks** • Introduction, Topology-Based versus Position-Based Approaches, Topologies-Based Routing Protocols, Position-Based Routing, Other Routing Protocols, Wireless LAN, Wireless PAN, Wireless BAN .	08
3	**Broadcasting, Multicasting, Geocasting and QoS in MANET** • Introduction, The Broadcast Storm, Multicasting, Geocasting, QOS requirements, objectives and Architecture	08
4	**TCP over Adhoc Networks** • Introduction, TCP Protocol Overview, TCP and MANETs, Solutions for TCP over Adhoc.	06

5	**Design Consideration in Sensor Network** • Introduction, Classifications of WSNs, MAC Layer, Routing Layer, High Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs, Cognitive Radio based sensor Networks. Nano Sensor Networks.	12
6	**Integrating MANETs, WLANs and Cellular Networks** • Introduction, Ingredients of a Heterogeneous Architecture, Protocol Stack, Comparison of the Integrated Architectures.	06

Textbooks and References:

1. *Adhoc & Sensor Networks Theory and Applications* by Cordeiro, Agrawal, Cambridge University Press India Pvt. Ltd, Edition 2010.
2. *Adhoc Wireless Networks Architecture and Protocols* by C.Siva Ram Murthy and B.S.Manoj, Pearson.
3. *Adhoc & Sensor Networks* by Houda Labiod, Wiley.
4. *Wireless Communication and Networking*-Vijay Garg, Elsevier Inc.
5. *Wireless and Mobile Networks, Concepts and Protocols* by Manvi, Kakkasageri, second edition, Wiley.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETC203	**RF and Microwave Engineering**	**04**

Course Pre-requisite:

- Wave Theory and Propagation
- Radio Frequency Modelling and Antennas
- Microwave and Radar Engineering

Course Objectives:

The aim of this course is

- To provide state-of-art knowledge in RF circuits and microwave systems.
- To explain various methodologies presently prevalent for design of active and passive RF circuits.
- To enable students to make system level design decisions.
- To expose students to state-of-art simulation systems.
- To teach students Computer aided design tools for analysis and design of circuits

Course Outcome:

Learners will be able to:

- Characterize devices at higher frequencies.
- Design and analyze RF circuits and components.
- Design and analyze amplifiers, oscillators and mixers at microwave frequencies.
- Demonstrate skills of planning, design and deployment of microwave networks.

Module	Detailed Content	Hours
1	**Passive Lines and Impedance Matching Network Design** • Strip lines, Microstrip lines and coupled lines :Analysis and design • Impedance matching using lumped and distributed parameters.	06
2	**Device Characterization** • S-parameters: Properties and characterization. • Non-linear Measurements: Load/Source pull, Vector Network Analysis, Pulsed measurements • Noise Characterization: Noise Figure, Noise temperature, Noise parameters. Noise Correlation matrix.	06
3	**Amplifier Design** • Two-port power gain stability • Single stage amplifier design: Design for maximum gain, design for specified gain, low noise amplifier design • Power amplifier design.: Characteristics of power amplifier and classes of amplifiers, design of class A power amplifier	12
4	**Frequency Generation**	10

	• One-port and two-port microwave oscillator design, Dielectric Resonator Oscillator (DRO). • Analysis of phase noise in oscillators • Mixers: Characteristics, • Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers.	
5	**Microwave Network Design and Deployment** • Spectrum management, Interference effects and frequency shaping, Microwave system engineering. • Digital microwave radio, Digital multiplexing, Cabling and signal termination, Field surveys.	08
6	**Microwave Integrated Circuits (MIC)** • MIC materials • Types of MIC • Hybrid and monolithic MIC • Chip mathematics.	06

Textbooks and References:

1. David Pozar, "*Microwave Engineering*", Wiley Publication, Fourth Edition
2. Matthew M. Radmanesh, "*Radio Frequency and Microwave Electronics*", Pearson Education.
3. F. Giannini, G. Leuzzi, "*Non-linear Microwave Circuit Design*", Wiley Publication.
4. Harvey Lahpamer, "Microwave Transmission Networks Planning, Design and Deployment", Tata McGraw Hill, second Edition.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO2021	**Satellite Networking**	**04**

Course Pre-requisite:

- Satellite Communication and Networks
- Internet Voice and Mobile Communication

Course Objectives:

The aim of this course is

- To understand and learn advanced networking techniques with satellite systems
- To be able to devise link budget model of satellite communication for specific applications
- To be able to apply knowledge to upgrade satellite communication systems

Course Outcome:

Learners will be able to:

- Perform link budget for specific satellite application
- Learn different advanced satellite networking concepts
- Understand usage of lasers in satellites and satellite service applications

Module	Detailed Content	Hours
1	**Introduction** • Origin of satellite communications, Development, space and ground segments, types of orbits, evolution of satellite communication, Development of satellite services and Launching mechanism in the Geostationary orbit, Orbits and orbital perturbations	08
2	**System Segment and Link Analysis** • AOCS, TTC, Equipment Reliability and Space qualifications, Link analysis	08
3	**Satellite Networks Architecture and organization** • Applications and services of satellite network, network reference models, Architecture, On board connectivity, frame organisation, Window organization	10
4	**Laser Satellite Communications** • Link introduction, optical satellite link transmitter, Receiver, satellite beam acquisition, Tracking and positioning, Single hop satellite connections, multi hop satellite connections, inter satellite links	08
5	**Specific Satellite Network** • Study of IRIDIUM and GLOBALSTAR Synchronous Digital Hierarchy (SDH), Integrated services digital networks (ISDN), ISDN over satellite, Interworking with heterogeneous networks,	08

	Case studies - satellite image analysis and photogrammetry.	
6	**Satellite Applications** • Communication applications (ATM service, DTH service, TV broadcast), Earth observation applications (Urban planning, Oceanography, resource management, agriculture services), Meteorology applications weather forecasting, Space science applications (Moon topography, Planet investigation), Navigation applications (Road, desserts, aerial and marine services).	06

Textbooks and References:

1. *Satellite Communication Systems, Techniques and Technology* -5th Edition by Gerard Maral and Michel Bousquet, John Wiley Publication (Text book for chapter-1 to 5)
2. *Mobile Satellite Communication Networks* – By Ray Sheriff, Y. Fun Hu, John Wiley Publication (Text book for chapter-1 to 3)
3. *Satellite Networking: Principles and Protocols* 2nd Edition by Zhili Sun, John Wiley Publication (Text book for chapter-3 & 5)
4. *Satellite Communications* by Roddy Dennis, 5th Edition, McGraw Hill Education Publication (Reference book)
5. *Satellite Communication* – Timothy Pratt, C. Boustian, J. Allmuti, Wiley Publication (Reference Book)
6. Digital resources for case studies from internet

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO2022	**Network and Cyber Security**	**04**

Course Pre-requisite:

- Computer Communication Networks
- Operating System
- Probability Theory and Random Processes

Course Objectives:

The aim of this course is

- To introduce advanced techniques to implement security mechanisms using IDS, Firewall, and Antivirus and Biometrics, Incident handling and Forensics
- To discuss security implications on Organizations, security standards and Cyber laws.

Course Outcome:

Learners will be able to:

- Describe security threats and apply security techniques using cryptosystems.
- Explain the key terms and concepts in cyber law, intellectual property and cyber crimes, trademarks and domain theft
- Build and configure firewall and intrusion detections systems' using GNU open source security tools.
- Incorporate approaches for incident analysis and response, for risk management and best practices and digital evidence collection, and evidentiary reporting in forensic acquisition

Module	Detailed Content	Hours
1	**Introduction to Network and Cyber Security** • Need for network security, Attacks and Their classification, • Network Vulnerabilities and control • Security services and mechanisms, • Impact of Security on Enterprises • Risk Factors and Cost Analysis.	04
2	**Cryptography and Cryptosystems** • Classical and modern cryptography, stream and block ciphers, • Message digest, digital signature, digital certificate, certificate authority, cryptanalysis • DES/AES/RSA/RC4/MD5/SHA algorithms • Secure protocols SSL, IPSec, VPN,PKI • Implementing security using symmetric and Public-Key cryptography.	10
3	**Ethical Hacking and Network Differences** • Cybercrimes, Cybercriminals, Cyberoffences, Cybercrimes in	10

	Mobile and Wireless Devices, Tools and Methods used in Cybercrimes • Network reconnaissance, scanning and sniffing, gaining access. • Security Technologies: Firewall, IDS and Antivirus, Reverse proxy • L7 content filtering firewall, NAT & reverse proxy, Firewall deployment and limitations, selection of firewalls. Performance analysis of firewall. • Signature and Anamoly based IDSs, IDS deployment, zone diagram, performance analysis of IDS, strengths and limitations of IDS. • Biometrics for security	
4	**Cybersecurity Principles and best Practices** • Layered Defense, Surveillance and Reconnaissance Outsider/Internal Threat Protection, • Privacy, Intellectual Property, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks ,Internet Fraud ,Electronic Evidence.	8
5	**Cybersecurity Implications on Organizations, Standards and Cyber laws** • Risk Management: Asset Evaluation and Business Impact Analysis, Risk Identification, Risk Quantification, Risk Response Development and Control Security Policy, Compliance, and Business Continuity. • Cyber Incident Preparation: Incident Detection and Analysis, Containment, Eradication, and Recovery ,Proactive and Post-Incident Cyber Services • Forensics: Forensic Technologies ,Digital Evidence Collection ,Evidentiary Reporting • The Indian IT Act and new amendments.	8
6	**System Security and Case Study** • Security Operations Center (SOC), Network Operations Center (NOC), • Network Security Audit • SET, Biometric Security, Digital Immune System • Cloud Security. Wi-Fi Security, Mobile and Cellular Security.	8

Textbooks and References:

1. *Cryptography and Network Security* by Behrouz Forouzan McGrawHill Publications
2. *Security in Computing* by Pfleeger and Pfleeger, Pearson Publications
3. *Management of Information Security* by M. Whitman Cengage Publications
4. Cengage Learning India, *Network Security and Cryptography* by B. Menezes.
5. *Computer Security* by Matt Bishop, Pearson Publication

6. *Cryptography and Network Security* by William Stallings, Pearson publications.
7. *Cyber Security* by Nina Godbole, John Wiley Publications
8. *Information Security: Principles and Practice,* 2nd edition by Mark Stamp and Deven Shah.
9. *Data Communication & Network Security* by Houston Carr and Charles Snyder, McGraw-Hill Publication.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO2023	**Remote Sensing**	**04**

Course Pre-requisite:

- Digital Image Processing

Course Objectives:

The aim of this course is

- To provide exposure to students in gaining knowledge on concepts and applications of Remote Sensing
- To give exposure to participants for Digital Image Processing with more emphasis on classification
- To acquire skills in advance techniques such as hyper spectral, thermal and microwave for mapping and monitoring.

Course Outcome:

Learners will be able to:

- Demonstrate detailed, integrated knowledge of the application and history of remote sensing
- Discuss the nature of electromagnetic radiation and its interaction with the earth's surface and atmosphere
- Demonstrate a critical understanding of the differences between remote sensing systems and be aware of their characteristics and limitations
- Critically identify specific applications where remote processing may be used as a tool for monitoring and research.

Module	Detailed Content	Hours
1	**Introduction to Remote Sensing** • What is Remote Sensing (RS)? Characteristics/elements of RS systems, Electromagnetic Radiation Electromagnetic Spectrum, Polarization, Interactions with the Atmosphere (Absorption, Scattering: Rayleigh, Mie, Non selective, absorption), Radiation - Target interactions, Passive vs. Active Sensing, Basic Image processing concepts: Image as a matrix, B/W and Colour (RGB)	08
2	**Sensors** • Ground and Air, Satellite Characteristics: orbits, swaths, Spatial Resolution, Pixel Size (IFOV, resolution cell), Spectral, Radiometric, Temporal Resolution, Cameras and Aerial Photography, Multispectral and Hyperspectral Scanning, Thermal Imaging, Geometric Distortion, Different Satellites: All Weather Satellites, Land Observation, Marine Observation,	08

	LIDAR, FLIR, RADAR, Side looking Radar.	
3	**Microwave Remote Sensing** • Introduction, RADAR Basics, Viewing Geometry, RADAR Image Distortions, Target Interaction and Image Appearance, RADAR Image Properties, RADAR Polarimetry (Polarization, Signatures, Backscatter, Parameters Affecting Backscatter, Applications), Synthetic Aperture RADAR (SAR), Airborne and Spaceborne Radars. Comparison of Optical and Microwave Remote Sensing Techniques.	10
4	**Image Transforms** • Visual Image Analysis (tone, shape, size, pattern, texture, shadow, and Association), Digital Image Processing steps (Pre-processing, Enhancement, Transformation and Classification), Contrast Enhancement: Global, Local Techniques, Filtering, Image Transformations: Arithmetic Operations (Subtraction, Spectral Ratio, NDVI, PCT, FT, Color , Hough Transforms)	08
5	**Image Classification and Analysis** • Visual Interpretation, Image Classification: Optimum band selection, Supervised (Minimum Distance, Parallelopiped and Maximum Likelihood), Assessment of Classification Accuracy (Confusion or Error Matrix, Omission and Commission Error, Kappa Coefficient), Unsupervised Classification techniques: K-means, ISODATA, Fuzzy C-means, Hierarchical clustering, Evaluation Techniques	10
6	**Applications of Remote Sensing** • Agriculture, Forestry, Land Cover/ Land Use Mapping, Water Resources, Snow and Glacier, Wetland Management, Oceans and Coastal, Soil Moisture	04

Textbooks and References:

Textbooks:

1. *Fundamentals of Remote Sensing***,** George Joseph, Universities Press; Second Edition, ISBN-10: 817371535, ISBN-13: 978-8173715358
2. *Remote Sensing: Models and Methods for Image Processing***,** Robert A. Schowengerdt, Academic Press, Third Edition, ISBN-10: 8131203182, ISBN-13: 978-8131203187
3. *Remote Sensing and Image Interpretation***,** Lillesand, Kiefer, Chipman, Wiley, Sixth Edition, ISBN-10: 8126532238, ISBN-13: 978-8126532230

References Books:

1. *Introduction to Microwave Remote Sensing*, Iain H. Woodhouse, CRC Press, ISBN-10: 0415271231, ISBN-13: 978-0415271233
2. *Digital Image Processing*, Rafael C. Gonzalez, Richard Eugene Woods, Prentice Hall, Third Edition, 2013, ISBN-13: 9789332518469
3. *Digital Image Processing*, S Jayaraman , S Esakkirajan, T Veerakumar, Mcgraw Hill Education, First Edition, 2009, ISBN-10: 0070144796, ISBN-13: 9780070144798

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ETDLO2024	**Error Control Coding**	**04**

Course Pre-requisite:

- Digital Communication
- Applied Maths

Course Objectives:

The aim of this course is

- To provide students a sound knowledge of traditional and modern coding theory, the motivation behind synthesis of channel coding techniques.

Course Outcome:

Learners will be able to:

- Design channel codes for the physical layer and storage applications
- Design new channel codes for wired/wireless communication systems

Module	Detailed Content	Hours
1	**Introduction to Algebra** • Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2m) and its basic properties, Computation using Galois Field GF (2m) Arithmetic, Vector spaces and Matrices.	08
2	**Linear Codes** • Block codes: Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed – Muller codes, Golay code, Product codes and Interleaved codes. • Cyclic Codes: Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes – Encoding using Feedback shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, Golay code, Shortened cyclic codes.	10
3	**BCH Codes** • Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction. Non – binary BCH codes: q – ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes, Decoding of Non – Binary BCH and RS codes: The Berlekamp - Massey Algorithm.	08

4	**Convolutional Codes** • Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft – output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding.	08
5	**Concatenated Codes and Turbo Codes** • Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.	08
6	**Burst Error Correcting Codes** • Burst and Random error correcting codes, Concept of Inter – leaving, cyclic codes for Burst Error correction – Fire codes, Convolutional codes for Burst Error correction.	06

Textbooks and References:

1. Shu Lin & Daniel J. Costello, Jr. *"Error Control Coding"* Prentice Hall, Second Edition, 2004.
2. S. B Wicker, *Error Control Systems for Digital Communication and Storage*, Prentice Hall International, 1995.
3. Blahut R. E, *Theory and Practise of Error Control Codes*, Addisson Wesley, 1983
4. Blahut R.E., *Algebraic codes for Data transmission*, Cambridge University Press, 2003.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum two modules) and the other is either a class test (on minimum three modules of the remaining) or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these, question number 1 will be compulsory and it will carry questions covering each module. From remaining questions any three questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
ILO2021	**Project Management**	**03**

Course Objectives:
The aim of this course is

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course Outcome:
Learners will be able to:

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module	Detailed Content	Hours
1	**Project Management Foundation:** • Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	05
2	**Initiating Projects:** • How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	06
3	**Project Planning and Scheduling** • Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8

4	**Planning Projects** • Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. • Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	06
5	**Executing Projects:** • Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. • Team management, communication and project meetings. **Monitoring and Controlling Projects:** • Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **Project Contracting** • Project procurement management, contracting and outsourcing	08
6	**Project Leadership and Ethics:** • Introduction to project leadership, ethics in projects. • Multicultural and virtual projects. **Closing the Project:** • Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	06

Textbooks and References:

1. Jack Meredith & Samuel Mantel, *Project Management: A managerial approach*, Wiley India, 7th Ed.
2. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 5th Ed, Project Management Institute PA, USA
3. Gido Clements, *Project Management*, Cengage Learning.
4. Gopalan, *Project Management*, , Wiley India
5. Dennis Lock, *Project Management*, Gower Publishing England, 9th Ed.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2022	**Finance Management**	**03**

Course Objectives:
The aim of this course is

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Course Outcome:
Learners will be able to:

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module	Detailed Content	Hours
1	**Overview of Indian Financial System** • Characteristics, Components and Functions of Financial System. **Financial Instruments** • Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets** • Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions** • Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
2	**Concepts of Returns and Risks** • Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money** • Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous	06

	Discounting.	
3	**Overview of Corporate Finance** • Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis** • Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
4	**Capital Budgeting** • Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management** • Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
5	**Sources of Finance** • Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure** • Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
6	**Dividend Policy** • Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Textbooks and References:

1. *Fundamentals of Financial Management*, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. *Analysis for Financial Management*, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. *Indian Financial System*, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. *Financial Management*, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2023	**Entrepreneurship Development and Management**	**03**

Course Objectives:
The aim of this course is

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME.

Course Outcome:
Learners will be able to:

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
  Understand government policies for entrepreneurs

Module	Detailed Content	Hours
1	**Overview Of Entrepreneurship** • Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership • Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
2	**Business Plans And Importance Of Capital To Entrepreneurship** • Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur • **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
3	• Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
4	**Indian Environment for Entrepreneurship** • Key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private	08

	partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
5	**Effective Management of Business** • Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
6	**Achieving Success In The Small Business** • Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Textbooks and References:

1. Poornima Charantimath, *Entrepreneurship development- Small Business Enterprise*, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, *Entrepreneurship*, latest edition, The McGrawHill Company
3. Dr TN Chhabra, *Entrepreneurship Development*, Sun India Publications, New Delhi
4. Dr CN Prasad, *Small and Medium Enterprises in Global Perspective*, New century Publications, New Delhi
5. Vasant Desai, *Entrepreneurial development and management*, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, *Entrepreneurship*, Excel Books
7. Rashmi Bansal, *STAY hungry STAY foolish*, CIIE, IIM Ahmedabad
8. *Law and Practice relating to Micro, Small and Medium enterprises*, Taxmann Publication Ltd.
9. Kurakto, *Entrepreneurship- Principles and Practices*, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2024	**Human Resource Management**	**03**

Course Objectives:
The aim of this course is

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Course Outcome:
Learners will be able to:

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Content	Hours
1	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	05
2	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on	07

	Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor) • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	
3	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	06
4	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	05
5	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	06
6	**HR & MIS** • Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** • Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** • Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act,	05

	Shops and Establishments Act	

Textbooks and References:

1. Stephen Robbins, *Organizational Behavior*, 16th Ed, 2013
2. V S P Rao, *Human Resource Management*, 3rd Ed, 2010, Excel publishing
3. Aswathapa, *Human resource management: Text & cases*, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, *Dynamics of Industrial Relations in India*, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, *Essentials of Human Resource management and Industrial relations*, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, *Management & Organizational Behavior*, Latest Ed, 2016, Pearson Publications

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2025	**Professional Ethics and Corporate Social Responsibility (CSR)**	**03**

Course Objectives:
The aim of this course is

- To understand professional ethics in business
- To recognized corporate social responsibility

Course Outcome:
Learners will be able to:

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Module	Detailed Content	Hours
1	**Professional Ethics and Business:** • The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
2	**Professional Ethics in the Marketplace** • Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment** • Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
3	**Professional Ethics of Consumer Protection** • Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination** • Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
4	**Introduction to Corporate Social Responsibility** • Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. • Trajectory of Corporate Social Responsibility in India	05
5	**Corporate Social Responsibility** • Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in	08

	India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	
6	**Corporate Social Responsibility in Globalizing India** • Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Textbooks and References:

1. *Business Ethics: Texts and Cases from the Indian Perspective (2013)* by Ananda Das Gupta; Publisher: Springer.
2. *Corporate Social Responsibility: Readings and Cases in a Global Context (2007)* by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. *Business Ethics: Concepts and Cases*, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. *Corporate Social Responsibility in India (2015)* by Bidyut Chakrabarty, Routledge, New Delhi.

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2026	**Research Methodology**	**03**

Course Objectives:
The aim of this course is

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Course Outcome:
Learners will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
  Review and analyze research findings

Module	Detailed Content	Hours
1	**Introduction and Basic Research Concepts** • Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology • Need of Research in Business and Social Sciences • Objectives of Research • Issues and Problems in Research • Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
2	**Types of Research** • Basic Research • Applied Research • Descriptive Research • Analytical Research • Empirical Research • Qualitative and Quantitative Approaches	07
3	**Research Design and Sample Design** • Research Design – Meaning, Types and Significance • Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
4	**Research Methodology** • Meaning of Research Methodology • Stages in Scientific Research Process:	08

	a. Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	
5	**Formulating Research Problem** • Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
6	**Outcome of Research** • Preparation of the report on conclusion reached • Validity Testing & Ethical Issues • Suggestions and Recommendation	04

Textbooks and References:

1. Dawson, Catherine, 2002, *Practical Research Methods*, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, *Research Methodology-Methods and Techniques*, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, *Research Methodology-A Step-by-Step Guide for Beginners*, (2nd ed), Singapore, Pearson Education

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2027	**IPR and Patenting**	**03**

Course Objectives:
The aim of this course is

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Course Outcome:
Learners will be able to:

- Understand Intellectual Property assets
- Assist individuals and organizations in capacity building
- Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Content	Hours
1	**Introduction to Intellectual Property Rights (IPR)** • Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment** • Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
2	**Enforcement of Intellectual Property Rights** • Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR** • Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
3	**Emerging Issues in IPR** • Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
4	**Basics of Patents** • Definition of Patents, Conditions of patentability, Patentable	07

	and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5	**Patent Rules** • Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
6	**Procedure for Filing a Patent (National and International)** • Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases** • Important websites, Searching international databases	07

Textbooks and References:

1. Rajkumar S. Adukia, 2007, *A Handbook on Laws Relating to Intellectual Property Rights in India*, The Institute of Chartered Accountants of India
2. Keayla B K, *Patent system and related issues at a glance*, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, *Intellectual Property Law in India*, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, *Intellectual Property and Human Development: Current Trends and Future Scenario*, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, *Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right*, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, *The enforcement of Intellactual Property Rights: A Case Book*, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, *Intellectual Property Rights*, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, *Intellectual Property Rights*, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, *Intellectual Property Rights*, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, *Fundamentals of IPR for Engineers*, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, *A Manual on Intellectual Property Rights*.
12. Mathew Y Maa, 2009, *Fundamentals of Patenting and Licensing for Scientists and Engineers*, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** *IPR: Drafting, Interpretation*

*of Patent Specifications and Claims***,** New India Publishing Agency
14. Vivien Irish, 2005, *Intellectual Property Rights for Engineers*, IET
15. Howard B Rockman, 2004, *Intellectual Property Law for Engineers and scientists*, Wiley-IEEE Press

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2028	**Digital Business Management**	**03**

Course Objectives:
The aim of this course is

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Course Outcome:
Learners will be able to:

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Module	Detailed Content	Hours
1	**Introduction to Digital Business** • Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts • Difference between physical economy and digital economy, **Drivers of digital business** • Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) • Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** • **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement • B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals • Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing • EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services** • ERP as e –business backbone, knowledge Tope Apps,	06

	Information and referral system **Application Development** • Building Digital business Applications and Infrastructure	
4	**Managing E-Business** • Managing Knowledge, Management skills for e-business, Managing Risks in e –business • Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy** • E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, • E-business strategy into Action, challenges and E-Transition • (Process of Digital Transformation)	04
6	**Materializing e-business** • From Idea to Realization-Business plan preparation • Case Studies and presentations	08

Textbooks and References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. *E-commerce from vision to fulfilment*, Elias M. Awad, PHI-Restricted, 2002
3. *Digital Business and E-Commerce Management*, 6th Ed, Dave Chaffey, Pearson, August 2014
4. *Introduction to E-business-Management and Strategy*, Colin Combe, ELSVIER, 2006
5. *Digital Business Concepts and Strategy*, Eloise Coupey, 2nd Edition, Pearson
6. *Trend and Challenges in Digital Business Innovation*, Vinocenzo Morabito, Springer
7. *Digital Business Discourse* Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. *Perspectives the Digital Enterprise –A framework for Transformation*, TCS consulting journal Vol.5
10. *Measuring Digital Economy-A new perspective* -DOI:10.1787/9789264221796-en OECD Publishing

Assessment Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ILO2029	**Environmental Management**	**03**

Course Objectives:
The aim of this course is

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Course Outcome:
Learners will be able to:

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Module	Detailed Content	Hours
1	**Introduction and Definition of Environment** • Significance of Environment Management for contemporary managers, Career opportunities. • Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
2	**Global Environmental concerns** • Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
3	**Concepts of Ecology** • Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
4	• Scope of Environment Management, Role & functions of Government as a planning and regulating agency. • Environment Quality Management and Corporate Environmental Responsibility	10
5	• Total Quality Environmental Management, ISO-14000, EMS certification.	05
6	• General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Textbooks and References:

1. *Environmental Management: Principles and Practice*, C J Barrow, Routledge Publishers London, 1999
2. *A Handbook of Environmental Management* Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. *Environmental Management*, T V Ramachandra and Vijay Kulkarni, TERI Press
4. *Indian Standard Environmental Management Systems* — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. *Environmental Management: An Indian Perspective*, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. *Introduction to Environmental Management*, Mary K Theodore and Louise Theodore, CRC Press
7. *Environment and Ecology*, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question paper. Minimum 80% syllabus syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
ETL201	**Laboratory-III - Wireless Adhoc and Sensor Networks**	**01**

Sr. No.	Title of Experiment
1	Study and Implementation of technical paper from the reputed Journal related to Adhoc and Wireless Sensor Networks by using any Simulator/tool. Or Implementing one hardware project related to WSN.
2	Implementation /Simulation of any two Routing Protocols in Adhoc Networks.
3	Implementation /Simulation of any two Routing Protocols in Wireless Sensor Networks.
4	Implementation /Simulation of any two MAC Protocols in Wireless Sensor Networks.

Simulator or Software can be NS2, NS3, MATLAB/SCILAB, NETSIM, etc.

Assessment

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners. (Examiners will be from PG recognized teachers)

Subject Code	Subject Name	Credits
ETL202	**Laboratory -IV- RF and Microwave Engineering**	**01**

Sr. No.	Title of Experiment
1	Study and calibration of vector network analyzer.
2	Measurement of S-parameters of one-port network.
3	Measurement of S-parameters of two-port network.
4	Stability analysis of two-port amplifier circuit.
5	Noise analysis of two-port amplifier circuit.
6	Design and analysis of microstrip line/ passive components.
7	Design and analysis of various matching networks using CAD tools.
8	Design and simulation of amplifier circuits using CAD tools.
9	Design and simulation of oscillator circuits using CAD tools.
10	Analysis of mixer spurs.

- Out of the 10 experiments, any 8 experiments to be performed.

Assessment

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners. (Examiners will be from PG recognized teachers)

Subject Code	Subject Name	Credits
ETS301	**Special Topic Seminar**	**03**

Guidelines for Seminar

- Seminar should be based on thrust areas in Electronics and Telecommunication Engineering
- Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literature and understand the topic and compile the report in standard format and present in front of Panel of Examiners appointed by the Head of the Department/Institute of respective Programme.
- Seminar should be assessed based on following points
  1. Quality of Literature survey and Novelty in the topic
  2. Relevance to the specialization
  3. Understanding of the topic
  4. Quality of Written and Oral Presentation

IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from PG Recognized Teachers by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years' experience in Industries.

2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.

3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

Subject Code	Subject Name	Credits
ETD301	**Dissertation I**	**12**
ETD401	**Dissertation II**	**15**

Guidelines for Dissertation

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor.
- Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by Analytical/ simulation/ experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
  1. Quality of Literature survey and Novelty in the problem
  2. Clarity of Problem definition and Feasibility of problem solution
  3. Relevance to the specialization
  4. Clarity of objective and scope
- Dissertation I should be assessed through a presentation by a panel of Internal examiners (PG Recognized Teachers) appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

- Dissertation II should be assessed based on following points
  1. Quality of Literature survey and Novelty in the problem
  2. Clarity of Problem definition and Feasibility of problem solution
  3. Relevance to the specialization or current Research / Industrial trends
  4. Clarity of objective and scope
  5. Quality of work attempted
  6. Validation of results
  7. Quality of Written and Oral Presentation
- Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai
- Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Refereed Journal)

PG- Instrumentation Engineering

Sr. No.	Subject Code	Subject Name	Count
1	ISEC101	Higher Mathematics for Control Engineering	1
2	ISEC102	Advanced signal processing for Sensors	1
3	ISEC103	Robust Control	1
4	ISEL101	Laboratory-I	1
5	ISEL102	Laboratory-II	1
6	ISEC201	Electronic Systems Design	1
7	ISEC202	State Estimation and Stochastic Processes	1
8	ISEC203	Advanced Process Control and Automation	1
9	ISEL201	Laboratory-III	1
10	ISEL202	Laboratory-IV	1
11	ISES301	Special Topic Seminar	1
12	ISED301	Dissertation–I	1
13	ISED401	Dissertation–II	1
		Total	13

AC 14/07/2016
Item No. 4.10

UNIVERSITY OF MUMBAI

Revised Syllabus for the

M.E. Instrumentation and Control

(As per Choice Based Credit and Grading System with effect from the academic year 2016-2017)

From Co-ordinator's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Choice Based Credit and Grading System were implemented for First Year Master of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Master of Engineering in the academic year 2017-2018.

Dr. Suresh K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and also to achieve recognition of the institution or program meeting certain specified standards. The main focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electrical Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for post-graduate program in Instrumentation and Control Engineering, more than ten senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs were finalized for post-graduate program in Instrumentation Engineering are listed below;

Program Educational Objectives (PEOs)

- To create the competent & skilled engineers to ensure them the careers and employment and in this way fulfill the requirement of Multinational industries.
- Expose them by giving an opportunity as an individual as well as team.
- Inculcate professional and ethical attitude and ability to relate automation issues to society at large.
- Facilitate strong base of basic scientific & engineering knowledge with professional ethics, lifelong learning attitude society globally.
- To give adequate knowledge of Advancements in the field of Automation, Processing and Control.
- To give the knowledge in the field of Sensors, transducers and Signal processing required in various field of Instrumentation such as Process Instrumentation, Biomedical Instrumentation, Optical Instrumentation and Nuclear Instrumentation.
- To familiarise the students with the advancements in Control engineering.

Program Outcomes (POs)

- Able to demonstrate & competent enough in basic knowledge in Mathematics, Engineering and Technology to obtain the solution of engineering problem.
- Have ability to formulate the engineering problem, design the setup for experimentation, analysis and interpretation of the result data, report preparation.
- Demonstrate the ability to work on basic engineering discipline as well as multi-disciplinary engineering teams to achieve the solution of engineering problem.
- Strong competency in using modern engineering tools like MATLAB / Simulink, LABVIEW/MultiSim for solution of control engineering problems.
- Able to use the acquired knowledge and professional skill and project as well as

budget management towards betterment of the society.

- Understand the needs of the society worldwide in the context of his professional knowledge to ensure environmental safety and better sustainability.
- Capable to apply ethical principles with committed professional ethics and duties towards the solution of complex engineering problems.
- Motivate to work independently as well as a member of team or team leader in multi functionaries and diversified knowledge platforms.
- Develop an effective inter personnel communication skill at large with public and professional bodies. They will be able to comprehend the data and accordingly will prepare technical design details, datasheets, reports, documentation etc.
- Inculcate the lifelong learning in the purview of updates /upgrade in engineering and technology.
- Investigate the complex engineering problems using acquired knowledge in instrumentation engineering to develop industrial level solutions in the interest of society.
- Students will be able to apply their knowledge for the use of various Instruments and systems in the field of Instrumentation.
- Students will be able to design basic circuits and systems required in various fields of Instrumentation such as Process Instrumentation, Biomedical Instrumentation, Optical Instrumentation and Nuclear Instrumentation.
- Students will be able to apply latest control strategies on various applications.

Dr. S. R. Deore,
Chairman,
Board of Studies in Electrical Engineering,
Member - Academic Council
University of Mumbai

Program Structure for
M.E. Instrumentation and Control
University of Mumbai
(With Effect from 2016-17)

Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISEC101	Higher Mathematics for Control Engineering	04	-	-	04	-	-	04
ISEC102	Advanced signal processing for Sensors	04	-	-	04	-	-	04
ISEC103	Robust Control	04	-	-	04	-	-	04
ISEDLO101X	Department Level Optional Course-I	04	-	-	04	-	-	04
ILO101X	Institute Level Optional Course-I	03	-	-	03	-	-	03
ISEL101	Laboratory-I	-	02	-	-	01	-	01
ISEL102	Laboratory-II	-	02	-	-	01	-	01
Total		**19**	**04**	**-**	**19**	**02**	**-**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /Oral	Total
		Internal Assessment			End Sem.	Exam. Duration			
		Test1	Test 2	Avg.					
ISEC101	Higher Mathematics for Control Engineering	20	20	20	80	03	-	-	100
ISEC102	Advanced signal processing for Sensors	20	20	20	80	03	-	-	100
ISEC103	Robust Control	20	20	20	80	03	-	-	100
ISEDLO101X	Department Level Optional Course-I	20	20	20	80	03	-	-	100
ILO101X	Institute Level Optional Course-I	20	20	20	80	03	-	-	100
ISEL101	Laboratory-I	-	-	-	-	-	25	25	50
ISEL102	Laboratory-II	-	-	-	-	-	25	25	50
Total		**100**	**100**	**100**	**400**	**-**	**50**	**50**	**600**

Program Structure for
M.E. Instrumentation and Control
University of Mumbai
(With Effect from 2016-17)

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISEC201	Electronic Systems Design	04	-	-	04	-	-	04
ISEC202	State Estimation and Stochastic Processes	04	-	-	04	-	-	04
ISEC203	Advanced Process Control and Automation	04	-	-	04	-	-	04
ISEDLO202X	Department Level Optional Course-II	04	-	-	04	-	-	04
ILO202X	Institute Level Optional Course-II	03	-	-	03	-	-	03
ISEL201	Laboratory-III	-	02	-	-	01	-	01
ISEL202	Laboratory-IV	-	02	-	-	01	-	01
Total		**19**	**04**	**-**	**19**	**02**	**-**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /Oral	Total
		Internal Assessment			End Sem.	Exam. Duration			
		Test1	Test 2	Avg.					
ISEC201	Electronic Systems Design	20	20	20	80	03	-	-	100
ISEC202	State Estimation and Stochastic Processes	20	20	20	80	03	-	-	100
ISEC203	Advanced Process Control and Automation	20	20	20	80	03	-	-	100
ISEDLO202X	Department Level Optional Course-II	20	20	20	80	03	-	-	100
ILO202X	Institute Level Optional Course-II	20	20	20	80	03	-	-	100
ISEL201	Laboratory-III	-	-	-	-	-	25	25	50
ISEL202	Laboratory-IV	-	-	-	-	-	25	25	50
Total		**100**	**100**	**100**	**400**	**-**	**50**	**50**	**600**

Program Structure for
M.E. Instrumentation and Control
University of Mumbai
(With Effect from 2016-17)

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theor	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISES301	Special Topic Seminar	-	06	-	-	03	-	03
ISED301	Dissertation–I	-	24	-	-	12	-	12
Total		-	30	-	-	15	-	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem. Exam.	Term Work	Pract. /Oral	Total
		Test1	Test 2	Avg.				
ISES301	Special Topic Seminar	-	-	-	-	50	50	100
ISED301	Dissertation–I	-	-	-	-	100	-	100
Total		-	-	-	-	**150**	**50**	**200**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theor	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISED401	Dissertation–II	-	30	-	-	15	-	15
Total		-	30	-	-	15	-	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem. Exam.	Term Work	Pract. /Oral	Total
		Test1	Test 2	Avg.				
ISED401	Dissertation–II	-	-	-	-	100	100	200
Total		-	-	-	-	**100**	**100**	**200**

Note:

- In case of Seminar, 01 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation I, 02 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation II, 02 Hour / week / student should be considered for the calculation of load of a teacher
- **End Semester Examination:** In all six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.

Subject Code	Department Level Optional Course-I	Subject Code	Department Level Optional Course-II
ISEDLO1011	Advanced Biomedical Instrumentation	ISEDLO2021	Rehabilitation Engineering
ISEDLO1012	Advanced Measurement Techniques	ISEDLO2022	Advanced Fiber Optics and LASER Instrumentation
ISEDLO1013	Expert Systems	ISEDLO2023	Advanced Nuclear Instrumentation
ISEDLO1014	Robotics and Control	ISEDLO2024	MEMS and Nanotechnology

Subject Code	Institute Level Optional Course-I	Subject Code	Institute Level Optional Course-II
ILO1011	Product Lifecycle Management	ILO2021	Project Management
ILO1012	Reliability Engineering	ILO2022	Finance Management
ILO1013	Management Information System	ILO2023	Entrepreneurship Development and Management
ILO1014	Design of Experiments	ILO2024	Human Resource Management
ILO1015	Operation Research	ILO2025	Professional Ethics and Corporate Social Responsibility (CSR)
ILO1016	Cyber Security and Laws	ILO2026	Research Methodology
ILO1017	Disaster Management and Mitigation Measures	ILO2027	IPR and Patenting
ILO1018	Energy Audit and Management	ILO2028	Digital Business Management
		ILO2029	Environmental Management

Subject Code	Subject Name	Credits
ISEC101	Higher Mathematics for Control Engineering	04

Course Objectives:

- To introduce different methods of solving systems of linear equations
- Introduce concept of Linear Vector Spaces
- To present the concept of Orthogonality and Quadratics Forms

Course Outcomes:

- Demonstrate ability to solve systems of linear equations
- Demonstrate ability to work with Vector Spaces
- Demonstrate ability to get least square solutions to systems
- Demonstrate ability to effect linear transformation

Module	Detailed content	Hours
	Prerequisite: Knowledge about Matrices, Matrix, Elementary Operations, Determinants and Matrix Inverse	
1	**Linear Equations in Linear Algebra:** Systems of Linear Equations, Gaussian Elimination, Row Reduction , Echelon Forms , LU Factorization.	08
2	**Euclidean Vector Spaces:** Euclidean n-Space, Linear Transformation from R^n to R^m, Properties of Linear Transformations from Rn to Rm, Linear Transformation.	08
3	**General Vector Spaces:** Real Vector Spaces, Subspaces, Linear Independence, Basis and Dimension, Row Space, Column Space and Nullspace, Rank, Nullity and Change of basis.	08
4	**Eigenvalues and Eigenvectors:** Eigenvectors and Eigenvalues, The Characteristic Equation, Diagonalization, Eigenvectors and Linear Transformations, Complex Eigenvalues, Discrete Dynamical Systems.	08
5	**Orthogonality and Least Squares:** Inner Product, length and Orthogonality, Orthogonal Sets, Orthogonal Projections, The Gram-Schmidt Process, Least –Square Problems, Applications to Linear Models, Inner Product Spaces, Applications of Inner Product Spaces.	08
6	**Symmetric Matrices and Quadratic Forms:** Diagonalization of Symmetric Matrices, Quadratic Forms, Constrained Optimization, The Singular Value Decomposition, Application to Image Processing and Statistics.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions

to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Anthanasios Papoulis, "Probability, random Variable & Stochastic Processes" 3rd Edn, McGraw Hill, Inc 1995
2. Gantmacher, Feliks R."the theory of Matrices Vol.I and II" Chelsia Publishing Co.1959
3. Gantmacher F.R. "Application of Theory of Matrices"
4. Hoffman K. & R. Kunez, "Linear Algebra" 2nd Edn, Printice Hall 1971
5. Howard Anton, "Elementary Linear Algebra"- Wiley Student End, 2011

Subject Code	Subject Name	Credits
ISEC102	Advanced Signal Processing for Sensors	04

Course Objectives:

- To give students knowledge in the field of advanced signal processing system required for processing the signals from various sensors.
- To give knowledge regarding applications of various types of sensors used for high resolution measurement of various parameters.

Course Outcomes:

- The students will be able to understand the methodology and design of electronic circuits utilized for processing the signals for various sensors.

Module	Detailed content	Hours
	Prerequisite: Knowledge in the field of transducers and sensors, Basic concepts in electronic signal processing	
1	**Classification of sensors and transducers:** Input and output characteristics of various transducers, variable resistance transducer and its equivalent circuit, potentiometers, their construction and performance, variable inductance and variable capacitance transducers, their construction and performance, Piezoelectric transducer.	08
2	**Design techniques for sensor signal conditioning:** Sensor and signal conditioning for strain, force, pressure, flow and temperature measurement, Bridge configurations, Amplifying and linearizing bridge outputs, Driving bridge circuits. Ratio metric techniques.	10
3	**High impedance sensors:** Photodiodes and high impedance charge output sensors, Signal conditioning of high impedance sensors, Chemical and Biosensors.	08
4	**Positioning, motion and temperature sensors:** LVDT, Hall effect magnetic sensors, optical encoders Accelerometer, RTDs, thermistors, thermocouples, semiconductors temperature sensors and their signal conditioning.	08
5	**Micro-sensors and smart sensors:** Construction, characteristics, and applications.	06
6	**Radioactivity detectors and Counting systems:** Gas filled, Scintillation and Semiconductor detectors, Preamplifiers, Shaping amplifiers, Single Channel analyzer, Multi-channel analyzer.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be

attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. H.K.P Neubert "Instrument Transducers Oxford Herman University Press Eighth Impression 2008.
2. Ramon Pallas-Arenyand Johan G. Webster "Sensor and Signal Conditioning" John Wiley, New York 1991.
3. Dan Sheingold-Editior "Transducer Interfacing Handbook", Analog Devices Inc 1980
4. "High Speed Design Technique" Analog Device Inc 1996
5. Jacoba Fraden "Handbook of Modern Sensors "2nd Edition, Springer-Verlag.New York 1996
6. Jerald G.Graeme "Photodiode Amplifiers And Op-Amp Solution", Mc Graw Hill 1995
7. Harry L. Trietly, "Transducers in Mechanical and Electronic Design", Marcel Dekker Inc 1986
8. Dan Shiengold, "Non Linear Circuits Handbook", Analog Device Inc
9. Walt Kester-Editior, "System Application Guide", Analog Devices Inc 1993
10. IMEGA, "Temperature Measurement Handbook", Omega Instruments Inc
11. Henry Ott, "Noise Reduction Technique In Electronic Systems", N.Y.John Wiley And Sons 1988
12. Ralph Morrison,"Grounding And Shielding Technique", Fourth Edition,John Wiley,1998
13. G.F.Knoll ,"Radiation detection and measurement", John Wiely and Sons, 2nd edition, 1998.

Subject Code	Subject Name	Credits
ISEC103	Robust Control	04

Course Objectives:

- To study the effect of disturbance, parametric uncertainties and model errors on the stability of the system.
- To study the robust control techniques such as a control based on Kharitonov theorem, internal model control and introduction to Quantitative feedback technique for the system with parametric uncertainties and external disturbances.
- To study the sliding mode control for asymptotic stability in presence of disturbances.

Course Outcomes:

- The students should be able to understand the robustness properties of the system against uncertainties.
- Students should be able to design the robust control that overcomes parametric uncertainties.
- Students should be able to design the internal model control for uncertain systems.
- Students should be able to understand concept of Quantitative feedback techniques.
- Students should be able to design the sliding mode control for uncertain systems.

Module	Detailed content	Hours
	Prerequisite: Regulators and Servo Mechanism, Concepts in State-space analysis, Controllability and Observability.	
1	**Introduction to Sliding Mode Control:** Main Concepts of Sliding Mode Control, Chattering Avoidance: Attenuation and Elimination, Concept of Equivalent Control, Sliding Mode Equations, The Matching Condition and Insensitivity Properties, Conventional Sliding Mode Controller Design	08
2	**Conventional Sliding Modes:** Introduction, Filippov Solution, Concept of Equivalent Control, State-Feedback Sliding Surface Design, Regular Form, Eigenvalue Placement, Quadratic Minimization, State-Feedback Relay, Control Law Design, Single-Input Nominal Systems, Single-Input Perturbed Systems, Relay Control for Multi-Input Systems.	10
3	**Interval Polynomials: Kharitonov's Theorem:** Kharitonov's Theorem for Real Polynomials, Kharitonov's Theorem for Complex Polynomials, Robust State Feedback Stabilization.	08
4	**Internal Model Control (IMC):** Introduction to Model-Based Control, Practical Open-Loop Controller Design, Generalization of the Open-Loop Control Design Procedure, Model Uncertainty and Disturbances, Development of the IMC Structure, IMC Background, The IMC Structure, The IMC Design Procedure, Effect of Model Uncertainty and Disturbances, Improving Disturbance Rejection Design	10
5	**The IMC-Based PID Control:** Background, The Equivalent Feedback Form to IMC, IMC-Based Feedback Design for Delay-Free Processes, IMC-Based Feedback Design for Processes with a Time Delay, Summary	08

	of IMC-Based PID Controller Design for Stable Processes, IMC-Based PID Controller Design for Unstable Processes	
6	**Introduction to Quantitative Feedback Theory:** Quantitative Feedback Theory (QFT), Why Feedback, QFT Overview, QFT Design Objective, Structured Parametric Uncertainty, Control System Performance Specifications, QFT Design Overview, QFT Basics, QFT Design, Insight to the QFT Technique, Open-Loop Plant, Closed-Loop Formulation, Benefits of QFT.	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. S. P. Bhattacharyya, H. Chapellat, and L. H. Keel. "*Robust control: the parametric approach*," Upper Saddle River (1995).
2. Manfred Morari and Evanghelos Za_riou, "*Robust process control*," Vol. 488. Englewood Cliffs, NJ, Prentice hall, 1989.
3. B. Wayne Bequette, "*Process Control: Modeling, Design and Simulation*," Prentice Hall Professional, 2003.
4. Constantine H. Houpis, Steven J. Rasmussen and Mario Garcia-Sanz, "*Quantitative feedback theory: fundamentals and applications*," CRC Press, 2005.
5. Oded Yaniv, "*Quantitative feedback design of linear and nonlinear control systems*,". Vol.509. Springer Science & Business Media, 2013.
6. Yuri Shtessel, Christopher Edwards, Leonid Fridman and Arie Levant, "*Sliding mode control and observation*," New York, USA: Birkhuser, 2014.
7. Christopher Edwards and Sarah Spurgeon, "*Sliding mode control: theory and applications*, CRC Press, 1998.
8. Dorf, Richard C., and Robert H. Bishop, "*Modern control systems*," Prentice Hall, 2011

Subject Code	Subject Name	Credits
ISEDLO1011	**Advanced Biomedical Instrumentation**	**04**

Course Objectives:

- To introduce concepts of advanced biomedical instruments used in hospitals.
- To study the design considerations of various signal conditioning systems for measurement of Bio-signals like ECG, EEG and EMG.
- To study the concept behind various Advanced Medical imaging techniques.

Course Outcomes:

- The students should be able to understand the principle and working of various advanced biomedical instruments.
- The students should be able to design signal conditioning systems for bio-signal measurements.
- The students should be able to apply concepts of biomedical techniques for various applications.
- The students should be able to understand the concept and working of various advanced medical image acquisition and reconstruction techniques.

Module	Detailed content	Hours
	Prerequisite: Knowledge of Anatomy and Physiology of Human Systems, Knowledge of various Bio-signals and their basic Measurement techniques, Knowledge of basic principle of Medical Imaging Techniques	
1	**Instrumentation for Bio-Potential Recording:** Sensors, Bio-Potential Amplifiers like Chopper Amplifiers, Isolation Amplifiers and Advanced Instrumentation Amplifiers, Signal Conditioning Circuit designing for ECG, EEG and EMG, Multi-Channel Data Acquisition System**.**	10
2	**Diathermy in Medicine:** Electro Surgical Diathermy, Short Wave Diathermy, Microwave Diathermy and Ultrasound Diathermy, Lithotripsy.	06
3	**Cardiac and Neuro-Assist Devices:** Cardiac Pace Makers-constructional details and design, Internal and External Defibrillators with Design, Stimulation Electronics – Nerve and Muscle Stimulators**.**	08
4	**Telemetry and Telemedicine:** Introduction to Telemetry System, Types of Wireless, Power and Data Transmission System, Receiver and Transmitter specifications, Telemedicine.	08
5	**Advanced Medical Imaging Systems:** CT Scanning Systems – tube design, types of Gantries, Image Reconstruction Techniques in Tomography. MRI – Image Acquisition and Reconstruction Techniques. Nuclear Imaging – Scanners, Gamma Camera, Positron Emission Tomography (PET), Single Photon Emission Computer Tomography (SPECT).	10
6	**Laser Application in Medicine:** Types of Lasers, Properties of Lasers and Interaction of Lasers with tissues, Basic Endoscope System and its characteristics.	06

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Jacobsons and Webster, "Medicine and Clinical Engineering", PHI, 1981.
2. Carr and Brown, "Introduction of Biomedical Equipment Technology", PHI, 1981.
3. Jacob Kline, "Handbook of Bio Medical Engineering", Academic Press, 1988.
4. J B Gupta, "A course in Electronic and Electrical Measurement and Instrumentation", S K Kataria and Sons, 1999.
5. Steve Webb, "The Physics of Medical Imaging", Taylor & Francis, New York, 1988.
6. Norris, A.C., "Essential of Telemedicine and Telecare", Wiley, 2002.

Subject Code	Subject Name	Credits
ISEDLO1012	Advanced Measurement Techniques	04

Course Objectives:

To provide knowledge to the students regarding various methods used for high resolution measurement of various parameters like voltage, current, resistance, inductance, capacitance, time, frequency and phase difference.

Course Outcomes:

- Understand principles and methods used for measurement of various parameters.
- Make use of proper methods of measurement depending upon requirement of resolution, accuracy and speed of measurement.

Module	Detailed content	Hours
	Prerequisite: Basic knowledge of Electronic measurements, analog and digital circuits.	
1	**High resolution measurement for electrical components:** Analog and digital techniques for high resolution measurement of Resistance, Inductance, Capacitance. Various bridge circuits and auto balancing methods. Polar and Cartesian type impedance meters. Tan delta measurement.	12
2	**High resolution time measurement:** Philosophy of digital and microprocessor/microcontroller based instruments.; Time measurement techniques: Time standards; Measurement of time interval between events, order of events, Vernier technique, Very low time, period, phase, time constant measurements	08
3	**Frequency measurement techniques:** Frequency, ratio and product, high and low frequency measurements; Deviation meter and tachometer, Peak/valley recorder.; Programmable circuits: Programmable resistors, amplifiers, filters.; Programmable amplifiers as DACs	12
4	**Applications of ADCs and DACs:** Application of various types of ADCs and DACs in measurement techniques; DVM and its design; Voltage and current ratio measurements.	08
5	**Sampling theory and applications:** Modulation index meter, Sampling theory and its application in current, voltage, power and energy measurements.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions

to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. T. S. Rathore, “Digital Measurement Techniques”, Narosa Publishing House, 1996.
2. B. S. Sonde, “Monographs on System Design using Integrated Circuits”, Tata Mc-Graw Hill, 1974.
3. D. J. DeFatta, J. G. Lucas, “Digital Signal Processing”, J Wiley and Sons, 1988.

Subject Code	Subject Name	Credits
ISEDLO1013	Expert Systems	04

Course Objectives:

- To give knowledge to the students regarding Neural Networks and their applications in control engineering.
- To familiarize the students with concepts in Fuzzy Logic and their applications in control engineering.

Course Outcomes:

- Students will be able to understand concepts in Neural Networks and their applications in control engineering.
- Students will be able to understand concepts in Fuzzy logic and their applications in control engineering.

Module	Detailed content	Hours
	Prerequisite: Basic knowledge in computer science and Control Engineering	
1	**Introduction to Neural Networks:** Artificial Neural Networks: Basic properties of Neurons; Neuron Models; Feedforward networks - Perceptrons; Widrow-Hoff LMS algorithm; Multiplayer networks - Exact and approximate representation; Back propagation algorithm; variants of Back propogation; Unsupervised and Reinforcement learning; Symmetric Hopfield networks and Associative memory; Competitive learning and self organizing networks, Hybrid Learning; Computational complexity of ANNs.	10
2	**Neural Networks Based Control:** ANN based control: Introduction: Representation and identification; modeling the plant, control structures - supervised control, Model reference control, Internal model control, Predictive control : Examples - Inferential estimation of viscosity an chemical process; Auto - turning feedback control; industrial distillation tower.	08
3	**Introduction to Fuzzy Logic:** Fuzzy Controllers: Preliminaries - Fuzzy sets and Basic notions - Fuzzy relation calculations - Fuzzy members - Indices of Fuzziness - comparison of Fuzzy quantities - Methods of determination of membership functions.	08
4	**Fuzzy Logic Based Control:** Fuzzy Controllers: Preliminaries - Fuzzy sets in commercial products - basic construction of fuzzy controller - Analysis of static properties of fuzzy controller - Analysis of dynamic properties of fuzzy controller - simulation studies - case studies - fuzzy control for smart cars.	12
5	**Neuro - Fuzzy and Fuzzy:** Neural Controllers: Neuro - fuzzy systems; A unified approximate reasoning approach - Construction of role bases by self learning : System structure and learning algorithm - A hybrid neural network based Fuzzy controller with self learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.	10

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Bose & Liang, " Artificial Neural Networks ", Tata Mcgraw Hill, 1996
2. Kosco B, " Neural Networks and Fuzzy Systems : A Dynamic Approach to Machine Intelligence, Prentice Hall of India, New Delhi, 1992.
3. Klir G.J. and Folger T.A., Fuzzy sets, " Uncertainty and Information " , Prentice Hall of India, New Delhi, 1994.
4. Simon Haykin - " Neural Networks ", ISA, Research Triangle Park, 1995

Subject Code	Subject Name	Credits
ISEDLO1014	Robotics and Control	04

Course Objectives:

- To introduce robot terminologies and robotic sensors
- To educate on direct and inverse kinematics
- To introduce robot control techniques

Course Outcomes:

- Students would be able to understand the concepts behind various robotic sensors and manipulators.
- Students would be able to understand the kinematics and control strategies behind robot movement.
- Students would be able to apply robots for various applications.

Module	Detailed content	Hours
	Prerequisite: Knowledge of basic control strategies, Knowledge of working of basic controllers, Knowledge of basic programming languages like C, C++	
1	**Robot Organization:** Coordinate transformation, kinematics and inverse kinematics, Trajectory planning and remote manipulation.	08
2	**Robot Hardware:** Robot sensors, Proximity sensors, Range sensors, Visual sensors, Auditory sensors, Robot manipulators, Manipulator dynamics, Manipulator control, Wrists, End efforts, Robot grippers.	10
3	**Robot and Artificial Intelligence:** Principles of AI, Basics of learning, Planning movement, Basics of knowledge representations, Robot programming languages.	10
4	**Robot Vision System:** Principles of edge detection, Determining optical flow and shape, Image segmentation, Pattern recognition, Model directed scene analysis.	08
5	**Robot Control System:** Linear control schemes, joint actuators, decentralized PID control, Computed torque control, force control, hybrid position force control, Robot control using voice and infrared.	08
6	**Robot Application:** Overview of robot applications. Prosthetic devices. Robots in material handling, processing assembly and storage.	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered

in question papers of end semester examination.

References:

1. Koren, “Robotics for Engineers”, McGraw Hill International Company, Tokyo, 1995.
2. Vokopravotic, “Introduction to Robotics”, Springer, 1988.
3. Rathmill. K., “Robot Technology and Application”, Springer, 1985.
4. Charniak and McDarmott, “Introducation to Artificial Intelligence”, McGraw Hill, 1986.
5. K. S. Fu, R. C. Gonzally, C.S. G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Company, 1997.
6. Barru Leatham, Jones, “Elements of Industrial Robotics”, Pittmann Publishing, 1987.
7. Mikell P. Groover, Mitchell Weiss, Roger. N. Nagel, Nicholas G. Odrey, “Industrial Robotic Technology Programming and Applications”, McGraw Hill Book Company, 1986.

Subject Code	Subject Name	Credits
ILO1011	Product Life Cycle Management	03

Objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	12
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	06
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	06
05	**Integration of Environmental Aspects in Product Design:** Sustainable	06

	Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuor iAntti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Subject	**Subject Name**	**Credits**

Code		
ILO1012	**Reliability Engineering**	**03**

Objectives:

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	10
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	10
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	10
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Subject Code	Subject Name	Credits
ILO1013	Management Information System	03

Objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development
- Define and analyze various MIS management responsibilities, including planning, budgeting, project management, and personnel management
- Discuss critical ethical and social issues in information systems

Outcomes: Learner will be able to…

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	**Introduction To Information Systems (IS):** Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	7
02	**Data and Knowledge Management:** Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	9
03	**Ethical issues and Privacy:** Information Security. Threat to IS, and Security Controls	6
04	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	**Computer Networks** Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	**Information System within Organization:** Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	10

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Management Information Systems: Kelly Rainer, Brad Prince by Wiley
2. Management Information Systems: Managing the Digital Firm (10th Edition). K.C. Laudon and J.P. Laudon, Prentice Hall, 2007.
3. Managing Information Systems: Strategy and Organization, D. Boddy, A. Boonstra, Prentice Hall, 2008

Subject Code	Subject Name	Credits
ILO1014	Design of Experiments	03

Objectives:

- To understand the issues and principles of Design of Experiments (DOE).
- To list the guidelines for designing experiments.
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action.
- Apply the methods taught to real life situations.
- Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction:** Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	06
02	**Fitting Regression Models:** Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	08
03	**Two-Level Factorial Designs:** The 2^2Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^kDesign, The Addition of Center Points to the 2^kDesign, Blocking in the 2^kFactorial Design, Split-Plot Designs.	07
04	**Two-Level Fractional Factorial Designs:** The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	07
05	**Conducting Tests:** Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.	07
06	**Taguchi Approach:** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question**

paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Philip J Ross, "Taguchi Technique for Quality Engineering," McGraw Hill.
7. Madhav S Phadake, "Quality Engineering using Robust Design," Prentice Hall.

Subject Code	Subject Name	Credits
ILO1015	Operations Research	03

Objectives:

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

- Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
- Understand the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems.
- Solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of, basic methods for, and challenges in integer programming
- Model a dynamic system as a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research***:* Introduction, Historical Background, Scope of Operations Research , Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools , Structure of the Mathematical Model, Limitations of Operations Research	02
02	**Linear Programming***:* Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, *Simplex Method* Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, ***Duality***, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	06
03	**Transportation Problem***:* Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem***:* Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	06
04	**Integer Programming Problem***:* Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	06
05	**Queuing models**: queuing systems and structures, single server and multi-server	06

	models, Poisson input, exponential service, constant rate service, finite and infinite population	
06	**Simulation***:* Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation *Monte-Carlo Method:* Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	04
07	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	04
08	**Games Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	04
09	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Subject Code	Subject Name	Credits
ILO1016	Cyber Security and Laws	03

Objectives:

- To understand and identify different types cyber crime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Outcomes: Learner will be able to…

- Understand the concept of cyber crime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	10
03	**Tools and Methods Used in Cyberline:** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace :** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.:** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000,IT Act. 2008 and its Amendments	8
06	**Information Security Standard compliances :** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions

to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Subject Code	Subject Name	Credits
ILO1017	Disaster Management and Mitigation Measures	03

Objectives:

- To understand the various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To know warning systems, their implementation and based on this to initiate training to a laymen
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

- Understand natural as well as manmade disaster and their extent and possible effects on the economy.
- Planning of national importance structures based upon the previous history.
- Understand government policies, acts and various organizational structure associated with an emergency.
- Know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	**Introduction:** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	**Natural Disaster and Manmade disasters**: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion . Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	06
03	**Disaster Management, Policy and Administration:** Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	**Institutional Framework for Disaster Management in India:** Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster	06

	Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
05	**Financing Relief Measures**: Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09
05	**Preventive and Mitigation Measures**: Pre-disaster, during disaster and post-disaster measures in some events in general, Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication. Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.

3. ‘Introduction to International Disaster Management’ by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. ‘Disaster Management Handbook’ by Jack Pinkowski, CRC Press Taylor and Francis group.
5. ‘Disaster management & rehabilitation’ by RajdeepDasgupta, Mittal Publications, New Delhi.
6. ‘Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Subject Code	Subject Name	Credits
ILO1018	Energy Audit and Management	03

Objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of	10

	insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Subject Code	Subject Name	Credits
ISEL101	Laboratory-I	01

Expt. No.	Title
1	Linearizing circuit for “single element” varying bridge.
2	Kelvin sensing system to drive remote bridges.
3	Active low pass, band pass and high pass filters for transducer signal processing.
4	Use of high resolution ADC for transducer signal processing.
5	Simulation of boiler start-up process control using PLC
6	Simulation of paint manufacturing process using PLC
7	Study of SCADA (HMI) software

NOTE: Perform any six experiments from above list and two experiments from Department Elective Course.

Term work: Term work consists of performing 08 practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners.

Subject Code	Subject Name	Credits
ISEL102	Laboratory-II	01

Expt. No.	Title
1	Experiments in MATLAB/Scilab for Computation of Eigen values, Eigen vectors, different types of norms etc.
2	QR Decomposition
3	LQ Decomposition
4	Gram Schmidt Orthogonalisation
5	Design the sliding mode control for SISO systems
6	Design the IMC controller for the — a) First order delay system b) First order NMP system
7	Design PID controller based on IMC controller
8	Design state feedback control for interval systems.

NOTE: Perform any six experiments from above list and two experiments from Department Elective Course.

Term work: Term work consists of performing 08 practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners.

Subject Code	Subject Name	Credits
ISEC201	Electronic Systems Design	04

Course Objectives:

- To provide students with knowledge to design basic electronic systems.
- To make students aware of practical design considerations like noise reduction, grounding techniques, shielding and isolation which are required to design high performance electronic instrumentation systems.

Course Outcomes:

- Students will be able to understand practical design considerations such as Noise reduction, Shielding and grounding techniques, Isolation and Power management associated with design of electronic systems.
- Students will be able to design Analog, Digital and Mixed signal processing circuits required for electronic systems.

Module	Detailed content	Hours
	Prerequisite: Basic knowledge of analog and digital electronic circuits.	
1	**Design of linear integrated circuits and their applications:** Linear and log amplifiers, peak detect and milli volt rectifier circuits, analog switches and multiplexers, current and voltages references and their stability	08
2	**Instrumentation and special operational amplifiers:** Advanced instrumentation amplifier and various designs to improve dynamic range and reduce power dissipation. High speed OP-amps CMOS OP-amps Micro power amplifiers low noise and chopper stabilized OP-amps	08
3	**Nonlinear integrated circuits:** Comparators, voltage to frequency and frequency to voltage converters switched capacitor circuit's filters. Analog filters, Sample and hold circuits.	08
4	**Converters:** D.C to D.C converters. Mixed signal processing. High speed and high resolution DACs and A/D converters. Various techniques of A/D conversion. flash, successive approximation, multi slope ADC. Delta sigma ADC.	10
5	**Noise reduction techniques:** Design of mixed signal processing circuits, grounding and isolation techniques R.F shielding, Power supply noise reduction and filtering, Over voltage and ESD protection.	10
6	**Power Management:** Power management issues in low power portable systems, Linear and switch mode regulators.	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions

to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. E.Allen Douglas R.Holberg, "CMOS Analog Circuit Design", Philip Oxford , University Press
   2004
2. Kevin M.Daugherty, "Analog To Digital Converter", Tata McGraw Hill Inc 1995
3. Manual: High Speed Design Technique- Analog Devices Inc 1996
4. Dan Shiengold, "Non Linear Integrated Circuits Hand Book", Analog Devices.
5. Ralph Morrison,"Grounding And Shielding Technique", Fourth Edition,John Wiley,1998

Subject Code	Subject Name	Credits
ISEC202	State Estimation and Stochastic Processes	04

Course Objectives:

- To study the concept of Stochastic Processes, Monte Carlo Simulation and fractional calculus
- To study the concept of Kalman filtering

Course Outcomes:

- The students should be able to understand the Stochastic Properties of random variable in terms of pdf.
- Students should be able to understand the concept of stochastic processes
- Students should be able to understand concept of least square estimation
- Students should be able to realize the significance of Kalman filter and its applications to linear and nonlinear systems.

Module	Detailed content	Hours
	Prerequisite: Knowledge about concept of probability and Random Variable, Knowledge about concept of state and state space models of systems	
1	**Random Variables:** Introduction to Random Variables, Probability Distribution Function, Probability Density Function, Exponential Distribution, Gaussian Distribution, Binomial Distribution, Poisson Distribution, Two Dimensional Random Variables, Joint Probability, Marginal Density Function, Conditional Probability and Independence, Correlation, Covariance, Introduction to n-dimensional Random Variables.	12
2	**Stochastic Processes:** Definition, Statistics of Stochastic Processes, Types of Stochastic Processes, Random Walk, Markov Process, Brownian Motion, Poisson Process, Concept of Monte Carlo Simulation, Monte Carlo Simulation of Stochastic Processes such as Random Walk. Correlation functions, Power Spectrum, White Noise, Linear Systems with Stochastic input.	10
3	**Parameter Estimation:** Point Estimation, Optimal Estimates, Acceptable Estimates, Least Squares Estimation: The deterministic point of view (Gauss), Sequential Bayes Theorem, Linear Minimum Mean-square-error Estimation: Vector case sequential MMSE Estimation.	10
4	**The Discrete-time Kalman Filter**: Propagation of states and covariances, Derivation of the discrete-time Kalman filter, Kalman filter properties, Divergence issues	06
5	**Nonlinear Kalman Filtering:** The extended Kalman Filter, The Unscented Kalman Filter, General Unscented transformations, The Simplex unscented transformation, The spherical unscented transformation, Introduction to Particle filtering	06
6	**Fractional Calculus:** Introduction to Fractional Calculus, Functions for	04

	the Fractional Calculus, Riemann-Liouvelli fractional derivate(Left Hand Definition), Caputo definition of fractional derivative (Right Hand Definition), Fractional random walk, Application of fractional calculus to engineering systems.	

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Starks and Woods, "Probability and Random Processes with applications to Signal Processing, Phi, 2002.
2. Simon Haykins, "Adaptive filter theory", Pearson 2012
3. W.C.Van Etten, " Introduction to Random signals and noise", Wiley 2009
4. G.N. Saridis, " Stochastic Processes, Estimation and Control", Wiley 1995
5. Meditch. J., " Stochastic Linaear Estimation and Control", Tata Macgraw Hills, 1969
6. Paupolis, "Probability , Random Variables and Stochastic Processes, Mc-Grawhill, 1995
7. Shantanu Das, "Functional Fractional Calculus" 2nd Edn, Springer Verlag, Germany, 2012
8. Dan Simon, "Optimal State Estimation" – Wiery 2006

Subject Code	Subject Name	Credits
ISEC203	Advanced Process Control and Automation	04

Course Objectives:

- To study the concepts of process modeling
- To study the effect of constraints and interaction between different loops
- To study the sizing of PLC and DCS.
- To study the knowledge about safety Instrumented System and advances in intrinsic safety.

Course Outcomes:

- The students should be able to design process and behavioral model of the process.
- The students should be able to select appropriate control configuration to minimize interaction between different loops
- The students should be able to design PLC and DCS based systems.
- The students should be able to calculate Safety Integrity Level for a given process.

Module	Detailed content	Hours
	Prerequisite: Basic knowledge of Process control and automation tools such as PLC, DCS and SCADA	
1	**Process Dynamics and Control:** Fundamentals of process modeling, Design for process modeling and behavioral model, Linearisation of model equations- Level process, evaporation and chemical reactor model. Dynamics of CSTR, Heat exchanger and evaporator.	07
2	**Multivariable control:** Constraint Control, SISO constraint control, Signal selectors, Relative gain analysis, steady state decoupling, dynamic decoupling.	06
3	**Integrated Automation:** Process and factory automation, PLC, DCS and SCADA- programming, selection and sizing, PLC networking, PLC-HMI interfacing, Installation and troubleshooting.	12
4	**Buses and Networks:** Introduction to networks in Industrial Automation, PLC Proprietary and open networks, hardware selection for Fieldbus systems, Fieldbus advantages and disadvantages, Limitations of open networks. Design and installation of Field Bus oriented Industrial Communication Networks- Foundation Fieldbus, Profibus PA, Devicenet, As-i segments in Hazardous and Non-Hazardous area.	10
5	**Safety Instrumented System:** Life cycle model of Safety Instrumented System, technologies, SIL calculation methods, SIL-calculation of PFD, RRF etc., Phases of SIS overall implementation and reliability.	08
6	**Advanced intrinsic safety:** Entity concept, FISCO, High power trunk, Dynamic arc recognition and termination technology with advantages and disadvantages.	05

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Myke King, "Process control-A practical approach", John Wiley, !st edition,2011.
2. Bela G Liptak, " Instrument Enginner's Handbook-Process software and digital networks", CRC press, ISA,3rd edition,2002.
3. Bela G Liptak, "Optimisation of Unit operaion", ISA.
4. Bela G Liptak, " Instrument Enginner's Handbook-Process Control", Chilton Book Company, 3rd edition.
5. Gary Dunning, "Introduction to Programmable Logic controller", Thomas Learning, edition, 2001.
6. Thomas Hughes, "Programmable Logic Controller", ISA Publication.
7. Stuart A. Boyer, "SCADA supervisory control and data acquisition", ISA Publication.
8. George Stephanopoulos, "Chemical process control", PHI-1999
9. Paul Gruhn, Harry L cheddie, " Safety Instrumented System: Design, Analysis and justification", ISA, 2nd edition, 2006.
10. Ian Verhappen, Augsto Periria, "Foundation fieldbus", ISA,2006

Subject Code	Subject Name	Credits
ISEDLO2021	Rehabilitation Engineering	04

Course Objectives:

- To develop an understanding of the principle and working of various rehabilitation aids.
- To give information about the application of various recent rehabilitation aids.
- To give information about rehabilitation medicine and Advocacy.

Course Outcomes:

- The students will be able to understand the principle and working of various rehabilitation aids.
- The students will be able to understand the design considerations of various rehabilitation aids.
- The students would be able to select which rehabilitation aid to apply for challenged people based on their medical conditions.
- The student would be aware of the various legal considerations while selecting a rehabilitation aid.

Module	Detailed content	Hours
	Prerequisite: Knowledge of Anatomy and Physiology of Human Systems, Knowledge of various basic stimulation techniques, Knowledge of basic concept of human-assist devices.	
1	**Prosthetic and orthotic devices:** Hand and arm replacement, different types of models for externally powered limb prosthetics, feedback in orthotic system, material for prosthetic and orthotic devices, mobility aids.	10
2	**Auditory and speech assist devices:** Types of deafness, hearing aids, application of DSP in hearing aids, cochlear implants	06
3	**Visual aids:** Retinal Implants, Types of retinal implants – Epi-retinal and sub-retinal, design and working, applications of retinal implants. Ultra sonic and laser canes, Intra ocular lens, Text voice converter, screen readers.	10
4	**Medical stimulator:** Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices.	10
5	**Rehabilitation medicine:** Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy.	08
6	**Advocacy:** Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered

in question papers of end semester examination.

References:

1. Rory A Cooper, “An Introduction to Rehabilitation Engineering”, CRC press, 2006.
2. Joseph D.Bronzino, “The Biomedical Engineering Handbook”,Third Edition,CRC Press,2006
3. Levine.S.N.Editor, “Advances in Bio Medical Engineering and Medical Physics”, Inter University Publication, New York 1968.
4. Albert M.Cook and Webster J.G, “Therapeutic Medical devices”, Prentice Hall Inc., New Jersey, 1982.
5. Reswick.J, “What is Rehabilitation Engineering, Annual review of Rehabilitation-volume2”, Springer-Verlag, New York 1982.

Subject Code	Subject Name	Credits
ISEDLO2022	Advanced Fiber Optics and LASER Instrumentation	04

Course Objectives:

- To expose the students to the concepts of instrumentation based on optical fibers and lasers along with their properties.
- To provide sufficient knowledge about the extensive utilization of optical fibers and lasers in Industries.

Course Outcomes:

- Understand the principle of optical fibers,its losses,sources and detectors and their importance.
- Understand the operation of lasers in detail.
- Master the various principles of optical fiber used for different parameter measurement.
- Perceive the significance of the intensive use of laser and optical fiber in Industrial applications.

Module	Detailed content	Hours
	Prerequisite: Awareness of light theory, Basics of fiber optics, Basics of Physics of Laser, Basics of measurement in Instrumentation.	
1	**Optical Fibers and their properties:** Ray theory, Principle of light propagation through a fiber, different types of fibers and their properties, Transmission characteristics of optical fiber, Absorption losses, Scattering losses, Dispersion losses, Non-linear phenomena.	08
2	**Optical sources and Detectors:** LED, LD, PIN, APD their characteristics, modulation circuits, optical detection principle, LED coupling to fiber	06
3	**Fiber Optic Sensors:** Principle of fiber optic sensors, classification, principle of intensity modulated sensors, phase modulated sensors, wavelength modulated sensors, distributed optical fiber sensing	08
4	**Optical Fiber Measurement:** Measurement of numerical aperture, refractive index profile, OTDR. concepts of temperature, flow, pressure and level measurement.	10
5	**Laser Fundamentals:** Fundamental characteristics of lasers,3 and 4 level laser, its properties, modes, resonator configuration, Q switching and mode locking. Types of lasers: solid, liquid and gas.	08
6	**Industrial & Biomedical Application of Lasers:** Laser for measurement of distance, length velocity, acceleration, Material processing, Laser heating, welding, melting and trimming of materials. Laser instruments for surgery, Application of Laser for removal of tumors, brain surgery, oncology, plastic surgery.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is

either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. Gerd Keiser, "Optical Fiber Communication", McGraw Hill
2. John M Senior, "Optical Fiber Communications Principles and Practice",3rd edition, Pearson
3. D.A.Krohn, "Fiber Optic Sensors- fundamentals and applications "3rd edition, ISA
4. I. John and Harry, "Industrial lasers and their applications", McGraw Hill
5. John Crisp, "Introduction to Fibre Optics", an imprint of Elseveir Science,1996
6. John F Ready, "Industrial applications of Lasers, Academic Press,1978

Subject Code	Subject Name	Credits
ISEDLO2023	Advanced Nuclear Instrumentation	04

Course Objectives:

- To give students knowledge in the field of nuclear instrumentation, which is used for various hi-tech applications including field of nuclear research, nuclear reactors, accelerators and nuclear medical instruments?

Course Outcomes:

- The students should be able to understand design and working of advanced nuclear instruments used in nuclear research, nuclear reactors and other related nuclear field.
- Students will be able to apply the concepts for basic design of nuclear instruments.

Module	Detailed content	Hours
	Prerequisite: Basic concepts of Radioactivity, Measurement of Radioactivity.	
1	**Nuclear instrumentation for research:** Radiation detectors for high resolution nuclear pulse spectroscopy, HPGE, Ge(Li), Si(Li) detectors, high resolution Multi Channel Analyzers, Nuclear ADCs, Wilkinson, Gatti's sliding scale technique, various modes of Multi-Channel Analyzer, portable spectroscopy systems and their design. Timing spectroscopy, Time Pick-off circuits, TDCs, TACs, spectrum stabilization.	16
2	**Instrumentation for reactors:** Log and linear amplifiers, in core and out of core instrumentation, Neutron detector, BF3 detector, Fission counters, nuclear instrumentation for pressurized water reactors, boiling water reactors, self-powered detectors, fast Neutron detection and spectroscopy.	08
3	**Detection of very low radio-activity:** Liquid scintillation counting systems, noise reduction by coincidence detection. Counting interferences in LSC, Methods of quench corrections.	04
4	**Instrumentation for accelerators:** Various types of accelerators, detectors and electronics used.	04
5	**Nuclear medical instrumentation:** Functional imaging, design and construction of imaging systems gamma camera, PET SPET. Calibrations and testing of various nuclear instruments and systems.	12
6	**Instrumentation for astrophysics experiments:** Detection of cosmic events, detector arrays and trigger systems	04

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered

in question papers of end semester examination.

References:

1. G.F.Knoll ,“Radiation detection and measurement”, John Wiely and Sons, 4th edition, 2010.
2. P.W. Nicolson, “Nuclear electronics”, John Wiely,1998.
3. Gerald. J.Hine, James A Sorenson, “Instrumentation in nuclear Medicine”, Vol II, Academic press,1974
4. Ramesh Chandra, “Nuclear Medicine Physics”, Williams and Wilkins,1998.
5. Irving Kaplan “Nuclear Physics.”, Narosa Publishing House.1992

Subject Code	Subject Name	Credits
ISEDLO2024	MEMS and Nanotechnology	04

Course Objectives:

- To give students adequate knowledge regarding quantum mechanics to understand principles utilized in Nanotechnology and MEMS.
- To familiarize the students with advanced technologies used in fabrication of nano materials and MEMS.

Course Outcomes:

- Students will be able to understand concepts in quantum mechanics used in nanotechnology
- Students will be able to understand technologies used in fabrication of nano materials and MEMS.

Module	Detailed content	Hours
	Prerequisite: Basic knowledge in quantum mechanics and material science.	
1	**Introduction:** Introduction to nanotechnology and Nanomaterials, How It All Began: Synthesis of carbon buckyballs, List of stable carbon allotropes extended, fullerenes, metallofullerenes, solid C_{60}, bucky onions, nanotubes, nanocones.	04
2	**Quantum Mechanics :** Review of classical mechanics, de Broglie's hypothesis, Heisenberg uncertainty principle Pauli Exclusion Principle, Schrödinger's equation, Properties of the wave function, Application: quantum well, wire, dot, quantum cryptography Solid State Physics and Nanodevices-Structure and bonding, Application: carbon nanotube, Electronic band structure Electron statistics, Application: Optical transitions in solids, Semiconductor quantum dots, photonic crystals.	12
3	**Nanomaterials - Fabrication, MEMS and NEMS nanotubes synthesis:** Bottom-up vs. top-down approach, Epitaxial growth, Self-assembly, Modeling and Applications Production Techniques of Nanotubes Carbon arc bulk synthesis in presence and absence of catalysts High-purity material (Bucky paper) production using Pulsed Laser Vaporization (PLV) of pure and doped graphite High-pressure CO conversion (HIPCO) nanotube synthesis based on Boudoir Reaction Chemical Vapor Deposition (CVD).	08
4	**Nanomaterials:** Characterization and commercial processes of synthesis of nonmaterial, Nanoclay, Nanoinroganic materials, Nanocarbontubes CNT, Applications of nanomaterials in water treatment, polymers,	08

	catalysis etc Structural, XRD, TEM, SEM, STM, AFM.	
5	**MEMS Technology:** Introduction to Microelectromechanical Systems (MEMS), Microsensors and Microactuators, Micromachining, System modeling and Simulation, different types of MEMS sensors and actuators.	08
6	**Micro Electromechanical Systems:** MEMS: Micro-transducers Analysis, Design and Fabrication, Microprocessor-Based Controllers and Microelectronics**,** Micro-switches, Micro-actuators for Electromechanical systems.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

References:

1. K. Eric Drexler, "Nanosystems: Molecular Machinery, Manufacturing, and Computation", 1992 .
2. Mark Ratner & Daniel Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", November 2002 Read reviews.
3. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill, New Delhi, 2007.
4. K. K. Appukuttan, "Introduction to Mechatronics", Oxford Higher Education, 2003.
5. Nitaigour Premchand Mahalik, "Machatronics", Tata McGraw-Hill, 2003

Subject Code	Subject Name	Credits
ILO2021	Project Management	03

Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **Monitoring and Controlling Projects:** Earned Value Management techniques for measuring	8

	value of work completed; Using milestones for measurement; change requests and scope creep. Project audit.**Project Contracting:** Project procurement management, contracting and outsourcing,	
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Subject Code	Subject Name	Credits
ILO2022	Finance Management	03

Objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation	05

	between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Subject Code	Subject Name	Credits
ILO2023	Enterpreneurship Development and Management	03

Objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Outcomes: Learner will be able to…

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Subject Code	Subject Name	Credits
ILO2024	Human Resource Management	03

Objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource Management (HRM) processes, related with the functions, and challenges in the emerging perspective.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of behavioral skills, Inter- personal, inter- group in an organizational setting.
- To prepare the students as future organizational change facilitators, stable leaders and managers, using the knowledge and techniques of human resource management.

Outcomes: Learner will be able to…

- Gain knowledge and understand the concepts about the different aspects of the human resource management.
- Understand and tackle the changes and challenges in today's diverse, dynamic organizational setting and culture.
- Utilize the behavioral skill sets learnt, in working with different people, teams & groups within the national and global environment.
- Apply the acquired techniques, knowledge and integrate it within the engineering/ non engineering working environment emerging as future engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR:** Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB) :** Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues, Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness, Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	7
03	**Organizational Structure & Design :** Structure, size, technology, Environment	6

	of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
04	**Human resource Planning:** Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR :** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment, Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. SubbaRao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Subject Code	Subject Name	Credits
ILO2025	Professional Ethics and Corporat Social Resonsibility (CSR)	03

Objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Outcomes: Learner will be able to…

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**rporate Social Responsibility:** Articulation of Gandhian Trusteeship rporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**rporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question**

paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Subject Code	Subject Name	Credits
ILO2026	Research Methodology	03

Objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences , Objectives of Research, **Issues** and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**10**
02	**Types of Research:** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	**08**
03	**Research Design and Sample Design :** Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**08**
04	**Research Methodology :** Meaning of Research Methodology, Stages in Scientific Research Process **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem:** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research:** Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	**04**

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Subject Code	Subject Name	Credits
ILO2027	IPR and Patenting	03

Objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

- understand Intellectual Property assets
- assist individuals and organizations in capacity building
- work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	06
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield,2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph&Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar andmohdIqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. KompalBansal and PraishitBansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual

Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005,Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Subject Code	Subject Name	Credits
ILO2028	Product Life Cycle Management	03

Objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business:** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce: E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system, **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business, Security Threats to e-business - Security Overview, Electronic Commerce Threats, Encryption, ryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation	08

	Case Studies and presentations	

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

.**REFERENCES:**

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-en OECD Publishing

Subject Code	Subject Name	Credits
ILO2029	Environmental Management	03

Objectives:

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarise environment related legislations

Outcomes: Learner will be able to…

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to**

number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Subject Code	Subject Name	Credits
ISEL201	Laboratory-III	01

Experiment No.	Title
1	To develop a VI to simulate bottle filling system
2	To develop a VI to Simulate Continuous Stirred Tank Reactor
3	To develop a VI to simulate Traffic Control system
4	To develop a VI to simulate temperature controller using fuzzy controller
5	To design and simulate signal conditioning and processing circuits using Multisim.
6	Acquire data for monitoring and controlling purpose using DAQ cards.
7	Monte Carlo simulation of stochastic process.

Virtual Instrumentation based experiments should be based on basic programming of Lab VIEW and Common Design Techniques and patterns: Sequential programming, state machines, architectures, events, timing a design pattern and event programming, Data Management Techniques: Communicating among multiple loops: Variables, functional global variable, race condition, synchronizing data transfer, File I/O techniques: Low, high and advanced, Data Acquisition and interfacing instruments.

NOTE: Perform any six experiments from above list and two experiments from Department Elective Course.

Term work: Term work consists of performing 08 practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners.

Subject Code	Subject Name	Credits
ISEL202	Laboratory-IV	01

Experiment No.	Title
1	Simulation of batch reactor control using PLC with GUI
2	Study of Ethernet network communication
3	Study of modbus communication
4	Simulation of furnace control using PLC with GUI
5	Simulation of Heat exchanger feedback control scheme using DCS
6	Simulation of cascade control scheme using DCS
7	Simulation of feedforward control scheme using DCS
8	Simulation of boiler level control using DCS

NOTE: Perform any six experiments from above list and two experiments from Department Elective Course.

Term work: Term work consists of performing 08 practical mentioned as above. Final certification and acceptance of the term work ensures satisfactory performance of laboratory work

Assessment:

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners.

Subject Code	Subject Name	Credits
ISES301	SEMINAR	03

Guidelines for Seminar:

- Seminar should be based on thrust areas in Instrumentation Engineering.
- Students should undergo literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the topic and compile the report in standard format and present in front of Panel of Examiners appointed by the Head of the Department/Institute of respective Program.
- Seminar assessment should be based on following points:
  - Quality of Literature survey and Novelty in the topic.
  - Relevance to the specialization
  - Understanding of the topic
  - Quality of Written and Oral Presentation

IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions/Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years' experience in Industries.

2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.

3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

Subject Code	Subject Name	Credits
ISED301/401	DISSERTATION (I AND II)	12 + 15

Guidelines for Dissertation:

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt the solution to the problem by analytical/simulation / experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation-I:

- Dissertation-I should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
- Dissertation-I should be assessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Program.

Guidelines for Assessment of Dissertation-II:

- Dissertation-II should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization or current Research / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- Dissertation-II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai.

Students should publish at least one paper based on the work in reputed International / National Conference / Refereed Journal.

PG- Information Technology

Sr.No.	Subject Code	Subject Name	Count
1	MEITC101	Data Science	1
2	MEITC102	IT Infrastructure Design	1
3	MEITC103	Advances in Software Engineering	1
4	MEITL101	Laboratory-I	1
5	MEITL102	Laboratory-II	1
6	MEITC201	Security & Risk Management	1
7	MEITC202	High Performance Computing	1
8	MEITC203	Advance web technology	1
9	MEITL201	Laboratory-III	1
10	MEITL202	Laboratory-IV	1
11	MEITS301	Seminar	1
12	MEITD301	Dissertation 1	1
13	MEITD401	Dissertation 2	1
		Total	13

AC 14/7/2016

Item No. 4.23

UNIVERSITY OF MUMBAI

Revised Syllabus

For

Master of Engineering

Program: M. E. (Information Technology)

Revised 2016

Under

FACULTY OF TECHNOLOGY

(As per Choice Based Credit and Grading System with effect from the academic year 2016–2017)

From Co-ordinator's Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Choice Based Credit and Grading System were implemented for First Year Master of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Master of Engineering in the academic year 2017-2018.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Preamble

It is an honor and a privilege to present the revised syllabus of Master of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.
Information Technology is comparatively a young branch among other engineering disciplines in University of Mumbai. It is evident from the placement statistics of various colleges affiliated to University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.
It has been observed that graduate engineers having work experience in IT industry would prefer to pursue their post graduate studies in IT in spite of having done their graduation degree in any branch .
Keeping these aspects in mind, University of Mumbai has designed postgraduate courses as per current requirements of IT industry.
The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.
I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.
I sincerely hope that the revised syllabus will help all post graduate engineers to face the future challenges in the field of information and technology

Program Outcome for Postgraduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

Chairman (Ad-hoc Board Information Technology)

University of Mumbai)

Program Structure for
ME Information Technology
Mumbai University
(With Effect from 2016-2017)

Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEITC101	Data Science	04	--	--	04	--	--	04
MEITC102	IT Infrastructure Design	04	--	--	04	--	--	04
MEITC103	Advances in Software Engineering	04	--	--	04	--	--	04
MEITDLO-I	Department Level Optional Course-I	04	--	--	04	--	--	04
ILO-I	Institute Level Optional Course-I	03	--	--	03	--	--	03
MEITL101	Laboratory-I	--	02	--	--	01	--	01
MEITL102	Laboratory-II	--	02	--	--	01	--	01
Total		**19**	**04**	**--**	**19**	**02**	**--**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract./ oral	Total
		Internal Assessment			End Sem.Exam.	Exam Duration (hrs)			
		Test1	Test 2	Avg.					
MEITC101	Data Science	20	20	20	80	3	--	--	100
MEITC102	IT Infrastructure Design	20	20	20	80	3	--	--	100
MEITC103	Advances in Software Engineering	20	20	20	80	3	--	--	100
MEITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--	--	100
ILO-I	Institute Level Optional Course-I	20	20	20	80	3	--	--	100
MEITL101	Laboratory-I	--	--	--	--		25	25	50
MEITL102	Laboratory-II	--	--	--	--		25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester I and Semester II. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Elective Course for Semester I and Semester II, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester I			
MEITDLO1011	User Experience Engineering	ILO1011	Product Lifecycle Management
MEITDLO1012	Adhoc Networks	ILO1012	Reliability Engineering
MEITDLO1013	Cloud Computing	ILO1013	Management Information System
MEITDLO1014	IT Strategy	ILO1014	Design of Experiments
MEITDLO1015	Knowledge Management	ILO1015	Operation Research
		ILO1016	Cyber Security and Laws
		ILO1017	Disaster Management and Mitigation Measures
		ILO1018	Energy Audit and Management

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEITC201	Security & Risk Management	04	--	--	04	--	--	04
MEITC202	High Performance Computing	04	--	--	04	--	--	04
MEITC203	Advance web technology	04	--	--	04	--	--	04
MEITDLO-II	Department Level Optional Course-I	04	--	--	04	--	--	04
ILO-II	Institute Level Optional Course-I	03	--	--	03	--	--	03
MEITL201	Laboratory-III	--	02	--	--	01	--	01
MEITL202	Laboratory-IV	--	02	--	--	01	--	01
Total		**19**	**04**	**--**	**19**	**02**	**--**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem.Exam.	Exam Duration (hrs)	Term Work	Pract./ oral	Total
		Test1	Test 2	Avg.					
MEITC201	Security & Risk Management	20	20	20	80	3	--	--	100
MEITC202	High Performance Computing	20	20	20	80	3	--	--	100
MEITC203	Advance web technology	20	20	20	80	3	--	--	100
ME-ITDLO-II	Department Level Optional Course-I	20	20	20	80	3	--	--	100
ILO-II	Institute Level Optional Course-I	20	20	20	80	3	--	--	100
MEITL201	Laboratory-III	--	--	--	--		25	25	50
MEITL202	Laboratory-IV	--	--	--	--		25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

 # Department Level Optional Course (DLO)

Every student is required to take one Department Level Optional Course for Semester I and Semester II. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

 # Institute Level Optional Course (ILO)

Every student is required to take one Institute Level Optional Course for Semester I and Semester II, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

Subject Code	Department Level Optional Course (DLO)	Subject Code	Institute Level Optional Course (ILO)
Semester II			
MEITDLO2021	E-Business & Social Network Analysis	ILO2021	Project Management
MEITDLO2022	AI & Machine Learning	ILO2022	Finance Management
MEITDLO2023	Ethical Hacking & Forensic	ILO2023	Entrepreneurship Development and Management
MEITDLO2024	Internet of Things	ILO2024	Human Resource Management
MEITDLO2025	Advanced Software Quality Assurance	ILO2025	Professional Ethics and CSR
		ILO2026	Research Methodology
		ILO2027	IPR and Patenting
		ILO2028	Digital Business Management
		ILO2029	Environmental Management

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEITS301	Seminar	--	06	--	--	03	--	03
MEITD301	Dissertation 1	--	24	--	--	12	--	12
Total		**--**	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Oral.	Oral
		Test1	Test 2	Avg.				
MEITS301	Seminar	**--**	**--**	**--**	--	50	50	100
MEITD301	Dissertation 1	**--**	**--**	**--**	--	100	--	100
Total		**--**	**--**	**--**	**--**	**150**	**50**	**200**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEITD401	Dissertation II	--	30	--	--	15	--	15
Total		**--**	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Oral	Total
		Test1	Test 2	Avg.				
MEITD401	Dissertation II	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	**100**	**100**	**200**

* The Term Work and Oral of Project II of Semester IV should be assessed jointly by the pair of Internal and External Examiners

Note- The Contact Hours for the calculation of load of teacher are as follows
Seminar - 01 Hour / week / student
A project I and II - 02 Hour / week / student

End Semester Examination: In all, six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.

Semester I

Subject Code	Subject Name	Credits
MEITC101	Data Science	04

Course Objectives:

- Provide Insights about the Roles of a Data Scientist and enable to analyze the Big Data.
- Understand the principles of Data Science for the data analysis and learn cutting edge tools and techniques for data analysis.
- Figure Out Machine Learning Algorithms.
- Learn business decision making and Data Visualization

Course Outcomes:

The student should be able:

- Demonstrate knowledge of statistical and exploratory data analysis data analysis techniques utilized in decision making.
- Apply principles of Data Science to the analysis of business problems.
- To use Machine Learning Algorithms to solve real-world problems.
- To provide data science solution to business problems and visualization.

Prerequisite: fundamentals of data base, basic programming skills

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Relational database, KDD process, Introduction to BIG data, What is Hadoop, Core components of Hadoop, Hadoop ecosystem.	**3**
I	An Introduction to Data Science	Definition, working, benefits and uses of Data Science, Data science vs BI, The data science process, Role of a Data Scientist,	**4**
II	Statistical Data Analysis & Inference	Populations and samples, Statistical modeling, probability distributions, fittings a model, Statistical methods for evaluation, Exploratory Data Analysis, Getting started with R, Manipulating and Processing data in R , working with function in R , Working with descriptive Statistics, Working with graph plot in R.	**8**
III	Learning Algorithms	k-nearest neighbor, Simple and multiple Linear Regression, Logistic Regression, Support vector machine, Model-Based Clustering, Clustering High-Dimensional Data,	**12**
IV	Data Visualization	Data Visualization basics, techniques, types, applications, tools, Data Journalism, Interactive dashboards,	**8**
V	Advance Analytical Methods	Text Analysis- Text analysis steps, A text analysis example, Collecting raw text and representing text, TF and TFIDF, Categorizing documents by topics, determining	**8**

		sentiments, Time series analytics- overview, ARIMA model,	
VI	Business problems and data science solutions	Data Science and Business Strategy: Thinking Data-Analytically, Redux, Competitive Advantage with Data Science, Data Science Case Studies, Case Study: Global Innovation Network and Analysis.	**5**

Text Books:

1. Data science and big data analytics, EMC

2. Doing Data Science, *Rachel Schutt and Cathy O'Neil*

3. Introducing Data Science, Davy Cielen

4. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly. Copyright © 2013

References:

1. Regression Analysis by Example,

2. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann

3. An Introduction to Statistical Learning with Applications in R , Gareth James • Daniela Witten • Trevor Hastie, Robert Tibshirani, Springer

List of Experiments : based on Laboratory Practical's/ Case studies

1. Exploratory Data Analysis and regression using R.

2. Text Analysis using R

3. Business problem : Data science solution.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of the end semester examination.

Subject Code	Subject Name	Credits
MEITC102	**IT Infrastructure Design**	**04**

Course Objective:

- Provide knowledge of Enterprise wide Network Design.
- Provide Knowledge of Data center design includes Storage network
- Give insight into the implementation of SDN and how it will impact current Design practice
- Understand latest trend in SDN

Course Outcome: Students should be able to

- Design Enterprise wide network design considering various QoS Parameter
- Explain the design challenge of large scale data center
- Implementation of SDN and how it will impact current Design practice
- explain latest trend in SDN

Prerequisite: Basic knowledge of Networking techniques.

Module	Detailed content	Hours
Prerequisite	- Basic of Networking Topology - OSI Layer Basics - Basics of Internetworking Devices	3
I	Enterprise Network Design: Understanding Network Requirement analysis, Architecture and Design Process Network Architecture: Component Architecture –Routing, Network Management, Performance, Security. Architectural models: topological, flow model, Functional model Addressing And Routing Architecture, Network Management Architecture, Performance Architecture Border less Network Architecture. Network Design: Designing the network topology and solutions-Top Down Approach Network Structure Model: Hierarchical Network Model, Enterprise wide network Architecture model- Enterprise Edge Area. E-commerce, Internet Connectivity to remote, enterprise branch and enterprise Data center module. High Availability Network Services- Workstation to Router redundancy and LAN High Availability protocols, Route, Server Redundancy, Load Balancing., link Media Redundancy.	8
II.	Enterprise LAN Design: Ethernet Design Rule. 100 Mbps Fast Ethernet Design rules, gigabit Ethernet Design Rules, 10 Gigabit Ethernet Design rules, 10GE Media types Understanding Working of Repeater, hub, Bridge, routers, Layer2/3 Switch Campus LAN Design Best Practice Server Farm Design, DMZ design. Campus LAN QoS consideration Multicast Traffic Consideration	6
III.	Data Center Design: Architecture Consideration: Infrastructure Model, Service Layers Model of Cloud computing. Cloud Reference Architecture Framework, Cloud Data Center Building Blocks. Cloud Data Center Technology Architecture Trust in Cloud Data Center The elements of cloud visibility The elements of cloud protection Cloud Control, Compliance and SLA. Telecommunications Infrastructure Standard for Data Centers ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers ,	10

	NSI/NECA/BICSI-002 Data Center Design and Implementation Best Practices Purpose of TIA-942 Design Elements - Cabling Design, Facility Design, Network Design. Relationship of Spaces, Data Center Topology Data Center Tiers Basic Data Center Design Example.	
IV.	Enterprise Wireless LAN Architecture: Components of Centralize Architecture: understanding 802.11X standards, LWAPP WLAN Controller. WLAN technologies (Narrow Band, Spread Spectrum, FHSS, DSS) and topologies, Wireless Network Components: Access Point and NICs, Router etc; WLAN enterprise design, WLAN performance, WLAN monitoring and troubleshooting, WLAN security. Intra and inter controller roaming.	5
V.	SAN: Need for storage Network, Data Protection and RAID, Storage Network Architecture and IP storage, Storage Network Backup and Recovery, Storage and Network in Storage Network, Software for Storage Network, Adopting and Managing SAN.	7
VI.	Software Defined Network : Understanding SDN and Open Flow : SDN – Network Virtualization Techniques, SDN Building Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , PoX and NoX, NetApp Development on top of SDN, Open Flow in Cloud Computing. Case study: how SDN changed Traditional Enterprise network Design	9

References:

1. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.
2. CCDA Cisco official Guide
3. Cisco Cloud Computing - Data Center Strategy, Architecture, and Solutions by Kapil Bakshi - Cisco Systems White paper
4. https://en.wikipedia.org/wiki/TIA-942
5. "Data Center Top-of-Rack Architecture Design" . *White paper*. Cisco Systems. April 18, 2011. Retrieved July 10, 2013.
6. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky
7. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India
8. Storage Networks explained by Ulf Troppen, wiley publication
9. Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs by Richard Barker, Paul Massiglia, Wiley India

List of Experiments: based on Laboratory Practical's/ Case studies

1. Design on Enterprise LAN.
2. Design on Enterprise Wireless LAN.
3. Case study on SAN and RAID.

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of the end semester examination.

Subject Code	Subject Name	Credits
MEITC103	**Advances in Software Engineering**	**04**

Course Objectives: Objectives of this course include:

1. To learn and understand the principles of Software Engineering
2. To Learn and understand Software Development Life Cycle
3. To apply Project Management and Requirement analysis principles to S/W project development..
4. To apply Design and Testing principles to S/W project development.

Course Outcomes: On successful completion of the course students will be able to

1. Compare and chose a process model for a software project development.
2. Analyze and model software requirements of a software system
3. Design and Modeling of a software system with tools
4. Prepare the SRS, Design document, Project plan of a given software system

Prerequisite: Any programming language

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Nature of Software, Software Definition, Software characteristics, Software Application Domains, Software Myths, Software Engineering Practice	**03**
I	Nature of Software	Software Engineering, The Software Process, A Generic Process Model, Prescriptive Process Models: The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Specialized Process Models, The Formal Methods Model, The Unified Process Personal, Agility Principles , Extreme Programming (XP), Scrum, Introduction to Clean Room Software Engineering	**06**
II	Requirements Engineering	Requirements Engineering, Eliciting Requirements, Collaborative Requirements Gathering, Quality Function Deployment, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements, Analysis: Scenario-Based Modeling, UML Models, Developing an Activity Diagram, Swim-lane Diagrams, Class-Based Modeling, Requirements Modeling Strategies: Flow Oriented Modeling, Creating a Behavioral Patterns for Requirements Modeling, State Machine Diagram with orthogonal states, Requirements Modeling for Web Apps,	**08**

		SRS	
III	Design Methods and Models	The Design Process, Concepts of design, Design Quality, Design Principles, Object-Oriented Design Concepts, Design Classes, The Design Model and elements, Software Architecture, Importance, Architectural Styles, Architectural Design, Assessing Alternative Architectural Designs, using Architectural Styles in Designs, Component Design, Class-Based Components, Conducting Component Level Design, Component-Level Design for WebApps, User Interface Design, The Golden Rules, User Interface Analysis and Design, Interface Analysis Interface Design Steps, WebApp Interface Design, Design Evaluation, Design Document, Modifiability: SAAM Method, ATAM Method, The HASARD Method.	**08**
IV	Testing Principles	Principles A Strategic Approach to Software Testing, Strategic Issues, Test Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System Testing, The Art of Debugging, Software Testing Fundamentals, White-Box Testing , Basis Path Testing, Control Structure Testing, Black-Box Testing, Model-Based Testing, Testing for Specialized Environments, Architectures, Object-Oriented Testing Strategies, Object-Oriented Testing Methods, Test Cases and the Class Hierarchy, Testing Concepts for WebApps, Testing Process—An Overview, User Interface Testing , Test plan, Positive Testing Negative Testing	**06**
V	Project Planning and management	The Management Spectrum, Software Scope, Problem Decomposition, Process Decomposition , Process and project metrics, Size-Oriented Metrics, Function Oriented Metrics, Reconciling LOC and FP Metrics, Object-Oriented Metrics, Integrating Metrics within the Software Process, Software Project Estimation, Decomposition, Process-Based Estimation, Estimation with Use Cases, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Model , Project scheduling: Basic Concepts, Defining a Task Set for the Software Project , Scheduling : Tracking the Schedule, Earned Value Analysis Risk management: Reactive versus Proactive Risk Strategies, Risk Identification, Assessing Overall Project Risk, Risk Projection, Developing a Risk Table, Assessing Risk, Project Plan	**11**
VI	Advanced Trends in Software Engineering	Introduction to Formal Specification Languages : Object Constraint Language (OCL), Z Specification Language, Software reuse, Distributed software engineering, Service-oriented architecture, Embedded software, Aspect-oriented software engineering, Introduction to DevOps, Docker, Github.	**06**

Text Books:

1. Roger S Pressman “Software Engineering : A Practitioner’s Approach “ 7th Edition Mcgraw-Hill ISBN:0073375977
2. Ian Sommerville “ Software Engineering” 9th edition Pearson Education SBN-13: 978-0- 13-703515-1, ISBN-10: 0-13-703515-2
3. Hong Zhu “Software Design Methodology”, Elsevier ISBN: 978-81-312-0356-9

References:

1. Pankaj Jalote " An Integrated Approach to Software Engineering" 3rd Edition Narosa Publication ISBN: 81-7319-702-4
2. Rajib Mall " Fundamentals of Software Engineering" 3rd edition PHI.
3. Pfleejer " Software Engineering- Theory and Practice" 4th edition
4. Martin Fowler "Distilled UML" 3rd edition Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson, 2003
5. 5. Hans Van Vilet "Software Engineering Principles and Practice" 3rd edition Wiley
6. Devops.com

List of Experiments: based on Laboratory Practical's

1. Introduction to DevOps, Docker, Github (The tools can be used to implement practical)
2. Technical paper reading. Student will read any technical paper in software engineering and explain its contents to the class.
3. Development of one software project with following deliverables
    a. Analysis Model
    b. Design Model
    c. Working application
    d. Test case Design
    e. RMMM plan

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO1011	**User Experience Engineering**	**04**

Course Objectives :

1 To stress the importance of a User Experience Engineering (UXE).
2 To Learn User Experience Engineering (UXE) Process.
3 To understand how to design Effective and Efficient User Interfaces for intended users.
4 To Learn techquies for Prototyping and Evaluating User Experiences.

Course Outcomes:

1 Understand importance of User Experience (UX).
2 Gain and apply knowledge of the theoretical frameworks, methodological approaches, and problems solving techniques related to user experience design.
3 Criticize existing interface designs, and improve them.
4 Design complete application with end-to-end understanding of current UXE best practices and processes.

Pre-requisites: Web Technologies; Software Engineering; Experience in designing interfaces for applications and web sites. Basic knowledge of designing tools and languages like HTML, Java, etc.

"User experience engineering (UXE)" -describe a structured research, design, and evaluation process whose goal is to make user interactions with a product or service easy, efficient, and enjoyable. It evolved from usability engineering and applies psychological principles and methodologies.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Pre-requisites	HCI and Usability, Usability Paradigms and Usability Principles, User Interface Design Tools.	3
I	Introduction	What is UX, Ubiquitous interaction, Emerging desire for usability, From usability to user experience, Emotional impact as part of the user experience, User experience needs a business case, Roots of usability.	6
II	The Wheel: A Lifecycle Template	Introduction, A UX process lifecycle template, Choosing a process instance for your project, The system complexity space, Meet the user interface team, Scope of UX presence within the team, More about UX lifecycles.	6
III	Contextual Inquiry: Eliciting Work Activity Data	Introduction, The system concept statement, User work activity gathering, Look for emotional aspects of work practice, Abridged contextual inquiry process, Data-driven vs. model-driven inquiry, History. ,Contextual Analysis, Extracting Interaction Design Requirements, Constructing Design-Information Models.	10
IV	Design Thinking, Ideation, and Sketching, Prototyping	Introduction, Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching, More about phenomenology, Mental Models and Conceptual Design, Wireframe, Prototyping	10
V	UX Evaluation, The Interaction	UX Goals, Metrics and Targets, UX Evaluation Techniques.- Formative vs summative ,Analysis.	8

	Cycle and the User Action Framework	Introduction, The interaction cycle, The user action framework—adding a structured knowledge base to the interaction cycle, Interaction cycle and user action framework content categories, Role of affordances within the UAF, Practical value of the UAF.	
VI	UX Design Guidelines	Introduction, Using and interpreting design guidelines, Human memory limitations, Selected UX design guidelines and examples, Planning, Translation, Physical actions, Outcomes, Assessment, Overall.	5

Text Books:

1. The UX Book by Rex Hartson and Pardha Pyla

2. Smashing UX Design by Jesmond Allen and James Chudley

3. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden

4. Don't Make Me Think, Revisited by Steve Krug

5. The User Experience Team of One by Leah Buley

6. The Elements of User Experience by Jesse James Garrett

7. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

References:

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler

2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill

3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler

4. Human Computer Interaction by Alan Dix

Lab Practical's: For any Case Study perform following practicals:-

Sr.No. Description

1. **Indentify and describe the objectives for UXE project-**
    a. Perform user research
    b. User requirement collection
    c. User Requirement Analysis
    d. Create User personas, user scenarios , customer journey maps etc
2. **UX Design –**
    a. Conceptual Design- Site Maps
    b. Create Wireframe
    c. Create Prototype
3. **UX Evaluation**

a. Set UX Goals

b. Perform UX Evaluation and Reporting

Assessment:

Term work consists of any two case studies or mini project covering the above syllabus.

Internal : Internal assessment will be of **20** marks .Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Theory paper will be of **80** marks. Some guidelines for setting the question Papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO1012	**Ad-hoc Networks**	**04**

Course Objectives:

1. Understand the basic concepts of ad-hoc networks
2. Explain the basics of mobile telecommunication system
3. Be familiar with network protocol stack
4. Gain knowledge of different mobile platforms and application development

Course Outcomes:

1. Explain the basic concepts of ad-hoc networks
2. Explain the basics of mobile telecommunication system
3. Identify the network protocol stack
4. Develop different mobile application using different platform.

Prerequisite: Network, Operating System, Wireless Technology

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite:	Introduction – Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio Propagation Mechanisms.	**3**
I	**Introduction**	Wireless Network. Characteristics of the Wireless channel. Cellular and Ad-Hoc Wireless Networks, Applications of Ad-Hoc Wireless Networks/MANET/Wireless Sensor Network/VANET. Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Mobility, Hidden and Exposed terminal Problems, Characteristics of an Ideal Routing Protocol for Ad-Hoc Wireless Networks	**7**
II	**Medium access protocols**	MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.11p, 802.15. HIPER LAN	**8**
III	**Ad hoc routing protocols**	Introduction – Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) – Location–Aided Routing (LAR) – Power–Aware Routing	**8**

		(PAR) – Zone Routing Protocol (ZRP).	
IV	**Multicast routing in ad-hoc networks**	Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols.	**8**
V	**Transport layer– security protocols**	Introduction – Issues in Designing a Transport Layer Protocol for Ad hoc Wireless Networks – Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks – Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks – Other Transport Layer Protocols for Ad hoc Wireless Networks – Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.	**8**
VI	**Mobile/vehicular Ad-hoc Networks**	MANET, VANET, Design issues, Routing, MANET vs VANET, Various Attacks on MANET/VANET, Attacks on Routing Mechanisms, Security Mechanisms in the Network Layer, Security Mechanisms in the Data - Link Layer, Key Management.	**6**

Text book

1. S. Sarkar, T. Basavraju and C. Puttamdappa, “Ad hoc mobile wireless networks principles, protocols and applications” , second edition, CRC Press, 2016.
2. Al-Sakib Khan Pathan, Muhammad Mostafa Monowar, Zubair Md. Fadlullah, “Building Next-Generation Converged Networks: Theory and Practice, CRC Press, 2013.
3. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic, “Mobile Ad Hoc Networking: The Cutting Edge Directions”, John Wiley 2013.
4. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007

References

1. C. K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR, 2001.
2. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000
3. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004
4. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005

Practical

1. Implement Ad-hoc network using BlueHoc Simulator.
2. Implement MANET using DARS Simulator.
3. Implement simple VANET/WSN using NS2.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO1013	**Cloud Computing**	**04**

Course Objectives:

1. Introduce the broad perceptive of cloud architecture and model

2. Able to set up private cloud

3. Understand the Business Aspects of Mobile Cloud Computing

4. Understands research challenges in mobile cloud computing systems

Course Outcomes:

1) Apply suitable virtualization concept
2) Design cloud services
3) Design various applications by integrating cloud services using mobile cloud
4) Apply the concepts of mobile cloud computing for implementing mobile cloud applications

Prerequisite: Mobile Computing, Cloud Computing

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite:	Mobile Computing**,** Generations of Mobile Communication, Mobile architecture, Mobile Operating Systems, Applications of Mobile Communication, Challenges of Mobile Communication, Cloud Computing**,** Cloud Computing Architecture, Cloud Computing Deployment Models, Issues of Cloud Computing.	**3**
I	**Cloud Computing**	Virtualization Techniques, Cloud Infrastructure , Architecture Design of Compute and Storage Clouds, Design challenges-Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Cloud Sim Simulator	**7**
II	**Mobile Cloud Computing**	Introduction, Motivation to Mobile Cloud Computing, Architecture of Mobile Cloud Computing, Platform and Technologies, Mobile Augmentation Approaches, Issues of Mobile Cloud Computing, Advantages of Mobile Cloud Computing, Applications of Mobile Cloud computing, Research Challenges in Mobile Cloud Computing	**8**
III	**Offloading in Mobile Cloud Computing**	Introduction, Offloading Decision, Types of Offloading, Topologies of Offloading, Offloading in Cloud Computing and in Mobile Cloud Computing: Similarities and Differences, Adaptive Computation Offloading from Mobile Devices, Cloud Path Selection for Offloading, Mobile Data Offloading Using Opportunistic Communication, Three-Tier Architecture of Mobile Cloud Computing, Requirements of Data Offloading, Performance Analysis of Offloading TechniquesMulti-Cloud Offloading in Mobile Cloud Computing Environment	**8**

IV	**Green Mobile Cloud Computing**	Introduction, Green Mobile Computing, Green Mobile Network, Green Cloud Computing, Green Mobile Cloud Computing, Green Mobile Devices Using Mobile Cloud Computing, Green Femtocell Using Mobile Cloud Computing, Green Seamless Service Provisioning with Mobile Cloud Computing, Green Location Sensing within Mobile Cloud Computing Environment	**8**
V	**Resource Allocation and Business Aspects of Mobile Cloud Computing**	Significance of Resource Allocation in Mobile Cloud Computing, Resource-Allocation Strategies in Mobile Cloud Computing, Research Challenges in Resource Allocation in Mobile Cloud Computing. Cloud Business Models, Business Model of Mobile Computing Environment, Cooperation among Service Providers, Weblet-Based Mobile Cloud Computing Model, Mobile Cloud Service Insurance Brokerage, Business Aspects of Social Mobile Cloud Computing	**6**
VI	**Application of Mobile Cloud Computing and Future Research Scope of Mobile Cloud Computing**	Introduction, Cloud Mobile Media Application, Biometric Application, Vehicle Monitoring, Mobile Learning, Application in Social Cloud, Context-Aware Navigation System. Efficient Bandwidth Allocation, Use of Cloudlet in Mobile Cloud Computing, Cross-Cloud communication, Elastic Application Model, Resource Management	**8**

Text Books:

1. Mobile Cloud Computing: Architectures, Algorithms and Applications, by Debashis De , CRC press

2. Mobile Clouds: Exploiting Distributed resources in wireless mobile and social networks,by Frank Fitzek, Marcos D. Katz Wiley

3. Mobile Cloud computing: Principles and paradigms by Khanna, Sarishma

References:

1. Architecting the cloud by Kavis Wiley publication

2. Advances in Mobile cloud computing systems by F. Richard Yu. , Victor Leung, CRC press

3. Mobile computing with Cloud byIshwaryaChandrasekaran Springer

4. Mobile cloud computing: An Introduction by Jyoti Grover and Gaurav KLheterpal , IGI GLobal

List of Experiments: based on Laboratory Practical's/ Case studies

1. Offloading the applications from mobile to cloud

2. Traffic analyses and measurements

3. Application in Social Cloud

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO1014	**IT Strategy**	**04**

Course Objectives:

1. To appraise the operational, competitive and strategic value of information technology, and how its management and governance contributes to the realization of that value
2. To introduce key concepts to develop a broad and critical understanding of IT strategy development, implementation and value issues (such as IT and business alignment, IT capability, strategic relevance of emerging IT, change management) and provide a conceptually and theoretically sound explanation about these issues.
3. To introduce methods for evaluating emerging technologies and forecasting the rate of technological advance.
4. To focus on procedures for quantifying various types of risk in IT investments, identifying tangible and intangible costs and benefits.

Course Outcomes: Learner will be able to:

1. To develop variety of ways were IT can enable and create business opportunities.
2. Design and develop the business strategy map and the IT strategy with end-to-end strategic business-IT alignment enabling management, coordination and monitoring the firm's strategy to ensure desired business outcomes.
3. Use data driven approaches to evaluate extant and predicting future directions and likely developments in technologies, identify solutions based on industry and technology trends that improve IT and business alignment, and business performance.
4. Analyze and evaluate the IT capabilities, develop ways to mitigate risky IT initiatives

Prerequisite: Fundamental of Computer Technology.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Basic of IT infrastructure and Internet Technology.	**3**
I	Business Models, Competitive Strategy and Organization Mission	How businesses are modeled, and how they compete. The mission of businesses and other organizations, and the relationship between an organization's mission and its strategy. Competitive Domains, Competitive Consequences of Technological Change – Creation of New Products, Changes in the Value Chain, Changes in the Value Constellation, Competitive Rivalry. Technological Characteristics of Competitive Domains – Technological Opportunity, Resource Requirements, Collateral Assets, Institutional Milieu, Speed. Dynamics of Change in the Competitive Domain – Technology Emergence Phase, Incremental Change Phase. Framework for Analysis of Technology Emergence, Influence of Environmental trends on competition. Technology as critical to Business Outcomes – Technology Strategy and Technology Leadership	**9**
II	Technology Intelligence	Signals of New Technology, What is Technology Intelligence, Importance of Technology Intelligence, Levels of Technology Intelligence, External versus Internal Technology Intelligence. Mapping the Technology Environment – Steps in Mapping, Mapping the Macro level	**8**

		and Industry Level Environment. Mechanisms for Data Collection – Challenges, Organizational Arrangements and Key Principles for Data Collection	
III	Business Strategy and Technology Strategy	Business Strategy , Strategic Analysis and Decision Making using Product Evaluation Matrix, Market-Growth-Market-Share Analysis Matrix, X-Y Coordinating Method, M-by-N Matrix, SWOT Matrix, Formulation of Technology Strategy, Core Competencies, Exploitation of Core Competencies, Integration, Linking Technology & Business Strategies, Creating the Product-Technology-Business Connection. Technology's Interface with – Market, Customers and Suppliers. Customer Supplier and Product-User relationships.	**8**
IV	IT and the Digital Organization	The functionality of the digital organization, and the role that IT plays in supporting it. Competitive and operational perspectives on IT, including analysis of both benefits and risk.	**4**
V	Alignment of IT with Business strategy	IT and Michael Porter's Competitive Forces Framework IT and Value Chain Framework IT and Business Process Reengineering; Virtual Organizations IT and Competitive Advantage	**8**
VI	Enterprise architecture & strategic planning	IT Strategy Initiation, IT management best practices Control Objectives for Information and related Technology (COBIT) framework , IT Strategy Planning, Outsourcing, Off shoring & IT Subsidy, Critical success factors of IT strategy	**8**

Text Books:

1. IT strategy issues and practices, James D. McKeen and Heather A. Smith, Pearson

2. IT strategy and man agent, S.S. Dubey, PHI

3. Management of Technology – The Key to Competitiveness and Wealth Technology & Business Strategy – An Introduction, Edited by Prashanta Kumar Banerjea, ICFAI books

References:

1. Strategic Management of Technology & Innovation, Robert A Burgelman, Modesto A Maidique, Steven C Wheelwright, MGH International Edition.

2. Managing Technology and Innovation for Competitive Advantage, V K Narayanan, Pearson Education, and 2009 Edition.

3. Technology Management – Text and International Cases, Norma Harrison and Danny Samson, MGH

List of Experiments: based on Laboratory Practical's/ Case studies

1. Prahalad, C. K., & Krishnan, M. S. (2002). The dynamic synchronization of strategy and information technology. *MIT Sloan management review*, *43*(4), 24. (Develop a set of questions based on this article for teaching)

2. IT-LED BUSINESS TRANSFORMATION AT RELIANCE ENERGY Deepa Mani; Geetika Shah; Revati Nehru available from Harvard Business Publishing

3. ENABLING THE STRATEGY-FOCUSED IT ORGANIZATION Robert S. Gold available from Harvard Business Publishing

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO1015	**Knowledge Management**	**04**

Course Objectives:

1 Establish a foundation of key terms and concepts, historical events and contributions, organizational benefits, and guiding principles on which to build greater understanding of knowledge management

2 Appreciate the role and use of knowledge for individuals, as well as organizations and institutions.

3 Increase information and understanding about knowledge transfer using low- and high technology strategies

4 Explore the future of knowledge management and its influence on our jobs, communities, and society

Course Outcomes: After completion of the course the learner will be able to

1) Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
2) Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems
3) Evaluate the impact of technology including telecommunications, networks, and Internet/intranet role in managing knowledge.
4) Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy Ponder KM's current and future impact on individuals, organizations and society at large

Prerequisite: An introductory course in IT/ IS

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Meaning of data, information, knowledge and expertise Meaning of epistemology, Types of Knowledge -Subjective & Objective views of knowledge, procedural Vs. Declarative, tacit Vs. explicit, general Vs. specific.	**3**
I	Introduction to Knowledge Management	What is Knowledge? Types of expertise – associational, motor skill,¬ theoretical Characteristics of knowledge – explicitness, codifiability, teachability, specificity Reservoirs of knowledge, Meaning of Knowledge Management, Forces Driving Organizational issues in KM, KM Systems & their role Relevance of KM in today's dynamic & complex environment Future of Knowledge Management	**5**
II	Knowledge management system life cycle	Challenges in Building KM Systems – Conventional versus KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture.	**8**
III	KM Solutions for capture, sharing & applications	KM Processes, KM Systems, Mechanisms & Technologies Knowledge Capturing Techniques: Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory	**8**

		Grid- Concept Mapping –Blackboarding, Nominal Group Technique, Delphi method,	
IV	Knowledge codification	Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing –Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation.	**8**
V	Knowledge transfer and sharing	Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.	**8**
VI	KM Impact	Dimensions of KM Impact – People, Processes, Products & Organizational Performance Factors influencing impact – universalistic & contingency views Assessment of KM Impact – Qualitative & quantitative measures Identification of appropriate KM solutions, Ethical Legal and Managerial Issues	**8**

Text Books:

1. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies . Prentice Hall. ISBN: 0-13-109931-0.

2. Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13-034820-1

3. Donald Hislop, Knowledge Management in Organizations, Oxford 2nd Edition. Ian Watson (2002).

4. Shelda Debowski, Knowledge Management, Wiley India Edition.

References:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.

2. Stuart Barnes (Ed.) (2002). Knowledge Management Systems Theory and Practice. Thomson Learning.

3. Kimiz Dalkir, Knowledge Management in Theory and Practice, Elsevier, Butterworth Hinemann.

4. Applying Knowledge Management: Techniques for Building Corporate Memories. Morgan Kaufmann. ISBN: 1558607609.

List of Experiments : based on Laboratory Practical's/ Case studies

1. Daimler Chrysler Knowledge Management strategy, Michael G Rukstad and Peter Coughlan , Harvard Publishing

2. Andreu, R., Grau, A., Lara, E., & Sieber, S. (2003). Knowledge Management at Siemens Spain, PRISM case# 9.5. 3, University of Navarra, IESE, Spain. *Distributed by The European Case Clearing house, England and USA*.

3. 5 Big Companies That Got Knowledge Management Right – John Mc Cormick

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Course Code	Course Name	Credits
ILO1011	Product Life Cycle Management	03

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to…

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:**Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**ProductDesign:**Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:**For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:**Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05

06	**Life Cycle Assessment and Life Cycle Cost Analysis:**Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper.Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to…

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to…

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

REFERENCES:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE).
2. To list the guidelines for designing experiments.
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to…

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action.
- Apply the methods taught to real life situations.
- Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	**Introduction:** Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	06
02	**Fitting Regression Models:** Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	08
03	**Two-Level Factorial Designs:** The 2^2Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^kDesign, The Addition of Center Points to the 2^kDesign, Blocking in the 2^kFactorial Design, Split-Plot Designs.	07
04	**Two-Level Fractional Factorial Designs:** The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	07
05	**Conducting Tests:** Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.	07
06	**Taguchi Approach:** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.	04

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001

3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss
6. Philip J Ross, "Taguchi Technique for Quality Engineering," McGraw Hill.
7. Madhav S Phadake, "Quality Engineering using Robust Design," Prentice Hall.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05

05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to…

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime andinformation security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation ofMobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed byMobile Devices, Registry Settings for Mobile Devices, AuthenticationService Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures forHandling Mobile, Devices-Related Security Issues, OrganizationalSecurity Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.

7. William Stallings, *Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 **Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.**	03
02	**Natural Disaster and Manmade disasters:** **2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion** **2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.**	09
03	**Disaster Management, Policy and Administration** **3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.** **3.2 Policy and administration:** **Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.**	06
04	**Institutional Framework for Disaster Management in India:** **4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.** **4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.**	06
05	**Financing Relief Measures:** **5.1 Ways to raise finance for relief expenditure, role of government agencies and**	09

	NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. **5.2 International relief aid agencies and their role in extreme events.**	
06	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO1018	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:**	04

	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
MEITC201	**Security & Risk Management**	**04**

Course Objective:

1. To gain knowledge about information security and Risk Management
2. To be familiar with Risk assessment methodology and risk mitigation approaches
3. To gain an overview about security management concepts and configuration management
4. To understand IT audit and its activities

Course Outcomes:

After completion of the course the gain knowledge of the following

1. Able to explain the knowledge about information security and Risk Management
2. Able to analysis Risk assessment methodology and risk mitigation approaches
3. Able to explain security management concepts and configuration management
4. Able to explain IT audit and its activities

Pre-requisite : Computer Networks.

DETAILED SYLLABUS:

Module	Detailed content	Hours
Prerequisite	**Overview of Information Security Management** The big picture, Learning from experience, Weaknesses in Information Security. The extent of crime in cyberspace, Cyberspace crimoid syndrome, Policies and technologies, A new frame work for Information security.	3
I	**Introduction to Information Security** Basic information security model, Need for security, Common vulnerabilities, threats and attacks, Asset Identification and Characterization – Asset types, Asset characterization, IT Asset life cycle and asset identification, Threat models, Encryption controls.	5
II	**Information Security Risk Assessment Basics** What is Risk? Information Security Assessment Overview, Risk Assessment Framework: NIST 800-39, OCTAVE, ISO 27000 series, Data Collection and Analysis, Asset scoping, Preparation of Threat and Vulnerability Catalogs, System Risk Computation, Impact Analysis Scheme, Final Risk Score.	8
III	**Risk Assessment Methodology** Introduction to Risk assessment, Defense-in Depth Approach, Qualitative and Quantitative risk assessment approaches, Problems with Quantitative approach, Risk Control Strategies, System Risk Analysis, Risk Prioritization, System Specific Risk Treatment.	8
IV	**Performing the Assessment** Vulnerability scan and Exploitation: Internet Host and network enumeration, IP network scanning, Assessing Remote Information Services, Assessing Web	10

	Servers, Assessing Web Applications, Assessing Remote Maintenance Services, Assessing Database Services, Assessing Windows Networking Services, Assessing Email Services. Scanning and Analysis tools and their working principle. Final Report Preparation and Post Assessment Activities.	
V	**Security Management Concepts and Principles** Measuring ROI on security, security patch management, Purpose of Information Security management, and The building blocks of information security. Overview of SSE CMM, SSE CMM relationship to other initiatives, capability levels, Security Engineering process overview. Configuration management: Role of CM in Security of an organization. CM framework, Three disciplines of CM:Business Process Infrastructure (Chain of Command, CCB), Operations and Services (Operational Group) ,End Products (technical group) with respect to security.	8
VI	**Planning for Security:** Information Security Planning and Governance, Information Security Policy Standards, EISP, ISSP, SysSP, Policy management. **Security Audit Process:** Pre-planning audit, Audit Risk Assessment, Performing Audit, Internal Controls, Audit Evidence, Audit Testing, Audit Finding, Follow-up activities.	6

References

1. Manish Agarwal, Alex Campoe and Eric Pierce, "Information Security and IT Risk Management" Wiley 2016.
2. Principles of Information Security, Michael E Whitman, Herbert J. Mattod, 4th Edition, Cengage Learning.
3. Mark Talabis, "Information Security Risk Assessment Toolkit: Practical Assessments through Data Collection and Data Analysis", Kindle Edition.ISBN:978-1-59749-735-0.
4. David L.Cannon, "CISA Certified Information Systems Auditor Study Guide", SYBEX Publication. ISBN: 978-0-470-23152-4.
5. Network Security Assessment, Chris McNab, O'reilly
6. Inside Security Assessment, Micheal Gregg, Pearson
7. The Security Risk Assessment Handbook: Douglas LanDoll, Auerbach Publication
8. Micki Krause, Harold F.Tripton, "*Information Security Management Handbook*", Auerbach Publications, 2012.

List of Experiments:

1. Working with scanning enumeration tool
2. Understanding practical aspect operating system security, Linux and Windows
3. Working with open source security information management for security audit (OSSIM)

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITC202	**High Performance Computing**	**04**

Course Objectives:

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using Parallel programming paradigms.
3. To learn CUDA Programming Language and tools.
4. Performance comparison between CUDA, MPI and OpenMP.

Course Outcomes: Learner will be able to:

1. Determine the complexity of a given parallel algorithm
2. Identify design Issues and limitations in Parallel Computing.
3. Design algorithms suited for Multicore processor and GPU systems using CUDA, MPI, OpenMP.
4. Analyze and optimize performance parameters.

Pre-requisite: Mathematics, Data structures.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Pre-requisite	High performance computing through a number of applications in science and engineering, including problems in linear algebra, partial differential equations (e.g. computational fluid dynamics), molecular dynamics, and agent based modelling. Study of various numerical methods used in engineering practice and how these applied to solving computational problems and hence programmed for execution on a supercomputer.	3
I	Parallel Processing Approaches	**Introduction to Parallel Processing:** Levels of Parallelism (instruction, transaction, task, thread, memory, and function), Models (SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation etc.), Loosely coupled and Tightly coupled **HPC Platforms:** CUDA, Message-passing Interface (MPI), Shared-memory thread-based OpenMP programs, hybrid (MPI/OpenMP) programs, Grid Computing, Cloud Computing , Multi-Core Processors, accelerators, GPGPUs	6
II	Design Issues and limitations in Parallel Computing	Parallel Architecture, (Interconnection network, processor Array, Multiprocessor) Designing Parallel algorithms (Partitioning, Communication, Mapping, Matrix input/output) **Issues:** Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms onto Parallel Architectures **Limitations:** Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their limitations	8

III	Programming using CUDA	CUDA: a) Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem microarchitecture) b) Memory hierarchy and transaction specific memory design c) Thread Organization, The Implementation of the Cilk-5 Multithreaded Language, MapReduce: simplified data processing on large clusters, StreamIt: A Language for Streaming Applications, PetaBricks: A Language and Compiler for Algorithmic Choice, Pregel: a system for large-scale graph processing, PowerGraph: Distributed Graph-Parallel Computation on Natural Graphs, GraphChi: Large-Scale Graph Computation on Just a PC, The Tao of Parallelism in Algorithms	12
IV	Programming using MPI and Open MP	MPI: Principles, building blocks, MPI, Overlapping communication and computation, collective communication operations, Composite synchronization constructs; OpenMP: Threading, Building blocks, Memory Allocators, Parallel programming model, combining MPI and OpenMP, Shared memory programing.	8
V	Performance Measures	Performance measures: Speedup, efficiency and scalability. Abstract performance metrics (work, critical paths), Amdahl`s Law, Gustavson's law, weak vs. strong scaling, performance bottlenecks, data races and determinism, data race avoidance (immutability, futures, accumulators, dataflow), deadlock avoidance, abstract vs. real performance (granularity, scalability)	07
VI	HPC enabled Advanced Technologies	(a) Petascale Computing (b) Optics in Parallel Computing (c) Quantum Computers (d) Recent developments in Nanotechnology and its impact on HPC	04

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing", Pearson Education, Second Edition, 2007.

2. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill, 1993.

3. Edward Kandrot and Jason Sanders, CUDA By Example – An Introduction to General Purpose GPU Programming, Addison-Wesley Professional ©, 2010.

4. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, "Heterogeneous Computing with OpenCL", McGraw-Hill, New York, 2011.

5. CUDA C PROGRAMMING GUIDE, September 2015.

Reference Books:

1. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

2. Michael J. Quinn, “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill International Editions, Computer Science Series, 2004.

3. Kai Hwang, “Scalable Parallel Computing: technology, architecture, programming”, McGraw Hill 1998

4. Laurence T. Yang, MinyiGuo, “High- Performance Computing: Paradigm and Infrastructure ” Wiley

List of Experiments:

1. OpenMP implementation
   workload partitioning based on 1, 2, 4 and 8 core configurations
2. MPI implementation
   workload partitioning based on 1, 2, 4, 8, 16, 32 node configuratations.
3. Performance comparison between CUDA, MPI and OpenMP implementations
   i. Execution time
   ii. Programming effort
      1. Quantify the speedup you are getting compared to a single processor (single thread) implementation with respect to the amount of programming and design effort you invested
   iii. Limitations of your implementation from both hardware and software perspectives
      1. how does the target architecture impact your paralleization strategy
      2. how does the programming environment effect the speedup you are achieving

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITC203	**Advanced Web Technology**	**04**

Course Objectives:

1 Get familiar with Web Technologies.

2 Gaining a good grasp over Web 2.0 technologies in order to develop responsive web applications

3 Exploring the advantages of emerging web technologies and what environment they are being used in

4 Exploring Web 3.0 and Semantic Web standards

Course Outcomes: Student will be able:

1) To design a responsive web site using HTML5 and CSS.

2) To design RIA using proper choice of Framework

3) To recognize and evaluate website organizational structure and design elements

4) Explain emerging web 3.0 standards

Prerequisite: web programming, C language

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	**Introduction to web technologies**: Web system architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators **Web Site Design Issues**: Planning a Web Site –Objective and Goals, Audience, Organizing contents. **Publishing of Web Site**. **Function of Web Server** **Basic HTML**: Formatting and fonts, Anchors, images, lists, tables, frames and forms. XML basics.	03
I	Web Technology Basics & HTML 5.0	**HTML 5:** Fundamental Syntax and Semantics, Progressive Markup and Techniques, Forms, Native Audio and Video, Micro data and Custom data, Accessibility, Geo-location, Canvas.	06
II	Responsive web design with HTML5 and CSS3	**Introduction to CSS**: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS	02
		CSS3 and Responsive Web Design. **CSS3:** Selectors, Typography and color Modes Stunning Aesthetics with CSS3, CSS3 Transitions, Transformations and Animations, Conquer Forms HTML5 and CSS3	06
III	Web Services	**Web Services:** Web services, Evolution and differences with Distributed computing, XML, WSDL, SOAP, UDDI, Transactions, Business Process Execution Language for Web Services, WS-Security and the Web services security specifications, WS-Reliable Messaging, WS-Policy, WS-	07

		Attachments. REST-ful web services, Resource Oriented Architecture, Comparison of REST, SOA, SOAP.	
IV	Rich Internet Application (RIA)	**Introduction to Ajax:** Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds **Working with JavaScript Object Notation (JSON):** Create Data in JSON Format, JSON parser, Implement JSON on the Server Side, Implementing Security and Accessibility in AJAX **Applications:** Secure AJAX Applications, Accessible Rich Internet Applications, **Developing RIA using AJAX techniques:** CSS, HTML, DOM, XMLHTTPRequest, JavaScript, PHP, AJAX as REST Client **Open Source Frameworks and CMS for RIA:** Django, Drupal, Joomla introduction and comparison.	08
V	Web Analytics 2.0	Introduction to Web Analytics 2.0 1: State of the Analytics Union, State of the Industry, Rethinking Web Analytics: Meet Web Analytics 2.0, Optimal Strategy for Choosing Your Web Analytics Soul Mate. The Awesome World of Clickstream Analysis: Metrics. The Key to Glory: Measuring Success. Failing Faster: Unleashing the Power of Testing and Experimentation.	08
VI	Web 3.0 and Semantic Web	**Web 3.0 and Semantic Web**: Challenges, Components, Semantic Web Stack: RDF, RDF Schema (RDFS), Simple Knowledge Organization System (SKOS), SPARQL as RDF query language, N-Triples as a format for storing and transmitting data, Turtle (Terse RDF Triple Language), Web Ontology Language (OWL) a family of knowledge representation languages, Rule Interchange Format (RIF), a framework of web rule language dialects supporting rule interchange on the Web.	08

Text Books:

1. HTML 5 Black Book: Kogent Learning solutions
2. Tim O'Reilly, What is Web 2.0? : Design Patterns and Business Models for the Next Generation of Software, O'REILLY
3. John Davies, Rudi Studer, and Paul Warren John , "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley & Son'
4. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity
Avinash Kaushik, ISBN: 978-0-470-52939-3, wiley publication.

References:

1. Grigoris Antoniou and Frank van Harmelen,. A Semantic Web Primer: MIT Press,2004, ISBN 0-262-01210-3
2. Deane Brker, Web Content Management: Systems, Features, and Best Practices, O'Reilly & Associates incorporated, 2016
3. John Domingue, Dieter Fensel, Handbook of Semantic Web Technologies, Springer Reference
4. Liyang Yu, a Developer's Guide to the Semantic Web, Second Edition, Springer
5. An introduction to RDF and Jena RDF API, www.jena.apache.org/tutorials/rdf_api.html.

List of Experiments: based on Laboratory Practical's/ Case studies

1. Design a website with features like login for users and several gadgets, it should atleast have a twitter box, a video, a calendar with events, event announcements and information with a registration form.

2. A mini project based on REST API and web analytics 2.0

3. Apache Jena based RDF and SPRQL based Tutorials

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO2021	**E-Business and Social Network Analysis**	**04**

Course Objectives:

1) To understand e-Business as a significant business segment for the future.

2) To get an overview of technological and strategic aspects of e-Business.

3) To know basics of Social Network Analysis.

4) To visualize, summarize and analyze the effect of Social Networks on e-Business.

Course Outcomes: At the end of the course the students will be able to

1) Develop a complete e-business strategy.
2) Develop and implement complete e-commerce site.
3) Visualize/Analyze real world Social Networks.
4) Analyze the impact of Social Networks on e-Business.

Prerequisite: E-Commerce and E-Business

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**
	Prerequisite	Defining e-Business, Framework for understanding e-Business.	**3**
I	Introduction to e-Business	Fundamental Models of e-Business, Preparing e-Business Plan, and Environmental forces affecting planning & practice, Trends in e-Business.	**5**
II	e-Business and e-Marketing Strategies	Strategic planning process, SCM, CRM and ERP, Marketing Strategies and Revenue Models.	**8**
III	e-Payment Systems and Security	Concept of Money, Electronic Payment Systems (EPS), Types of EPS, Smart Card and EPS, Electronic Fund Transfer, Security issues and measures like digital certificate, digital signature, encryption, SSL and SET protocols.	**8**
IV	Introduction to Social Network Analysis	Concepts: nodes, edges, adjacency matrix, one and two node networks, node degree, Introduction to social network analysis, Network examples, Graph theory basics, Statistical network properties, Degree Distribution, Clustering Coefficients, Frequent patterns, Network motifs, Cliques and k-cores, Node centralities and ranking on Network nodes and edges, Network diameter and average path length.	**8**
V	Network Communities and Visualization	Network Structure, Network Communities, Graph partitioning and cut metrics, Information and Influence of propagation on networks, Network visualization and Graph layouts, Social diffusion.	**8**
VI	SNA in real world	Applications/Case Studies based on the impact of SNA on e-	**8**

		Business, Impact of SNA on consumer behavior.	

Text Books:

1. E-Business: Business, Technology and Society: Kenneth C. Laudon (Author), Carol Traver (Author)

2. E-Business and E-Commerce management Strategy, Implementation and Practice: Dave Chaffey

3. John Scott, "Social network Analysis" Third edition, SAGE Publications

References:

1. E-Commerce : Ninth edition : Gary Schneider, Cengage
2. Christina Prell, "Social Network Analysis: History, Theory and Methodology", SAGE 2011
3. Stephen P Bergatti, Martin G Everett, Jaffery C Johnson, "Analyzing Social Networks", SAGE 2013.
4. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications"

List of Experiments: based on Laboratory Practical's/ Case studies

1. Develop a Business Plan – Identifying the business model, Develop strategic plan, Design Screen Shots, Show few activities (related to CRM, SCM, Marketing, security etc.), organizational structure, s/w & h/w requirements.

2. Create random Networks, Calculate component distribution, average shortest path and evaluate impact of structure on ability of information to diffuse, calculate and interpret node centrality for real world networks.

3. Read recent research based on these services and learn how SNA concepts are applied on e-Business.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO2022	**AI and Machine Learning**	**04**

Course Objectives:

1 To learn the basic concepts and techniques of AI and machine learning
2. To explore the various mechanism of Knowledge and Reasoning used for building expert system.
3. To become familiar with supervised and unsupervised learning models
4. To design and develop AI and machine learning solution using modern tools.

Course Outcomes: Students will able to:

1. Explain the fundamentals of AI and machine learning.
2. Identify an appropriate AI problem solving method and knowledge representation technique.
3. Identify appropriate machine learning models for problem solving.
4. Design and develop the AI applications in real world scenario.

Prerequisite: Probability Theory and Statistics, PROLOG, R Programming

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Basics of AI, Need for AI Basics of ML, Types, need for ML	3
I	Introduction to AI	Definition, Problem, State space representation. Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Applications of AI, Current trends in AI, Intelligent Agents: Anatomy, structure, Types	6
II	Problem solving	Solving problem by Searching: Problem Solving Agent, Formulating Problems. Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Local beam search	8
III	Knowledge and Reasoning	Knowledge based Agents, The Wumpus World, and Propositional logic. First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining, Knowledge Engineering in First-Order Logic, Unification, Resolution,	8
IV	Concepts of Machine learning	Supervised, unsupervised, semi-supervised, Rote learning, Reinforcement learning, Issues, steps and applications, Designing a learning System. Case study: hand written digit recognition, stock price prediction	3
V	Learning Models	Decision tree learning. Probabilistic Models: Multivariate Bernoulli Naive Bayes	12

		Classifier, Linear and Logistic Regression. Deterministic Models: Support Vector Machine. Hidden Markov Model: Process, Model, Problems of HMM, Viterbi algorithm, Baum- welch algorithm. Reinforcement Learning: Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.	
VI	Artificial Neural Network	Introduction, neural network representation, Problems for neural network learning, perceptron, multilayer network & Back propagation Algorithm. Deep learning: Definition, relationship between AI, ML, and Deep Learning, Trends in Deep Learning.	8

Text Books:

1. Artificial Intelligence and Machine Learning By Vinod Chandra S.S., Anand Hareendran S

2. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education

3. Tom M. Mitchell. "Machine Learning" McGraw-Hill, 1997.
4. Ethem Alpaydin "Introduction to machine learning" 2nd ed. The MIT Press, 2010

References:

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight "Artificial Intelligence "Third Edition
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

5. "Machine learning with R" by Brett Lantz

List of Experiments : based on Laboratory Practical's/ Case studies

1. Logic programming with **Prolog**

2. Machine Learning with **R**

3. Training and testing using Artificial Neural Network

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO2023	**Ethical Hacking and Digital Forensic**	**04**

Course Objectives:

1 Lerner should learn various aspects of network security
2 Lerner should learn different technologies for website security
3 Lerner should learn various aspects of mobile security
4 Lerner should learn various forensic methods for identification of fraud.

Course Outcomes:

1) Explain Knowledge about various aspects of network security.
2) Design and Develop of secure website.
3) Identify various security aspects with respect to mobile technology.
4) Explain solutions for various case studies with the help of forensic techniques.

Prerequisite: Computer Network fundamentals for communication, Static and Dynamic website development, Basics of mobile communications

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	**Introduction:** Ethical Hacking terminology, Five stages of hacking, Vulnerability Research, Legal implication of hacking, Impact of hacking.	**3**
I	Overview of Computer Forensics Technology	Introduction to Computer Forensics, Use of Forensics in Law Enforcement, Employment Proceedings, Computer Forensics services. Types of Computer, Forensics Technology- Military, law, Spyware and Adware, Biometrics security systems.	**5**
II	Foot Printing & Social Engineering	Information gathering Methodologies, Competitive Intelligence, DNS Enumerations, Social Engineering attacks. **Types of Computer Forensics systems:** Internet security, IDS, Firewall, Public key, Net privacy systems, Vendor and computer Forensics services.	**6**
III	Incident and Incident Response and Storage	Introduction to Incident, Incident Response Methodology, Steps, Activities in Initial Response Phase after detection of an incident. **Initial Response and Forensic Duplication:** Initial Response & Volatile Data Collection from Windows system, Initial Response & Volatile Data Collection from Unix system, **Forensic Duplication:** Forensic duplication as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic Duplicate/Qualified Forensic Duplicate of a Hard Drive. **Storage and Evidence Handling:** File Systems: FAT, NTFS, Forensic Analysis of File systems, Storage Fundamentals: Storage Layer, Hard Drives. Evidence Handling: Types of Evidence, Challenges in evidence handling, Overview of evidence handling procedure. **Digital Forensics:** Introduction – Evidential potential of digital devices: closed vs. open systems, evaluating digital evidence potential, Device handling: seizure issues, device identification, networked devices and contamination.	**10**

IV	Network Forensics	Collecting Network Based Evidence, Investigating Routers, Network protocols, Email Tracing, Internet Fraud.	**8**
V	Mobile Phone Forensics	Crime and mobile phones, evidences, forensic procedures, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems. Android Forensics: Procedures for handling an android device, imaging android USB mass storage devices, logical and physical techniques.	**8**
VI	Hacking	**Scanning & Enumeration:** Port Scanning, Network Scanning, Vulnerability Scanning, NMAP Scanning tool, OS Fingerprinting, Enumeration. **System Hacking:** Password cracking techniques, Key loggers, Escalating privileges, Hiding Files, Steganography Technologies, Countermeasures. **Sniffers & SQL Injection:** Active and passive sniffing, ARP Poisoning, Session Hijacking, DNS Spoofing, Conduct SQL Injection attack, Countermeasures. **Systems Investigation and Ethical Issues:** Data Analysis Techniques, Investigating Live systems (Windows & Unix), Investigating Hacker Tools, Ethical Issues, Cybercrime. Reconnaissance, Scanning Host discovery, Network devices discovery, service discovery, Backdoors and Trojan horses, Buffer Overflows, Covering Tracks: Networks and systems, Denial of service Attacks, Exploiting system using Netcat, IP address Spoofing, Network Sniffing, Password Attacks, rootkits, Session Hijacking and Defenses.	**8**

Text Books:

1. Kevin Mandia, chirs Proise, “Incident Response and Computer Forensic”

2. Gregory Kipper, “” Wireless Crime and Forensic Investigation”, Auerbach publication, 2007

3.Peter Stepheson,”Investigating Computer Crime: A handbook for corporate investigation”, Sept 1999

References:

1.Skoudis E. Perlman R. counter hack: A step by step Guide to Computer Attacks and effective Defense, Prentice Hall Professional technical Reference, 2001.

2. John R Vacca “Computer Forensic ” Second Edition

3.Hacker Techniques, Exploits and incident Handling http://www.sans.org

List of Experiments : based on Laboratory Practical’s/ Case studies

1. Develop secure web site.

2. Sniffers and SQL Injection.

3. Digital Forensics.

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO2024	**Internet of Things**	**04**

Course Objectives: The course objectives are to:

- Provide an overview of concepts, main trends and challenges of Internet of Things.
- Develop the ability to use Internet of Things related software and hardware technologies.
- Provide the knowledge of data management business processes and analytics of IoT.
- Develop skills to relate the IoT technologies for practical IoT applications such as smart objects.

Course Outcomes: Learner will able to:

- Explain and interpret the Internet of Things concepts and challenges.
- Experiment with the software and hardware IoT Technologies.
- Identify data management and business processes and analytics of IoT
- Design and develop small IoT applications to create smart objects

Perquisite: Web Programming, Microcontroller

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**
	Perquisite	Web Programming Concepts, Tools, Framework.	3
I	Introduction to Internet of Things	Definition of Internet of Things (IoT), IoT Paradigm, IoT Architecture – State of the Art, IoT Protocols, IoT Communication Models, IoT in Global Context, Real world scenarios, Different Areas, Examples Trends in the Adaption of the IoT (Cloud Computing, Big Data Analytics, Concepts of Web of Things, Concept of Cloud of Things with emphasis on Mobile Cloud Computing, Smart Objects).	5
II	Open – Source Prototyping Platforms for IoT	Basic Arduino Programming Extended Arduino Libraries, Arduino – Based Internet Communication, Raspberry PI, Sensors and Actuators and Interfacing.	8
III	IoT Protocol & Technology	RFID + NFC, Wireless Networks + WSN, RTLS + GPS, Agents + Multi – Agent Systems, Composition Models for the Web of Things and resources on the Web, Discovery, Search, IoT Mashups and Others. IoT Protocols - M2M, BacNet, ModBus, Bluetooth, Wifi, ZigBee.	8
IV	Wireless Sensor Networks	History and Context, The Node, Connecting Nodes, Networking Nodes, Secured Communication for IoT. Networking and the Internet - IP Addressing, Protocols - MQTT, CoAP, REST Transferring data.	6
V	Data Analytics for IoT	Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis,	10

		Structural Health Monitoring Case Study, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study - Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.	
VI	Application and Use Cases	Concrete Applications and Use – Cases of Web Enabled Things: Energy Management and Smart Homes, Ambient Assisted Living, Intelligent Transport, Etc. Cloud of Things and Big Data. Business Cases and Issues - Agriculture, Music Therapy, Smart Home, Smart Grid Network, Wearable, Healthcare.	8

Text Books:

1 The Internet of Things (MIT Press) by Samuel Greengard.

2 The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).

3 Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti.

Reference Books:

1 The Internet of Things Key applications and Protocols, 2nd Edition, (Wiley Publication) by Olivier Hersent, David Boswarthick and Omar Elloumi.

2 IoT –From Research and Innovation to Market development (River Publication) by Ovidiu Vermesan and Peter Friess.

3 Building Internet of Things with Arduino by Charalampos Doukas.

List of Experiments :

1) Implement A Heterogeneous, Hierarchical Wireless Sensor Network using Cooja/ MSPSim Simulator also add routing protocol, broadcasting message in WSN.
2) Create a smart city and IoT WSN using CupCARBON U-ONE 2.8.5 simulator and senscript.
3) Building machine to machine (M2M) applications such as remote monitoring/Vehicle Tracking, fleet management or smart grid using M2MLabs open source application framework.

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Subject Code	Subject Name	Credits
MEITDLO2025	**Advanced Software Quality Assurance**	**04**

Course Objectives: Objectives of this course include:

1. Examining various methods and approaches used to improve the quality of a product or service.
2. Exploring the principles and techniques used to evaluate both functional and non-functional requirements
3. Distinguish between the various activities of quality assurance, quality planning and quality control.
4. Understand the importance of standards in the quality management process and their impact on the final product.

Course Outcomes: On successful completion of the course students will be able to

1. Explain the established concepts, the fundamental test process, test management principles, test strategies/approaches, risks and principles to support test objectives.
2. Analyze and prioritize both functional and non-functional specifications, such as performance efficiency and usability, design tests using established techniques for functional tests at all test levels for systems of small to medium complexity
3. Interpret and execute tests according to agreed test specifications and analyze and report on the results of tests independently
4. Implement testing tools for various testing activities

Prerequisite: Software engineering.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Software engineering (or) Experience in software development. Any one programming language and IDE. Knowledge of testing tools is advantageous.	**3**
I	Fundamentals of software Testing Process: defects, hypotheses, and tests	Basic Definitions, Software Testing Principles , The Role of Process in Software Quality, Testing as a Process , Overview of the Testing Maturity Model , The Tester's Role in a Software Development Organization Origins of Defects, Defect Classes, the Defect Repository, and Test Design. Requirements and Specification Defects. Design Defects. Coding Defects. Testing Defects, Developer/Tester Support for Developing a Defect Repository.	**4**

II	Strategies and methods for test case design	Test Case Design Strategies - Using the Black Box Approach to Test Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis , Cause-and-Effect Graphing, State Transition Testing, Error Guessing, Black Box Testing and Commercial Off-the-Shelf Components (COTS). Using the White Box Approach to Test Design, Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic, Paths: Their Role in White Box–Based Test Design, Data Flow and White Box Test Design, Loop Testing, Mutation Testing.	**11**
III	Levels of testing	Levels of Testing and Software Development Paradigms , Unit Test: Functions, Procedures, Classes, and Methods as Units , Unit Test Planning , Designing the Unit Tests , The Class as a Testable Unit, The Test Harness. Integration Test: Integration Strategies for Procedures and Functions, Integration Strategies for Classes, Designing Integration Tests, Integration Test Planning ,System Test: The Different Types, Functional Testing, Performance Testing , Stress Testing, Configuration Testing, Security Testing, Recovery Testing , Regression Testing , Alpha, Beta, and Acceptance Tests .Role of Use Cases.	**10**
IV	Reviews as a testing activity	Types of Reviews – Inspections, Walkthroughs, Developing a Review Program, The Need for Review Policies, Components of Review Plans, Review Goals, Preconditions and Items to be Reviewed, Review Procedures, Review Checklists. Reporting Review Results, Review, Rework, and Follow-Up , Review Metrics , The Self-Check or Personal Review, software Quality Evaluation	**4**
V	Evaluating software quality	Quality Costs, Quality Control, Statistical Testing, Software Reliability, Measurements for Software Reliability, Applying Reliability Models, Confidence Levels and Quality Control, Usability Testing and Quality Control , Assessment Usability Testing, Validation Usability Testing. Resource Requirements - Usability Tests and Measurements DEFECT ANALYSIS AND PREVENTION -Processes and Defects, Techniques for Defect Analysis Defect Causal Analysis, Making Process Changes, Monitoring Actions and Process Changes, Benefits of a Defect Prevention Program, Defect Prevention and the Three Critical Views	**8**
VI	Test driven development	Overview of testing on agile project**.** What is TDD? TDD and traditional testing, Incremental design, continuous integration, Self-documenting code. TDD and documentation, Scaling TDD via Agile Model-Driven Development (AMDD). Overview of agile TDD tools. Introduction to digital testing	**8**

Text Books:

1. Ilene Burnstein, “Practical software testing”, Springer Professional computing

2. Kshirasagar Naik and Priyadarshi Tripathy (Eds), "Software Testing and Quality Assurance: Theory and Practice", John Wiley, 2008

3. Kent Beck “Test Driven Development”, Addison Wesley.

References:

7. Marnie L. Hutcheson, “Software Testing Fundamentals- Methods and Metrics”, Wiley

8. Boriz Beizer, "Software Testing Techniques", 2nd Edition, DreamTech, 2009.

9. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008
10. Mauro Pezze and Michal Young, "Software Testing and Analysis. Process, Principles, and Techniques", John Wiley, 2008
11. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Edition, Pearson, 2003

List of Experiments: Use the following tools in laboratories.

CVS: For the software configuration management repository

Bugzilla: For tracking and reporting bugs and change requests

CheckStyle: To verify the source code conformance to the programming language standard

Eclipse: A development environment with a multitude of plug-ins

Logiscope: Product quality measurement

IBM academic program gives many software tools such as the IBM RequisitePro Traceability tool.

DevOps tools: GitHub, Jenkins and Docker.

Laboratory Practical’s/ Case studies –

1. Develop a small application or program additional features into existing software using CVS tool/GitHub

2. Test the software produced using open-source software tools for unit and integration testing. Use IBM RequisitePro/Excel, Bugzilla to update information on defects/changes and inspection,

3. Product quality assessment- Assess source code conformance to customer standards using CheckStyle and software complexity/quality using Logiscope.

4. TDD – Use of DevOps Tools – Jenkins and Docker to build code, create Docker containers, run tests and stage production.

Assessment:

Internal:	Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.
End Semester Examination:	Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Course Code	Course Name	Credits
ILO2021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	8

06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of	05

	Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2023	Enterpreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi

4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	6

	• Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks

3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2025	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached	**04**

	6.2 Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:**Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group

on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business	06

	Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Course Code	Course Name	Credits
ILO2029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Subject Code	Subject Name	Credits
MEITL101	**Laboratory I (Core Course Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Two Laboratory Practical's to be conducted for each of the core subjects as suggested in the subject syllabus.**	24

Modality and Assessment:

1. Each Laboratory assignment will be done in a group of two students. The Faculty teaching each core subject will be required to propose and evaluate the respective Laboratory assignments. These will be essentially hands-on practical and not theory / research review types of assignments.
2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners.

Subject Code	Subject Name	Credits
MEITL102	**Laboratory II –(DLOC & ILOC Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Three Laboratory Practical's to be conducted for each of the DEC & IEC subjects as suggested in the subject syllabus.**	24

Modality and Assessment:

1. Each mini project assignment will be done by individual student. The Faculty teaching elective subject will be required to propose and evaluate the respective mini projects. These will be essentially hands-on practical and not theory / research review types of projects
2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
MEITL201	**Laboratory III-(Core Course Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Two Laboratory Practical's to be conducted for each of the core subjects as suggested in the subject syllabus.**	24

Modality and Assessment:

1. Each Laboratory assignment will be done in a group of two students. The Faculty teaching each core subject will be required to propose and evaluate the respective Laboratory assignments. These will be essentially hands-on practical and not theory / research review types of assignments.
2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
MEITL202	**Laboratory IV –(DLOC & ILOC Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Three Laboratory Practical's to be conducted for each of the DLOC & ILOC subjects as suggested in the subject syllabus.**	24

Modality and Assessment:

1. Each mini project assignment will be done by individual student. The Faculty teaching elective subject will be required to propose and evaluate the respective mini projects. These will be essentially hands-on practical and not theory / research review types of projects
2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners

Subject Code	Subject Name	Credits
MEITS301	**Seminar**	**03**

Guidelines for Seminar

- Seminar should be based on thrust areas in Information Technology
- Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literatures (at least 10 papers from Refereed Journals) and understand the topic and compile the report in standard format and present in front of Panel of Examiners. (pair of Internal and External examiners appointed by the University of Mumbai)
- **Seminar should be assessed based on following points**
  - Quality of Literature survey and Novelty in the topic
  - Relevance to the specialization
  - Understanding of the topic
  - Quality of Written and Oral Presentation

IMPORTANT NOTE :

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years' experience in Industries.

2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.

3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.
4. Students should publish at least one paper based on the seminar work in reputed International / National Conference/Journal (desirably in Referred Journal should be ISI/Scopus/SCI indexing)

Subject Code	Subject Name	Credits
MEITD301/ MEITD401	**Dissertation (I and II)**	**12 + 15**

Guidelines for Dissertation

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
-
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
- Dissertation I should be accessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

- Dissertation II should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization or current Research / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- Dissertation II should be accessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai
- Students should publish at least one or two paper based on the work in reputed International / National Conference/Journal (desirably in Referred Journal should be ISI/Scopus/SCI indexing) (desirably in Referred Journal)

PG-Master Of Computer Applications(MCA)

Sr. No	Subject Code	Subject Name	Count
1	MCA12,MCAL 12	Advanced Java,Advanced Java Lab	2
2	MCA13,MCAL13	Advanced Database Management System,Advanced Database Management System Lab	2
3	MCA14	Software Project Management	1
4	MCAL11	Data Structure Lab using C and / C++	1
5	MCA L14	Web Technologies	1
6	MCAP11	Mini Project – 1 A	1
7	MCA21	Mathematical Foundation for Computer Science 2	1
8	MCA22,MCAL 21	Artificial Intelligence and Machine Learning,Artificial Intelligence and Machine Learning Lab	2
9	MCA23	Information Security	1
10	MCAE24,MCALE23	Elective - 1,Elective 1 Lab	2
11	MCAL22	Soft Skill Development Lab	1
12	MCAL24	Skill based Lab Course AWT Lab	1
13	MCAL25	Skill based Lab Course User Interface Lab	1
14	MCAL26	Skill based Lab Course Networking with Linux Lab	1
15	MCA P21	Mini Project 1-B	1
16	MCA301 ,MCAL301	Database Management systems, Database Management systems and Software Testing Lab	2
17	MCA302,MCA L302	Java programming,Java Programming and Unified Modeling Language Lab	2
18	MCA303	Information Security	1
19	MCA305	Software Testing and Quality Assurance	1

20	MCAPR 301	Mini Project	1
21	MCA401 ,MCAL401	Data Mining and Business Intelligence,Advanced Web Technology and Data Mining and Business Intelligence Lab	2
22	MCA402,MCAL401	Advanced Web Technology,Advanced Web Technology and Data Mining and Business Intelligence Lab	2
23	MCA403,MCAL402	Computer Graphics,Computer Graphics and Image Processing Lab	2
24	MCAL403	Soft Skill Development Activity Lab	1
25	MCA501,MCA L501	Wireless and Mobile technology,Mobile Application and User experience Design Lab	2
26	MCA502 ,MCA L501	Advanced Distributed Computing,Open Source System For ADC Lab	2
27	MCA503 ,MCA L501	User Experience Design,Mobile Application and User experience Design Lab	2
28	MCAPR 501	Mini Project	1
29	MCA PR601	Internship –Project	1
30	MCA 602	Seminar –Research Paper	1
		Total	42

University of Mumbai

No. UG/ 87 of 2021

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology is invited to this office pamphlet No. 194 w.e.f. from 2002 to the revised Ordinance, Regulations, Scheme and syllabus for the degree of M.C.A.

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in **Master of Computer Application** at its meeting held on 25th June, 2020 and subsequently approved by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 7 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. **4.134** and subsequently approved by the Management Council at its online meeting held on 28th August, 2020 vide item No. **2** and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) and the amended Ordinance 2646 relating to the two years program in Master of Computer Application have been brought into force with effect from the academic year **2020-21**. (The said course might be introduced from the academic year 2021-2022 in the wake of prolonged Covid-19 pandemic situation in the country and subsequent delay in the commencement of the new academic year) accordingly. (The same is available on the University's website www.mu.ac.in).

Amended Ordinance 2646 to the duration of the course for the degree of Master of Application (MCA)

Existing Ordinance	Amended Ordinance
The duration of the course for the degree Master of Computer Application (MCA) will of three years i.e six academic terms	The duration of the course for the degree Master of Computer Application (MCA) will of two years i.e. four academic terms

(Dr. B.N.Gaikwad)
I/c. REGISTRAR

MUMBAI – 400 032
23rd January, 2021
To,

The Principals of the affiliated Colleges and Directors of the recognized Institutions in Faculty of Humanities. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.134/23/07/2020
M.C/2/28/08/2020

****

---2/-

No. UG/ 80 of 2021 MUMBAI-400 032 25th January, 2021

Copy forwarded with Compliments for information to:-

1) The Chairman, Ad-hoc Board of Deans,
2) The Dean Faculty of Science & Technology,
3) The Chairman, Board of Studies in Master of Computer Application,
4) The Director, Board of Examinations and Evaluation,
5) The Director, Board of Students Development,
6) The Co-ordinator, University Computerization Centre,

(Dr. B.N.Gaikwad)
I/c. REGISTRAR

Copy to :-

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publication Section),**
7. **The Deputy Registrar, (Special Cell),**
8. **The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
9. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. **P.A to Hon'ble Vice-Chancellor,**
2. **P.A Pro-Vice-Chancellor,**
3. **P.A to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A to Finance & Account Officers, (F.& A.O),**
6. **P.A to Director, Board of Examinations and Evaluation,**
7. **P.A to Director, Innovation, Incubation and Linkages,**
8. **P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Walfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-Campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA**

for information.

AC 23/7/2020
Item No. 4.134

UNIVERSITY OF MUMBAI

Master of Computer Applications

MCA

First Year with Effect from AY 2020-21

Second Year with Effect from AY 2021-22

(New Scheme - 2020) from Academic Year 2020 – 21

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the Academic Year 2020–2021)

AC 23/07/2020
Item No. 4.134

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Master of Computer Applications (MCA)
2	Eligibility for Admission	After Passing minimum three year duration Bachelor's Degree and Studied Mathematics as one of the subjects at (10+2) level or at Graduate level examination
3	Passing Marks	50% marks in aggregate or equivalent (at least 45% in case of candidates of backward class categories and Persons with Disability belonging to Maharashtra State only).
4	Ordinances / Regulations (if any)	
5	No. of Years / Semesters	2 years/4 Semesters
6	Level	P.G.
7	Pattern	Semester
8	Status	New
9	To be implemented from Academic Year	With effect from Academic Year: 2020-2021

Date :

A Majumdar
Dr. Anuradha Majumdar

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Mazumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in Master Program in Computer Applications (MCA: referred as Master of Computer Applications) education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Science Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs), course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. We are happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of Master of Computer Applications (MCA) education.

Semester based Credit and Grading system enables a much required shift in focus from teacher centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE guidelines.

The present curriculum will be implemented for First Year of Master of Computer Applications (MCA) from the academic year 2020-2021. Subsequently this system will be carried forward for Second Year of MCA in the academic year 2021-2022.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Mujumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation of Massive Open Online Courses (MOOC) & Institutional Social Responsibility (ISR) Activities

The new curriculum is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to the learners. In the earlier revision of curriculum, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of the students.

In this new syllabus based on AICTE guidelines overall credits are reduced to provide opportunity of self-learning to the learner. The learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

Massive Open Online Courses (MOOC) are free online courses available for anyone to enroll. MOOC provide an affordable and flexible way to learn new skills and deliver quality educational experiences at scale. The Principals/Directors/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Institutional Social Responsibility (ISR) may be slightly impractical, especially in the modern competitive world, where everyone works for self-interest, but it will succeed if we take decisions based on what will benefit a large number of people and respect everyone's fundamental rights. As individuals we can make our small contributions to society by doing social activities, individual or in association with Institute/Social organizations/NGOs/Clubs etc. To create awareness among students towards institutional & individual social responsibility for societal development ISR activities are incorporated in new MCA syllabus.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Mujumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface By BoS

As AICTE declared Master of Computer Application a two-year program from academic year 2020-2021, it was a challenge to design the curriculum for two years program keeping the employability intact. It is a privilege to present the new syllabus of Master of Computer Applications (MCA) which will be in effect from academic year 2020-2021.

The basic objective of the syllabus is to equip the students with the strong foundation, necessary skills and latest tools and technology required for making the impression globally. The syllabus is designed keeping in view the requirements of the IT Industry so the inclusion of outcome based approach and project based learning. Since the M.C.A. program is inclined more towards Application Development and thus has more emphasis on latest technology and tools to develop better and faster applications using integrated approach.

The earlier revised curriculum was more focused on providing information and knowledge across various domains, which led to heavily loading of students in terms of direct contact hours. In this regard, MCA Ad-hoc Board of Studies under the faculty of science and technology resolved to minimize the burden of contact hours, resulting total credits of entire program to 88, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning on higher cognitive levels. Therefore in the present curriculum self-learning topics, skill based laboratories and mini projects are incorporated every semester, Semester IV offers MOOC course to enable self-learning. Bridge course is designed additionally as a prerequisite for graduates coming from non IT/CS background. Inclusion of Institute Social Responsibility is another flavor of the curriculum, aimed to inculcate social awareness, values and environmentally responsible behavior among the learners. Curriculum offers the courses from Emerging Areas like Artificial Intelligence, Machine Learning, Data Science, Quantum Computing, IoT, Block chain. Soft skill lab will enable the learners to get proficiency in soft skills, the flexibility in course allows to deliver the content as per the need of each batch of learners. Flexible continuous assessment helps academicians for academic experiments to improve learning experience. These skills further enable the students to take a full, active and responsible role in the IT enabled industries. The course structures are carefully designed so that students get superiority in dealing with diverse situations when they step into the corporate world.

We would like to extend our thanks to Dean Dr. Anuradha Muzumdar, Associate Dean Dr. Suresh Ukarande, Board of Studies members, Directors /Principals, HODs for valuable inputs to strengthen the scope and contents of the syllabus. We would also like to extend our thanks to all M.C.A. Faculty members, Industry experts and alumni for their contribution in designing an outcome based curriculum for 2 years MCA program.

Ad-hoc Board of Studies, MCA, University of Mumbai

Dr. Pooja Raundale : Chairman
Dr. Kavi Arya : Member
Dr. Murlidhar Dhanawade : Member
Dr. Suhasini Vijaykumar : Member
Dr. Jyoti Kharade : Member

Structure for Student Induction Program

New students enter an institution with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

New students be informed that the Induction is mandatory non-credit course for which a certificate will be issued by the institution. At the start of the induction, the incumbents learn about the institutional policies, processes, practices, culture and values, and their mentor groups are formed. The different activities are:

1. **Orientation**: In the first session of Induction program learners and parents to be oriented about institute policies, processes, practices, culture and values. In addition to this, learners will be educated for 1st year academic program information in terms of academic calendar, Assessment plan, grading information, university ordinances, rules and regulations related to academics.

2. **Mentoring**: Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring process shall be carried out in small groups. For each groups one faculty mentor to be allocated, who will remain the mentor till those students post graduates from the institute. In the second session of Induction program, groups for mentoring to be formed and student mentors and faculty mentors to be introduced to newly inducted students. Introduction of mentoring system to be given to new students. Minimum one meeting to be conducted every month during semesters with students group by faculty mentors. For record keeping appropriate formats to be developed and information to be updated regularly by faculty mentors.

3. **Universal Human Values**: Universal Human Values gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many

thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do‘s and dont‘s, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

4. **Proficiency Modules**: The induction program period can be used to overcome some critical lacunas that students might have, for example, English, Mathematics, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. A diagnostic test should be conducted on Day 2 itself. Before the test, the students should be informed that the test would not affect their grades or any aspect of their admission, placement, study, etc. Purpose of the test is to provide help to those students who need help in English, Mathematics, Computer proficiency etc. Students having more than 80% marks in their qualifying examination in respective subjects need not take the diagnostic test. For those below this cut-off, writing the test is mandatory. Students with weak performance in the test, must attend a non-credit course in Basic English, Basic Mathematics, and Basic Computer Operation etc. Their attending the course is mandatory. There would be no separate fee payable for the course. The classes of Basic courses must start from Day 4 at the latest. Students those who are excluded from basic courses, for them some activity in the domain of creative arts, cultural and literature to be organised.

5. **Physical Activity**: Fitness session, yoga classes, lecture(s) on facing world with sportsman spirit, making young students aware that there is nothing like being failure in the world. The world gives opportunities to all. The incoming students must be divided into batches of 50 students maximum, and a qualified coach in physical education/ faculty member should be attached to each batch. The list of available games, sport, or physical activities should be announced in orientation program on Day 1. They should be asked to fill their choice with three preferences, and the game or sport be allotted to them as per their preference. The physical activity should start from Day 3 onwards, wherein the student learns and plays his assigned game during the induction program. It is also important that along with his assigned game the student also practices yoga.

6. **Creative Arts, Cultural and Literary Activity**: Qualified instructors for arts may be hired on contract basis and be paid honorarium as per norms of the institute. Daily 90 to 120 minute sessions may be arranged. The list of available art forms, such as vocal music, instrumental music, folk music, painting, sketching, dance, group dance, clay modeling, pottery, dramatics, etc. should be announced. They should be asked to fill their choice with three preferences, and the art form be

allotted to them as per their preference. There should be sufficient number of teachers for each art form. The ratio may be kept as 1 teacher for every 25 students. A faculty member interested in literary activity should be assigned for organizing the activity. A list of books which are interesting and educational should be prepared beforehand. Books in Indian languages must be included and even given priority. Students are losing connection with languages in general and their own language, in particular. Students should be assigned a book or other smaller reading material. They should be asked to read and write a critical summary. They should present their summary in front of their group. A literary group may consist of around 30-40 students. Similarly, debating and public speaking activity could also be undertaken. If the college can arrange for a drama workshop where a group of students learn and enact a play it would be very good. Not all the incoming students would do this, but those who wish may be provided the opportunity. Help may be taken from senior students engaged in such extra-curricular activities in the college.

7. **Familiarisation with Institute and Department**: The students admitted visit their department. The Head of the department and other associated faculty should address the new student‘s right on Day 2 or so. Arrangements should be made about the meeting/gathering. The parents of the students should also be welcomed if they accompany their ward. It would be helpful if an alumnus of the Dept. relates his professional experience related to the field of the study to the incoming students.

8. **Lectures /Workshops by Eminent People**: Eminent people from all walks of life may be invited to deliver lectures, namely, from industry, academia, social science (authors, historians), social work, civil society, alumni etc. be identified and invited to come and address the new students. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, S-VYASA university, Vivekanand Kendras, etc. may be organized. Workshops which rejuvenate or bring relief to students

would also be welcome, such as, Art of Living workshops.

9. **Extra-Curricular Activity**: Every college has extra-curricular activities. Most of them are student

driven. They are organized by student councils and clubs. The extra-curricular activities going on in the college should be presented to the new students under the guidance of faculty advisors for such activity. The new students should be informed about how they can join the activities. Related facilities should be described to them. Presentation on the activities by the student council should be made.

10. **Feedback and Report on the Program**: A formal feedback at the end of the program should be

collected from students by their filling a form in writing or online. Besides the above, each group (of 20 students) should write a report on the Induction Program towards the end of the semester. They would also have to make a presentation of their report. They should be encouraged to use slides while making a presentation. Presentation of the report should be made in the language they are comfortable with, without any insistence that it should be in English. It is more important that they feel comfortable and confident. Each group may make the presentation through 4-5 of its group members or more. In each session, their faculty mentors and student guides, if any, should also be in the audience. These sessions would tell you how well the program ran, and what the students are feeling at the end of the program. This would also serve as a grand closure to the program. A certificate shall be awarded to all the students, upon successful completion of the induction program based on their report and presentation.

Tentative schedule of 1st Week Induction Program:

Day 1

Session 1 Orientation program

Session 2 Mentoring (group formation and introduction)

Day 2

Session 3 Diagnostic test (basic English, Mathematics and Computer Operation)

Session 4 Familiarisation of Department and Institute (Visits to department, Laboratory, Library, Examination cell, Office etc.)

Day 3

Session 5 Physical Activity (Yoga, Sports etc.)

Session 6 Universal human values session

Day 4

Session 7 Proficiency Modules (Short courses on basic Mathematics, English and Computer Operation etc. for identified students)

Session 8 Physical Activity (Yoga, Sports etc)

Day 5

Session 9 Proficiency Modules (Short courses on Basic Mathematics, English and Computer Operation etc. for identified students)

Session 10 Creative Arts, Cultural and Literary Activity

Program Structure for
First Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2020-2021)
Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
MCA11	Mathematical Foundation for Computer Science 1	3	--	1	3	--	1	4
MCA12	Advanced Java	3	--	--	3		--	3
MCA13	Advanced Database Management System	3	--	--	3	--	--	3
MCA14	Software Project Management	3	--	1	3	--	1	4
MCAL11	Data Structure Lab using C and / C++	--	4	--	--	2	--	2
MCAL12	Advanced Java LAB	--	2	--	--	1	--	1
MCAL13	Advanced Database Management System LAB	--	2	--	--	1	--	1
MCAL14	Web Technologies	--	4	--	--	2	--	2
MCAP11	Mini Project – 1 A	--	2	--	--	1	--	1
Total		**12**	**14**	**2**	**12**	**07**	**2**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					**Term Work**	**Pract & oral**	**Total**
		Internal Assessment			**End Sem. Exam**	**Exam. Duration (in Hrs)**			
		CA	**Test**	**Avg**					
MCA11	Mathematical Foundation for Computer Science 1	20	20	20	80	3	25	--	125
MCA12	Advanced Java	20	20	20	80	3	--	--	100
MCA13	Advanced Database Management System	20	20	20	80	3	--	--	100
MCA14	Software Project Management	20	20	20	80	3	25	--	125
MCAL11	Data Structure Lab using C and / C++	--	--	--	--	--	50	50	100
MCAL12	Advanced Java LAB	--	--	--	--	--	25	50	75
MCAL13	Advanced Database Management System LAB	--	--	--	--	--	25	50	75
MCAL14	Web Technologies	--	--	--	--	--	50	50	100
MCAP11	Mini Project – 1 A	--	--	--	--	--	50	--	50
Total		**--**	**--**	**80**	**320**	**--**	**250**	**200**	**850**

Program Structure for
First Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester II

Teaching Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA21	Mathematical Foundation for Computer Science 2	3	--	1	3	--	1	4
MCA22	Artificial Intelligence and Machine Learning	3	--	--	3	--	--	3
MCA23	Information Security	3	--	--	3	--	--	3
MCAE24	Elective - 1	3	--	--	3	--	--	3
MCAE25	Elective - 2	3	--	1	3	--	1	4
MCAL21	Artificial Intelligence and Machine Learning Lab	--	2	--	--	1	--	1
MCAL22	Soft Skill Development Lab	--	2	--	--	1	--	1
MCALE23	Elective 1 Lab	--	2	--	--	1	--	1
MCAL24	Skill based Lab Course AWT Lab	--	4	--	--	2	--	2
MCAL25	Skill based Lab Course User Interface Lab	--	2	--	--	1	--	1
MCAL26	Skill based Lab Course Networking with Linux Lab	--	2	--	--	1	--	1
MCAP21	Mini Project 1-B	--	**2**	--	--	1	--	1
Total		**15**	**16**	**2**	**15**	**8**	**2**	**25**

Program Structure for
First Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2020-2021)

Semester II

Examination Scheme

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		CA	Test	Avg.					
MCA21	Mathematical Foundation for Computer Science 2	20	20	20	80	3	25	--	125
MCA22	Artificial Intelligence and Machine Learning	20	20	20	80	3	--	--	100
MCA23	Information Security	20	20	20	80	3	--	--	100
MCAE24	Elective - 1	20	20	20	80	3	--	--	100
MCAE25	Elective – 2	20	20	20	80	3	25	--	125
MCAL21	Artificial Intelligence and Machine Learning Lab	--	--	--	--	--	25	50	75
MCAL22	Soft Skill Development Lab	--	--	--	--	--	50	--	50
MCALE23	Elective 1 Lab	--	--	--	--	--	25	50	75
MCAL24	Skill based Lab Course AWT Lab	--	--	--	--	--	50	50	100
MCAL25	Skill based Lab Course User Interface Lab	--	--	--	--	--	25	50	75
MCAL26	Skill based Lab Course Networking with Linux Lab	--	--	--	--	--	25	50	75
MCAP21	Mini Project 1-B	--	--	--	--	--	50	--	50
Total		--	--	**100**	**400**	--	**300**	**250**	**1050**

Elective 1

Sr. No.	Course Code	Course Name	Lab Course Code
1	MCAE241	Image Processing	MCALE231
2	MCAE242	Internet Of Things	MCALE232
3	MCAE243	Robotic Process Automation	MCALE233
4	MCAE244	Computer Vision	MCALE234
5	MCAE245	Embedded Systems	MCALE235

Elective 2

Sr. No.	Course Code	Course Name
1	MCAE251	Natural Language Processing
2	MCAE252	Geographic Information System
3	MCAE253	Design and Analysis of Algorithm
4	MCAE254	Digital Marketing and Business Analytics
5	MCAE255	Research Methodology

Program Structure for
Second Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2021-2022)

Semester III
Teaching Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	**Pract.**	**Tutorial**	**Theory**	**Pract.**	**Tutorial**	**Total**
MCA31	Big Data Analytics and Visualization	3	--	--	3	--	--	3
MCA32	Distributed System and Cloud Computing	3	--	--	3	--	--	3
MCAE33	Elective - 3	3	--	--	3	--	--	3
MCAE34	Elective - 4	3	--	1	3	--	1	4
MCAL31	Big Data Analytics and Visualization Lab	--	2	--	--	1	--	1
MCAL32	Distributed System and Cloud Computing Lab	--	2	--	--	1	--	1
MCALE33	Elective 3 Lab	--	2	--	--	1	--	1
MCAL34	Skill based Lab Mobile Computing Lab	--	4	--	--	2	--	2
MCAL35	Software Testing Quality Assurance Lab	--	2	--	--	1	--	1
MCAP31	Mini Project: 2 A	--	2	--	--	1	--	1
Total		**12**	**14**	1	**12**	**07**	**1**	**20**

Program Structure for
Second Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2021-2022)

Semester III
Examination Scheme

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		CA	Test	Avg					
MCA31	Big Data Analytics and Visualization	20	20	20	80	3	--	--	100
MCA32	Distributed System and Cloud Computing	20	20	20	80	3	--	--	100
MCAE33	Elective - 3	20	20	20	80	3	--	--	100
MCAE34	Elective - 4	20	20	20	80	3	25	--	125
MCAL31	Big Data Analytics and Visualization Lab	--	--	--	--	--	25	50	75
MCAL32	Distributed System and Cloud Computing Lab	--	--	--	--	--	25	50	75
MCALE33	Elective 3 Lab	--	--	--	--	--	25	50	75
MCAL34	Skill based Lab Mobile Computing Lab	--	--	--	--	--	50	50	100
MCAL35	Software Testing Quality Assurance Lab	--	--	--	--	--	25	50	75
MCAP31	Mini Project: 2 A	--	--	--	--	--	50	-	50
Total		**--**	**--**	**80**	**320**	--	**225**	**250**	**875**

Elective 3

Sr. No.	Course Code	Course Name	Lab Course Code
1	MCAE331	Blockchain	MCALE331
2	MCAE332	Deep Learning	MCALE332
3	MCAE333	Game Development	MCALE333
4	MCAE334	Ethical Hacking	MCALE334
5	MCAE335	Quantum Computing	MCALE335

Elective 4

Sr. No.	Course Code	Course Name
1	MCAE341	Intellectual Property Rights
2	MCAE342	Green Computing
3	MCAE343	Management Information System
4	MCAE344	Cyber Security and Digital Forensics
5	MCAE345	Entrepreneurship Management

Program Structure for
Second Year Master of Computer Applications
UNIVERSITY OF MUMBAI (With Effect from 2021-2022)
Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	**Pract.**	**Theory**	**Pract.**	**Total**
MCAI41	Internship	--	40	--	15	15
MCAR42	Research Paper	1	--	1	--	1
MCAM43	Online Course- (MOOC)	4#	--	4	--	4!
MCAS44	Institute Social Responsibility*	--	--	--	--	2*
Total		**5**	**40**	**5**	**15**	**20+2***

Course Code	Course Name	Examination Scheme			
		Internal Assessment		**University Assessment**	**Total**
		Mid term Presentation I	**Mid term Presentation II**	**Final Presentation**	
MCAI41	Internship	25	25	200	250
MCAR42	Research Paper	25	25	--	50
Total		**50**	**50**	**200**	**300**

Work load only for students

! Credits transferred from MOOC courses

* Credits allotted in semester IV based on the (ISR) work done in semesters I II III

Note: Internal assessment of Tutorials to be done separately and term work marks to be given out of 25 for those courses where tutorial is mentioned.

Program Structure for Bridge Course
(With Effect from 2020-2021)

For the graduates, not having graduation in Computer Science/Information Technology/ Computer Application, need to complete the bridge course in first year of MCA along with the semester I and II of MCA

Course Code	Course Name	Group	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut	Total
MCABR1	Programming with C++	ICT	3	--	--	--	--	--	--
MCABR2	Data Structures	ICT	3	--	--	--	--	--	--
MCABR3	Operating Systems	ICT	3	--	--	--	--	--	--
MCABR4	Computer Networks	ICT	3	--	--	--	--	--	--
MCABR5	Discrete Mathematics	M	3	--	--	--	--	--	--
	Total		15		--	--	--	--	--

Course Code	Course Name	Group	Examination Scheme							
			Theory					Pract		
			Internal Assessment			End Sem.	Exam. Duration	Pract	Oral	Total
			CA	Test	Avg.		In Hrs			
MCABR1	Programming with C++	ICT	20	20	20	80	3	--	--	100
MCABR2	Data Structures	ICT	20	20	20	80	3	--	--	100
MCABR3	Operating Systems	ICT	20	20	20	80	3	--	--	100
MCABR4	Computer Networks	ICT	20	20	20	80	3	--	--	100
MCABR5	Discrete Mathematics	M	20	20	20	80	3	--	--	100
	Total									500

Semester I

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA11	Mathematical Foundation for Computer Science 1	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	25	80	125

Pre-requisite: Student must know

- Measures of central tendency and dispersion
- Set theory
- Basic principles of counting

Course Objectives: Learner/Student will learn and perform

Sr.No.	Course Objective
1	Statistical measures on various types of data
2	Correlation and regression techniques for estimation
3	Probability aspects to take proper decision
4	Application of discrete and continuous probability distributions
5	Various methods of hypothesis testing

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO 1	Apply different statistical measures on various types of data	Applying
CO 2	Evaluate using regression analysis.	Evaluating
CO 3	Analyze different types of Probability and their fundamental applications and random variable.	Analyzing
CO 4	Apply probability distribution to real world problems	Applying
CO 5	Formulate and test the hypothesis for business problem using various methods	Creating

Module	Detailed Contents	Hrs
01	**Module: Skewness** Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness. **Self Learning Topics:** Determining skewness of data related to real system and its graphical representation	04
02	**Module: Regression and correlation** Correlation: Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient. Regression: Linear and Non-linear regression (quadratic and cubic), Estimation using linear regression. **Self Learning Topics:** Apply correlation and regression on real world data and its graphical representation	08
03	**Module: Introduction to probability & conditional probability** Introduction to probability, Random experiment, Sample space, Events, Axiomatic Probability, Algebra of events. Conditional Probability, Multiplication theorem of Probability, Independent events, Bayes' Theorem **Self Learning Topics:** Applications based on Bayes' theorem	08
04	**Module: Random variable** Discrete random variable, Continuous random variable, Two-dimensional random variable, Joint probability distribution, Stochastic independence, Properties of Expectation and Variance, Covariance. **Self Learning Topics:** Study of various random variables and its independence.	08
05	**Module: Theoretical probability distributions** Binomial, Poisson, Normal. **Self Learning Topics:** Study of properties of standard normal variate.	07
06	**Module: Testing of hypothesis** Hypothesis testing, Type I and Type II errors. Tests of significance – single sample, Student's t-test, large sample test (z-test), Chi-Square test - test for independence of attributes. **Self Learning Topics:** Study of elementary sampling methods.	05

Reference Books:

Reference No	Reference Name
1	S C Gupta, Fundamentals of Statistics, Himalaya Publishing house, Seventh edition.
2	S.C.Gupta, V.K.Kapoor , S Chand , Fundamentals of Mathematical Statistics, Sultam and Chand sons publication, First Edition
3	Kishore Trivedi, Probability and Statistics with Reliability, Queuing, And Computer Science Applications, PHI ,First Edition
4	Hwei P. Hsu, Schaum's Outlines Probability, Random Variables & Random Process, Tata McGraw Hill, Third Edition
5	J.Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics, Tata McGraw Hill, Fourth Edition
6	Dr J Ravichandran ,Probability & Statistics for Engineers, Wiley
7	Dr Seema Sharma, Statistics for Business and Economics, Wiley
8	Ken Black, Applied Business Statistics, Wiley, Seventh Edition

Web References:

Reference No	Reference Name
1	IIT Kharagpur – Probability and Statistics by Dr. Somesh Kumar https://nptel.ac.in/courses/111105041/
2	IIT Madras – Introduction to Probability and Statistics by Dr. G. Srinivasan https://nptel.ac.in/courses/111/106/111106112/
3	IIT Kanpur – Descriptive Statitics with R Software by Prof. Shalabh https://nptel.ac.in/courses/111/104/111104120/
4	IIT Roorkee – Business Statistics by Prof. Mukesh Kumar Barua https://nptel.ac.in/courses/110/107/110107114/
5	MIT – Introduction to Probability and statistics by Jeremy Orloff and Jonathan Bloom https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/index.htm
6	An Introduction to Statistical Learning with Applications in R by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani http://faculty.marshall.usc.edu/gareth-james/ISL/data.html

Tutorials:

SrNo	Topic	Hrs
1	Find Bowley's coefficient of skewness	**1**
2	Find Karl Pearson's coefficient of skewness	**1**
3	Calculate Karl Pearson's coefficient of correlation	**1**
4	To fit linear regression and estimate	**1**
5	Examples on addition and multiplication theorem of probability	**1**
6	Examples based on Bayes' theorem	**1**
7	Examples based on independence of discrete random variables.	**1**

8	Examples based on independence of continuous random variables.	**1**
9	Example on Poisson distribution	**1**
10	Example on normal distribution	**1**
11	Example on t-test	**1**
12	Example on Chi-square test	**1**

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA12	Advanced Java	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	--	80	100

Pre-requisite:

1.Basic understanding of any Object Oriented Programming Language

2. Successfully completed Programming Concepts of Core Java course

Course Objectives: Learner/Student will learn and perform

Sr.No.	Course Objective
1	Learn the basic data structure operation using Java Collection Framework and understand Lambda expressions.
2	Build web applications using JSP and JSTL.
3	Understand Spring Framework and build Java EE applications and services.
4	Apply Data Access using Spring Framework
5	Understand how to simplify Spring applications using Spring Boot and spring Boot RESTful WebServices.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.	Creating
CO 2	Create JSP using standard actions, custom tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags.	Creating
CO 3	Understand and develop applications using Spring Framework, Lightweight Container and Dependency Injection with Spring.	Creating
CO 4	Develop applications using Aspect Oriented Programming with Spring.	Creating
CO 5	Apply JDBC Data Access with Spring and demonstrateData access operations with Jdbc Template and Spring.	Creating
CO 6	Create Spring Boot Web Application and Spring Boot RESTful WebServices.	Creating

Module	Detailed Contents	Hrs
01	**Collection and Generic :** Introduction to Generics , Generics Types and Parameterized Types, WildCards , Java Collection Framework, Collections (Basic Operations, Bulk Operations, Iteration) List, Set, Maps **Lambda Expressions** - Lambda Type Inference, Lambda Parameters, Lambda Function Body, Returning a Value,From a Lambda Expression, Lambdas as Objects. **Self learning topics** Collection Queues and Arrays	9
02	**Introduction Java EE Programming** JSP Architecture, JSP building blocks, Scripting Tags,implicit object,Introduction to Bean,standardactions,session tracking types and methods. Custom Tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags. **Self learning topics** Simple Application using Servlet	8
03	**Spring Frameworks:** Introduction to Spring Framework,POJO Programming Model, Lightweight Containers(Spring IOC container, Configuration MetaData, Configuring and using the Container) Dependency Injection with Spring- Setter Injection, Constructor Injection, Circular Dependency, Overriding Bean, Auto Wiring Bean Looksup, Spring Manage Beans) **Self learning topics** Bean Definition Profiles	6
04	**Spring and AOP** AspectOriented Programming with Spring, Types of advices, Defining Point Cut Designator,Annotations. **Self learning topics** AspectJ	5
05	**JDBC Data Access with Spring** Managing JDBC Connection, Configuring Data Source to obtain JDBC Connection, Data Access operations with JdbcTemplate and Spring, RDBMS operation classes , Modelling JDBC Operations as Java Objects **Self learning topics** JDBC Architecture and basic JDBC Program using DML operation	6
06	**Getting Started with Spring Boot** Spring Boot and Database, Spring Boot Web Application Development, Spring Boot RESTful WebServices. **Self learning topics** Understanding Transaction Management in Spring	6

Reference Books:

Reference No	Reference Name
1	Java 6 Programming Black Book, Wiley–Dreamtech ISBN 10: 817722736X ISBN 13: 9788177227369
2	Web Enabled Commercial Application Development using java 2.0, Ivan Byaross ISBN-10: 8176563560 / ISBN-13: 978-8176563567
3	Java Server Programming java EE6, Black book, Dreamtechpress. ISBN-10: 8177229362 / ISBN-13: 978-8177229363
4	Core Servlets and Java Server Pages :Vol I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson , ISBN: 9788131701638, 8131701638
5	Java Enterprise in a Nutshell, 3rd Edition A Practical Guide, Jim Farley, William Crawford,O'Reilly ISBN-13: 978-0596101428 / ISBN-10: 0596101422
6	Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD, ISBN-10: 9788184049411 / ISBN-13: 978-8184049411
7	Spring in Action, Craig Walls, 3rd Edition,Manning, ISBN 9781935182351
8	**Professional Java Development with the Spring Framework** by Rod Johnsonet al.John Wiley & Sons 2005 (672 pages) ISBN:0764574833
9	Beginning Spring , Mert Calıs kan and KenanSevindik Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, IN 46256 www.wiley.com

Web References:

Reference No	Reference Name
1	https://docs.oracle.com
2	Spring.io

Assessment:

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA13	Advanced Database Management System	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	--	80	100

Pre-requisite: Database Management System

Course Objectives Course is aim to

Sr. No.	Course Objective
1	Explain the concept of parallel, distributed & ORDBMS and understand their applications
2	Explain the architecture of Data Warehouse and perform ETL and data preprocessing tasks.
3	Understand Dimensional Modeling and OLAP architecture.
4	Analyze data, identify the problems ,choose relevant data mining models and algorithms for respective applications
5	Understand the optimization Algorithms used for training Models.
6	Understand concepts of web and text mining methods.

Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Demonstrate complex database systems like parallel, distributed & object oriented databases	Understanding
CO 2	Model data warehouse with ETL process and dimensional modeling and data analysis using OLAP operations.	Applying
CO 3	Discover association among items using Association rule mining.	Analyzing
CO 4	Evaluate different data mining techniques like classification, prediction, clustering, web and text mining to solve real world problems.	Evaluating

Module	Detailed Contents	Hrs
01	**Module: Parallel Database Distributed Database and ORDBMS:** Architecture for Parallel Databases, Types of Distributed Databases, Distributed DBMS Architecture, Storing Data in a Distributed DBMS. ORDBMS: Structured Data Types, Operations on Structured Data, Objects, OIDs and Reference Types, Object oriented versus Object relational database. **Self Learning Topics:** Mapping OODBMS to ORDBMS	05
02	**Module: Data warehousing and OLAP:** Data warehouse: Introduction to DW, DW architecture, ETL Process, Top-down and bottom-up approaches, characteristics and benefits of data mart. Dimensional Modeling: Star, snowflake and fact constellation schema. OLAP in the data warehouse: Major features and functions, OLAP models-ROLAP and MOLAP, Difference between OLAP and OLTP **Self Learning Topics:** Study any one DW implementation	06
03	**Module: Data Mining and Preprocessing:** Introduction to data mining, Knowledge discovery- KDD process. Data Preprocessing: Types of attributes, Data Cleaning - Missing values, Noisy data, data integration and transformations. Data Reduction - Data cube aggregation, dimensionality reduction, data compression, Numerosity reduction, discretization and concept hierarchy. **Self Learning Topics:** Application of data mining in Business Intelligence	05
04	**Module: Data Mining Algorithm- Association rules:** Association rule mining: support and confidence and frequent item sets, market basket analysis, Apriori algorithm,, Associative classification- Rule Mining. **Self Learning Topics:** Association Rule Mining applications	06
05	**Module: Data Mining Algorithm-Classification:** Classification methods: Statistical-based algorithms- Regression, Naïve Bayesian classification, Distance-based algorithm- K Nearest Neighbor, Decision Tree-based algorithms -ID3, C4.5,CART. **Self Learning Topics:** Comparative study of classification algorithms	08
06	**Module: Data Mining Algorithm-Clustering:** Clustering Methods: Partitioning methods- K-Means, Hierarchical-Agglomerative and divisive methods **Self Learning Topics:** Clustering algorithm applications	06
07	**Module: Web Mining and Text Mining:** Web Mining: web content, web structure, web usage. Text Mining: Text data analysis and Information retrieval, text retrieval methods. **Self Learning Topics:** Web Mining Applications	04

Reference Books:

Reference No	Reference Name
1	Ponniah, Paulraj, Data warehousing fundamentals: a comprehensive guide for IT professionals, John Wiley & Sons, 2004.
2	Dunham, Margaret H, Data mining: Introductory and advanced topics, Pearson Education India, 2006.
3	Gupta, Gopal K, Introduction to data mining with case studies, PHI Learning Pvt. Ltd., 2014.
4	Han, Jiawei, Jian Pei, and Micheline Kamber, Data mining: concepts and techniques, Second Edition, Elsevier, Morgan Kaufmann, 2011.
5	Ramakrishnan, Raghu, Johannes Gehrke, and Johannes Gehrke, Database management systems, Vol. 3, McGraw-Hill, 2003.
6	Elmasri, Ramez, and Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, 2008, (2015).
7	Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan,Database system concepts, Vol. 5,McGraw-Hill, 1997.

Web References:

Reference No	Reference Name
1	https://www.guru99.com/data-mining-vs-datawarehouse.html
2	https://www.tutorialspoint.com/dwh/dwh_overview
3	https://www.geeksforgeeks.org/
4	https://blog.eduonix.com/internet-of-things/web-mining-text-mining-depth-mining-guide/

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA14	Software Project Management	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	25	80	125

Pre-requisite: Knowledge of Basic Programming Courses

Course Objectives: course aim to

Sr.No.	Course Objective
01	Understand the concepts of Software Engineering and Project Management.
02	Familiarize Project Management framework and Tools.
03	Apply knowledge of Project Life Cycle to implement the projects.
04	Apply the requirement specification and designing tools along with UML.
05	Understand the techniques of project scheduling & project implementation.
06	Learn software cost estimation and software quality assurance techniques.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Software Project Management.	Remembering
CO2	Demonstrate understanding of the requirements Analysis and Application of UML Models.	Understanding
CO3	Make use of estimation logic for estimation of software size as well as cost of software.	Applying
CO4	Examine the need of change management during software development as well as application of quality tools.	Analyzing
CO5	Assess various factors influencing project management, quality assurance and risk assessment.	Evaluating
CO6	Develop process for successful quality project delivery.	Creating

Module	Detailed Contents	Hrs.
01	**Module: An Overview of Software Project Management:** Introduction to Project, Project Management, Difference between Software Engineering & Software Project Management. An Overview of IT Project Management: Define project, project management framework, The role of project Manager, Systems View of Project Management, Stakeholder management,Leadership in Projects: Modern Approaches to Leadership & Leadership Styles.	04

	Self Learning Topics: Evolving role of software.	
02	**Module: Software Process Models:** Project phases and the project life cycle, Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model, Incremental Process model: Iterative approach, RAD model, Agile Development Model: Extreme programming, Scrum. **Self Learning Topics:** JAD &DevOps Model, Comparison among models.	**05**
03	**Module: Software Requirement Analysis and Design:** Types of Requirement, Feasibility Study, Requirement Elicitation Techniques: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), Requirement Analysis and Design: Data Flow Diagram (DFD), Data Dictionary, Software Requirement Specification (SRS). **Object Oriented Analysis and Design:** UML Overview, The Nature and purpose of Models, UML diagrams(Use Case diagram, Activity Diagram, Class & Object Diagram, Sequence Diagram, State Transition Diagram, Deployment Diagram). **Self Learning Topics:** Comparison of Requirements Elicitation Techniques.	**09**
04	**Module: Software Project Planning & Software Cost Estimation:** Business Case, Project selection and Approval, Project charter, Project Scope management, Creating the Work Breakdown Structures (WBS). Software Estimation: Size Estimation: Function Point (Numericals). Cost Estimation: COCOMO (Numericals), COCOMO-II (Numericals)till Early design model. **Self Learning Topics:**COCOMO II Post- Architecture model.	**07**
05	**Module: Project Scheduling and Procurement Management**:Relationship between people and Effort: Staffing Level Estimation, Effect of schedule Change on Cost, Project Schedule, Schedule Control, Critical Path Method (CPM) (Numericals), Basics of Procurement Management, Change Management. **Self Learning Topics:** Degree of Rigor.	**06**
06	**Module: Software Quality Assurance:** **Software and System Quality Management:** Overview of ISO 9001, SEI Capability Maturity Model, McCalls Quality Model, Six Sigma, Formal Technical Reviews, Tools and Techniques for Quality Control, Pareto Analysis, Statistical Sampling, Quality Control Charts and the seven Run Rule. **Software Risk Management:** Identify IT Project Risk, Risk Analysis and Assessment, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation. **Self Learning Topics:** Software ReliabilityMetrics, Reliability Growth Modeling.	**08**

07	**Module: The Project Implementation Plan and Closure:** The Project Implementation Plan and Closure : Project Implementation Administrative Closure. **Self Learning Topics:** Ethics in Projects, Multicultural Projects.	**01**

Reference Books:

Reference No.	Reference Name
1	Software Engineering, 5th and 7th edition, by Roger S Pressman, McGraw Hill publication.
2	Managing Information Technology Project, 6edition, by Kathy Schwalbe, Cengage Learning publication.
3	Information Technology Project Management by Jack T Marchewka Wiley India publication.
4	Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
5	The Unified Modelling Language Reference manual, Second Edition, James Rambaugh,Iver Jacobson, Grady Booch, Addition- Wesley.
6	Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI(2005).

Web References:

Reference No.	Reference Name
1	https://www.projectmanager.com
2	https://www.tutorialspoint.com
3	https://technologyadvice.com
4	https://www.javatpoint.com
5	https://www.geeksforgeeks.org

SPM : Tutorials

Sr. No.	Detailed Contents	Hrs.
01	Business Case for Project (Case study).	01
02	Software Requirement Specification (SRS Case Study).	01
03	Project Scheduling tools (any open source tools like Microsoft Projects): Creating a Project Plan or WBS, Establishing the Project Start or Finish Date, Entering Tasks.	01
04	Gantt chart, Critical Path Analysis.	01
05	Software Cost Estimation using COCOMO-I / COCOMO-II for Project.	01
06	UML Diagrams: Use Case Diagram.	01
07	UML Diagrams: Activity Diagram.	01
08	UML Diagrams: Class Diagram.	01

09	UML Diagrams: Sequence Diagram	01
10	UML Diagrams: State Chart Diagram.	01
11	UML Diagrams:Component Diagram.	01
12	UML Diagrams:Deployment Diagram.	01

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL11	Data Structures Lab using C/C++	04	02	50	30	20	100

Pre-requisite: Basic understanding of fundamentals of any programming language

Lab Course Objectives:

Sr. No.	Course Objective
1	Understand concepts of searching and sorting algorithms.
2	Impart a thorough understanding of linear and non-linear data structures
3	Choose the appropriate data structure for solving real world problems
4	Learn hashing techniques and collision resolution

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Implement searching and sorting algorithms	Applying
CO 2	Implement linear and non-linear data structures	Applying
CO 3	Choose the appropriate data structures to solve complex real life problems	Creating
CO 4	Analyze hashing techniques for data storage and retrieval	Analyzing

Description:

Module No	Detailed Contents	Hrs
01	**Module: Sorting Techniques:** Bubble Sort, Insertion Sort, Selection Sort, Shell Sort, Radix Sort **Self Learning Topics:** Quick sort	04
02	**Module: Searching and Hashing Techniques:** Linear search, Binary search, Methods for Hashing: Modulo Division, Digit Extraction, Fold shift, Fold Boundary, Linear Probe for Collision Resolution. **Self Learning Topics :** Direct and Subtraction hashing	08
03	**Module: Stacks:** Array implementation, Linked List implementation, Evaluation of postfix expression and balancing of parenthesis **Self Learning Topics:** Conversion of infix notation to postfix notation	06
04	**Module: Queue:**	08

	Linked List implementation of ordinary queue, Array implementation of circular queue, Linked List implementation of priority queue, Double ended queue **Self Learning Topics :** Other queue applications	
05	**Module: Linked List:** Singly Linked Lists, Circular Linked List, Doubly Linked Lists : Insert, Display, Delete, Search, Count, Reverse(SLL), Polynomial Addition **Self Learning Topics :** Comparative study of arrays and linked list	**10**
06	**Module: Trees:** Binary search tree : Create, Recursive traversal: preorder, postorder, inorder, Search Largest Node, Smallest Node, Count number of nodes, Heap: MinHeap, MaxHeap: reheapUp, reheapDown, Delete **Self Learning Topics:** Expression Tree, Heapsort	**08**
07	**Module: Graphs:** Represent a graph using the Adjacency Matrix, BFS, Find the minimum spanning tree (using any method Kruskal's Algorithm or Prim's Algorithm) **Self Learning Topics :** Shortest Path Algorithm	**08**

Reference Books:

Reference No	Reference Name
1	Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia, Second Edition, ISBN No. 978-81-203-1177-0
2	Richard F Gilberg Behrouz A Forouzan , Data Structure A Pseudocode Approach with C, Cengage India, Second Edition, ISBN No. 978-81-315-0314-0
3	S. Lipchitz, Data Structures, Mc-Graw Hill Education, ISBN No. 978-12-590-2996-7
4	Ellis Horowitz, S. Sahni, D. Mehta, Fundamentals of Data Structures in C++, Galgothia Publication, ISBN No. 978-81-751-5278-6
5	Michael Berman, Data structures via C++, Oxford University Press, First Edition, ISBN No. 978-01-980-8952-0

Web References:

Reference No	Reference Name
1	https://www.digimat.in/nptel/courses/video/106106133/L25.html
2	https://www.youtube.com/watch?v=zWg7U0OEAoE
3	https://www.digimat.in/nptel/courses/video/106106145/L01.html
4	https://www.cs.auckland.ac.nz/software/AlgAnim/ds_ToC.html
5	https://nptel.ac.in/courses/106/101/106101208/

Suggested list of experiments

Practical No	Problem Statement
1	Implementation of different sorting techniques.
2	Implementation of searching algorithms.
3	Implementation of stacks(Using arrays and Linked List)
4	Implementation of Stack Applications like: a. Postfix evaluation

	b. Balancing of Parenthesis
5	Implement all different types of queues.
6	Demonstrate application of queue (eg. Priority Queue, Breath First Search)
7	Implementation of all types of linked lists.
8	Demonstrate application of linked list (eg. Polynomial addition, Sparse matrix)
9	Create and perform various operations on BST.
10	Implementing Heap with different operations performed.
11	Create a Graph storage structure (eg. Adjacency matrix)
12	Perform various hashing techniques with Linear Probe as collision resolution scheme.
13	Create a minimum spanning tree using any method Kruskal's Algorithm or Prim's Algorithm
14	Implementation of Graph traversal. (DFS and BFS)
15	Group project (3 to 4 members) to be given to work on one application to a real world problem like: a) Bus routes of school buses for XYZ school b) Voucher system for a canteen c) Game like Sudoku solver d) Car pooling application etc.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments and group project (refer Practical No. 15 in suggested list of experiments).
   Experiments 25 marks
   Group Project 15 marks
   Attendance 10 marks
2. Practical will be evaluated by the subject teacher and documented according to a rubrics.

End Semester Practical Examination: Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL12	Advanced Java Lab	02	01	25	30	20	75

Pre-requisite: 1. Basic understanding of Core Java Programming.
2. Basics of web technology.

Lab Course Objectives: Students will be able to

Sr.No.	Course Objective
1	Write programs based on Java Generics, Collection framework and Lambda expressions.
2	Develop web applications using JSP and JSTL.
3	Demonstrate Data Access with Spring.
4	Build an application using Spring Framework.
5	Develop Spring applications using Spring Boot and spring Boot RESTful Web Services.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.	Applying
CO 2	Build JSP web application using standard actions, custom tags and JSTL Tags.	Creating
CO 3	Develop application using Spring Framework, Lightweight Containers and Dependency Injection with Spring.	Applying
CO 4	Develop applications using Aspect Oriented Programming with Spring.	Applying
CO 5	Build JDBC application with Spring using JdbcTemplate.	Creating
CO 6	Develop Spring Boot Web Application and Spring Boot RESTful web services.	Creating

Description:

Module	Detailed Contents	Hrs
01	**Module: Java Collections and Generics**: Programs based on Generic classes and Java Collection Framework List, Set and Map, Wildcards and Lambda expressions.	4

	Self Learning Topics: Collection Queues and Arrays	
02	**Module: Introduction Java EE Programming:** Programs based on JSP elements, Standard Actions, JSP Directives, Implicit objects, Error handling in JSP, Session tracking – Cookies and Session, Custom tags, JSTL tags. **Self Learning Topics:** Simple Application using Servlet	**4**
03	**Module: Spring Framework**: Programs based on using Spring Framework, dependency injection. **Self Learning Topics:** Bean Definition Profiles	**4**
04	**Module: Aspect Oriented Programming**: Programs based on Spring AOP – Before, After, Around, After Returning and After Throwing advice, PointCuts. **Self Learning Topics:** AspectJ	**4**
05	**Module: JDBC Data Access with Spring using Oracle/ MySQL database**: Programs based of Spring JDBC, JdbcTemplate, PreparedStatementCallback, ResultSetExtractor and RowMapper interface. **Self Learning Topics:** Basic JDBC Program using DML operation	**6**
06	**Module: Getting Started with Spring Boot:** Programs based on Spring Boot, RESTful Web Services with Spring Boot. **Self Learning Topics:** Understanding Transaction Management in Spring	**4**

Reference Books:

Reference No.	Reference Name
1	Java 6 Programming Black Book, Wiley–Dreamtech
2	Web Enabled Commercial Application Development using java 2.0, Ivan Byaross
3	Java Server Programming java EE6, Black book, Dreamtech Press.
4	Core Servlets and Java Server Pages: Vol. I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson
5	Java Enterprise in a Nutshell, 3rd Edition A Practical Guide, Jim Farley, William Crawford, O'Reilly
6	Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD
7	Spring in Action, Craig Walls, 3rd Edition, Manning
8	Professional Java Development with the Spring Framework, Rod Johnson et al., John Wiley & Sons
9	Beginning Spring, Mert Caliskan and Kenan Sevindik, John Wiley & Sons
10	Spring Recipes A Problem Solution Approach, Gary Mak, Josh Long and Daniel Rubio, Apress

Web References:

Reference No	Reference Name
1	https://docs.oracle.com
2	https://spring.io/

Suggested list of experiments

Practical No	Problem Statement
1.	**Assignments on Java Generics** 1. Write a Java Program to demonstrate a Generic Class. 2. Write a Java Program to demonstrate Generic Methods.

	3. Write a Java Program to demonstrate Wildcards in Java Generics.
2.	**Assignments on List Interface** 1. Write a Java program to create List containing list of items of type String and use for-each loop to print the items of the list. 2. Write a Java program to create List containing list of items and use ListIterator interface to print items present in the list. Also print the list in reverse/ backword direction.
3.	**Assignments on Set Interface** 1. Write a Java program to create a Set containing list of items of type String and print the items in the list using Iterator interface. Also print the list in reverse/ backword direction. 2. Write a Java program using Set interface containing list of items and perform the following operations: a. Add items in the set. b. Insert items of one set in to other set. c. Remove items from the set d. Search the specified item in the set
4.	**Assignments on Map Interface** Write a Java program using Map interface containing list of items having keys and associated values and perform the following operations: a. Add items in the map. b. Remove items from the map c. Search specific key from the map d. Get value of the specified key e. Insert map elements of one map in to other map. f. Print all keys and values of the map.
5.	**Assignments on Lambda Expression** 1. Write a Java program using Lambda Expression to print ”Hello World”. 2. Write a Java program using Lambda Expression with single parameters. 3. Write a Java program using Lambda Expression with multiple parameters to add two numbers. 4. Write a Java program using Lambda Expression to calculate the following: a. Convert Fahrenheit to Celcius b. Convert Kilometers to Miles. 5. Write a Java program using Lambda Expression with or without return keyword. 6. Write a Java program using Lambda Expression to concatenate two strings.
6.	**Assignments based on web application development using JSP** 1. Create a Telephone directory using JSP and store all the information within a database, so that later could be retrieved as per the requirement. Make your own assumptions. 2. Write a JSP page to display the Registration form (Make your own assumptions) 3. Write a JSP program to add, delete and display the records from StudentMaster (RollNo, Name, Semester, Course) table. 4. Design loan calculator using JSP which accepts Period of Time (in years) and Principal Loan Amount. Display the payment amount for each loan and then list the loan balance and interest paid for each payment over the term of the loan for the following time period and interest rate: a. 1 to 7 year at 5.35% b. 8 to 15 year at 5.5% c. 16 to 30 year at 5.75% 5. Write a program using JSP that displays a webpage consisting Application form for change of Study Center which can be filled by any student who wants to change his/ her study center. Make necessary assumptions 6. Write a JSP program to add, delete and display the records from StudentMaster (RollNo, Name, Semester, Course) table. 7. Write a JSP program that demonstrates the use of JSP declaration, scriptlet, directives, expression, header and footer.
7.	**Assignment based Spring Framework** 1. Write a program to print “Hello World” using spring framework. 2. Write a program to demonstrate dependency injection via setter method.

	3. Write a program to demonstrate dependency injection via Constructor.
8.	**Assignment based Aspect Oriented Programming** 1. Write a program to demonstrate Spring AOP – before advice. 2. Write a program to demonstrate Spring AOP – after advice. 3. Write a program to demonstrate Spring AOP – around advice. 4. Write a program to demonstrate Spring AOP – after returning advice. 5. Write a program to demonstrate Spring AOP – after throwing advice. 6. Write a program to demonstrate Spring AOP – pointcuts.
9.	**Assignment based Spring JDBC** 1. Write a program to insert, update and delete records from the given table. 2. Write a program to demonstrate PreparedStatement in Spring JdbcTemplate 3. Write a program in Spring JDBC to demonstrate ResultSetExtractor Interface 4. Write a program to demonstrate RowMapper interface to fetch the records from the database.
10.	**Assignment based Spring Boot and RESTful Web Services** 1. Write a program to create a simple Spring Boot application that prints a message. 2. Write a program to demonstrate RESTful Web Services with spring boot.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 marks

   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on the suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL13	Advanced Database Management System Lab	02	01	25	30	20	75

Pre-requisite: Database Management System, SQL.

Lab Course Objectives

Sr.No.	Course Objective
1	Understanding functioning of advanced databases like distributed and ORDBMS.
2	Understand ETL process performed to create data warehouse.
3	Understand basic OLAP Operations.
4	Understand the data mining process and important issues around data cleaning.
5	Identify the problems, choose relevant data mining algorithms and analyze the results for respective applications.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate distributed and ORDBMS concepts	Applying
CO 2	Perform ETL operations used in the building data warehouse.	Applying
CO 3	Demonstrate and analysis various OLAP operations.	Analyzing
CO 4	Implement and evaluate different data mining techniques like classification, prediction, clustering and association rule mining in R	Evaluatin

Description:

Module No	Detailed Contents	Hrs
1	**Distributed Database** : Implementation of Partitions: Range, List. Self-Learning Topics : Hash Partition, Composite partition	2
2	**OLAP with Oracle** : Analytical Queries Self-Learning Topics: Cume_list, Percent_rank	4
3	**ORDBMS** : Implementation of, • Abstract Data Type • Reference Self-Learning Topics: Nested ADT, Inheritance	2
4	**ETL through Pentaho** : ETL Transformation with Pentaho Self-Learning Topics: Any two more transformation operation in Pentaho beyond the syllabus	4
5	**Basics Of R and Data Acquisition** : Introduction to R, Data Types and Objects, Reading and writing data, Reading data from the console Packages, Loading packages, Attach, and detaching data. Loading Data from different Data Source Self-Learning Topics: Operators, Conditional Statements and Loops, Functions, Loading data from Relational Databases, XML	2
6	**Preprocessing in R** : Data preprocessing techniques in R Self-Learning Topics:Sorting, Date Conversion	2
7	**Data Mining - Classification using R-Programming** : Implementation and Analysis of -Regression, Classification Models Self-Learning Topics: Implement One classification algorithm in weka	6
8	**Data Mining - Clustering and Association using R-Programming** : Implementation of Market Basket Analysis and Clustering. Self-Learning Topics: Implementation clustering, association in Weka	4

Reference Books:

Reference No	Reference Name
1	John M. Quick, "Statistical Analysis with R""", PACKT Publishing, 2015ISBN NO: 9781849512084, 9781849512084
2	G.K. Gupta, "Introduction to data mining with case studies", PHI Learning Publishing, ISBN: 9788120350021, 8120350022

Web References:

Reference No	Reference Name
1	http://cookbook-r.com
2	https://www.r-project.org/about.html
3	"Statistical Analysis with R - a quick start", Oleg Nenadic, Walter Zucchini, September 2004, http://www.statoek.wiso.uni-goettingen.de /mitarbeiter /ogi /pub /r_workshop.pdf
4	https://www.rstudio.com/
5	http://www.r-project.org/doc/bib/R-books.html

Suggested List of Experiments	
Practical No.	**Problem Statement**
1	Implementation of Data partitioning through Rang and List partitioning
2	Implementation of Analytical queries like Roll_UP, CUBE, First, Last , Lead ,Lag,Rank AND Dense Rank
3	Implementation of ORDBMS concepts like ADT(Abstract Data Types), Reference
4	Implementation of ETL transformation with Pentaho like Copy data from Source (Table/Excel/ Oracle) and store it to Target (Table/Excel/ Oracle) , Adding sequence,Adding Calculator Concatenation of two fields, Splitting of two fields, Number Range, String Operations, **Sorting data,** Implement the merge join transformation on tables, Implement data validations on the table data.
5	Introduction to R programming and Data acquisition Install packages , Loading packages Data types, checking type of variable, printing variable and objects (Vector, Matrix, List, Factor, Data frame, Table) cbind-ing and rbind-ing, **Reading and Writing data.** setwd(), getwd(), data(), rm(), Attaching and Detaching data. Reading data from the consol. Loading data from different data sources.(CSV, Excel).
6	Implementation of Data preprocessing techniques like, Naming and Renaming variables, adding a new variable. Dealing with missing data. Dealing with categorical data. Data reduction using subsetting
7	Implementation and analysis of Linear regression through graphical methods.
8	Implementation and analysis of Classification algorithms like Naive Bayesian, K-Nearest Neighbor, ID3 , C4.5
9	Implementation and analysis of Apriori Algorithm using Market Basket Analysis.
10	Implementation and analysis of clustering algorithms like K-Means , Agglomerative

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 marks
   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on the suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL14	Web Technologies	04	02	50	30	20	100

Pre-requisite: Basic understanding of fundamentals of Web Technologies and JavaScript

Lab Course Objectives Course aim to

Sr.No.	Course Objective
1	Create simple websites based on Node.js features
2	Demonstrate database connectivity and operations
3	Make applications making use of Angular.js concepts
4	Construct Angular.js Forms and Single Page Applications

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Build simple websites making use of various Node.js features	Applying
CO 2	Design a dynamic web application enabled with database connectivity	Creating
CO 3	Use the fundamentals of Angular.js Filters, Directives and Controllers to build applications	Applying
CO 4	Develop Forms and Single page applications (SPA)	Creating

Description:

Module No	Detailed Contents	Hrs
1	**Introduction to Node.js** : What is Node.js, Advantages of Node.js, Node.js Process Model, Traditional Web Server Model, Setup Development Environment: Installation of Node.js on Windows, Working in REPL, Node JS Console ***Self-Learning Topics**: W3C Architecture*	2
2	**Node.js Modules, Events & Functions** : Standard Callback Pattern, Event Emitter Pattern, Event Types, Event Emitter API, Creating an Event Emitter, Defer Execution of a Function, Cancel Execution of a Function, Schedule/Cancel repetitive execution of a Function, Block/Escape Event Loop ***Self-Learning Topics**: Additional Events*	6
3	**File Handling& HTTP Web Server** : File Paths, fs Module, Opening a file, Reading from a file, Writing to a file, Closing a file. HTTP request/response object, Headers, Piping, Shutting down the server ***Self-Learning Topics:**TCP server*	12
4	**Databases** : Connect and Communicate with a MySQL Database, Adding data to the database, Reading data	4

	Self-Learning Topics: *Working with any other database*	
5	**Angular JS Basics :** Introduction to AngularJS, MVC Architecture, Conceptual Overview:Setting up the Environment,First Application, Understanding ng attributes, Expressions: Number and String Expressions, Object Binding and Expressions,Working with Arrays ***Self-Learning Topics:*** *Comparison of Angular and React js*	**6**
6	**Filters, Directives** : Built-In Filters, Uppercase and Lowercase Filters, Currency and Number Formatting Filters,OrderBy Filter, Introduction to Directives, Directive Lifecycle, Conditional Directives,Styles Directives, Mouse and Keyboard Events Directives, Using Angular JS built-in directives: app, init, model ***Self-Learning Topics:*** *Creating a custom filter and a custom directive*	**8**
7	**Controllers** : Understanding Controllers, Programming Controllers & $scope object, Adding Behavior to a Scope Object, Passing Parameters to the Methods, Having Array as members in Controller Scope. ***Self-Learning Topics:*** *Nested Controllers*	**6**
8	**Forms and SPA (Single Page Application):** Working with Simple Angular Forms, Working with Select and Options, Input Validations, Using CSS classes, Form Events, Custom Model update triggers, Custom Validation. Introduction to SPA, Creating HTML Template, Configuring Route Provider, Creating Single Page Application ***Self-Learning Topics:*** *Animations*	**8**

Reference Books:

Reference No	Reference Name
1	Powell TA, Powell TA. HTML & CSS: the complete reference. New York: McGraw-Hill; 2010. ISBN No. 9780071496292
2	Haverbeke M. Eloquent Javascript: A modern introduction to programming. No Starch Press; 2018. ISBN No. 9781593279509
3	Teixeira P. Professional Node.js: Building Javascript based scalable software. John Wiley & Sons; 2012. ISBN No. 9781118185469
4	Brown E. Web development with node and express: leveraging the JavaScript stack. O'Reilly Media; 2014. ISBN No. 9781491949306
5	Karpov V, Netto D. Professional AngularJS. John Wiley & Sons; 2015. ISBN No. 9781118832073
6	Dayley B. Learning AngularJS. Pearson Education; 2014. ISBN No. 9780134034546
7	Seshadri S, Green B. AngularJS: Up and Running: Enhanced Productivity with Structured Web Apps. O'Reilly Media; 2014. ISBN No. 9781548785710

Web References:

Reference No	Reference Name
1	https://nptel.ac.in/courses/106106222/
2	https://learn.shayhowe.com/html-css/
3	https://www.w3schools.com/nodejs/
4	https://www.coursera.org/learn/server-side-nodejs
5	https://www.coursera.org/learn/single-page-web-apps-with-angularjs
6	https://docs.angularjs.org/tutorial
7	https://www.freecodecamp.org/news/want-to-learn-angular-heres-our-free-33-part-course-by-dan-wahlin-fc2ff27ab451/

Suggested list of experiments

Practical No	Problem Statement
1	Create an application to demonstrate Node.js Modules
2	Create an application to demonstrate various Node.js Events
3	Create an application to demonstrate Node.js Functions
4	Using File Handling demonstrate all basic file operations (Create, write, read, delete)
5	Create an HTTP Server and perform operations on it
6	Create an application to establish a connection with the MySQL database and perform basic database operations on it
7	Create an application using Filters
8	Create an application to demonstrate directives
9	Demonstrate controllers in Angular.js through an application
10	Demonstrate features of Angular.js forms with a program
11	Create a SPA (Single Page Application)

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 40 marks
   Attendance 10 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP11	Mini Project – 1 A	02	01	50	-	--	50

Pre-requisite: NIL

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquaint with the process of applying basic computer applications and provide solutions to the problems in various application domains.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate the ability to produce a technical document.	Understanding
CO2	Apply software project management skills during project work.	Applying
CO3	Build small groups to work effectively in team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating

Guidelines for Mini Project:

1. Students shall form a group of 2 to 3 students.
2. Students should do survey and identify needs, which shall be converted into problems in consultation with the faculty Supervisor/Guide/HOD/Internal Committee of faculties. The project contact hours shall be allotted in the time table and 2 hours workload shall be considered for the guide/ supervisor.
3. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

4. A log book to be prepared by each group, wherein the group can record weekly work progress, Guide/Supervisor can verify and record notes/comments.
5. Faculty may give inputs during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with Guide/ Supervisor.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Mini Project:

I) Term work (25 Marks):

- The progress of the mini project to be evaluated on a continuous basis.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Self contribution and use of skill set in project : 10
    - Quality of Project report : 05

II) Mini Project Internal Examination (25 Marks):

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- The students shall present a seminar on Mini project and demonstrate their understanding of need/problem.
- Mini Project shall be evaluated through a presentation and demonstration of working model by the student project group to a panel of examiner at Institute level.
- Mini Project shall be assessed based on following points:
    - Quality of survey/ need identification.
    - Clarity of Problem definition based on need.
    - Innovativeness in solutions.
    - Feasibility of proposed problem solutions and selection of best solution.
    - Cost effectiveness.
    - Societal impact.
    - Full functioning of working model as per stated requirements.
    - Effective use of skill sets.
    - Contribution of an individual as a member or leader.
    - Clarity in written and oral communication.

Semester II

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCA21	Mathematical Foundation for Computer Science 2	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	1	3	1	4
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	25	80	125

Pre-requisite: Basic knowledge of Mathematics and Statistics

Course Objectives: The course aim to

Sr.No	Course Objective
1	Study the formulation of Linear programming problems and obtain the optimum solution using various methods.
2	Solve the transportation, assignment problems and obtain their optimal solution
3	Use competitive strategy for analysis and learn to take decisions in various business environments
4	Understand queuing and simulation models and analyze their performance in real world systems

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Formulate mathematical model for a broad range of problems in business and industry.	Creating
CO 2	Apply mathematics and mathematical modeling to forecast implications of various choices in real world problems	Applying
CO 3	Think strategically and decide the optimum alternative from various available options	Evaluating
CO 4	Evaluate performance parameters of a real system using various methods	Evaluating

Module No	Detailed Contents	Hrs
01	**Linear Programming Problem**: Introduction, Formulation of linear programming problem and basic feasible solution: graphical method, Simplex method, artificial variables, Big M method, Two Phase method. **Self Learning Topics:**special cases of LPP	10
02	**Transportation Problem**: Definition of Transportation Problem, Initial basic feasible solution: North-West Corner method, Least Cost method, Vogel's Approximation method, optimum solution: MODI method. **Self Learning Topics:** optimization using stepping stone method	6
03	**Assignment Problem & Travelling Salesman Problem**: Definition of assignment Problem : Hungarian method (minimization and maximization), Travelling Salesman Problem : Hungarian method. **Self Learning Topics:** Simple applications in daily life	6
04	**Game Theory & Decision Making** : Rules of Game Theory, Two person zero sum game, solving simple games (2x2 games), solving simple games (3x3 games) Decision making under certainty, under uncertainty,Maximax Criterion,Maximin Criterion, Savage Minimax Regret criterion, Laplace criterion of equal Likelihoods, Hurwicz criterion of Realism **Self Learning Topics:** Decision tree for decision-making problem.	7
05	**Queuing Models**: Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing models, solution of queuing M/M/1 : □ /FCFS, M/M/1 : N/FCFS. **Self Learning Topics:** Understanding Kendle's notation in queuing theory	5
06	**Simulation**: Introduction to simulation, steps in simulation, advantages of simulation, limitations of simulation, applications of simulation, Monte-Carlo method: simple examples, single server queue model. **Self Learning Topics:** Generation of pseudo random numbers and their properties.	6

Reference Books:

Reference No	Reference Name
1	Hamdy A. Taha, University of Arkansas, "Operations Research: An Introduction", Pearson, 9th Edition, ©2011, ISBN-13: 9780132555937
2	Sharma, S.D. and Sharma, H. , "Operations Research: Theory, methods and Applications",KedarNath Ram Nath, 2010, 15, reprint

3	J. K. Sharma, “Operations Research : Theory And Applications” , Macmillan India Limited, 2006 (3 Edition),ISBN 1403931518, 9781403931511
4	S. C. Gupta, “Fundamentals of Statistics” – Himalaya Publishing House, 2017, 7th edition, ISBN 9350515040, 9789350515044
5	Prem Kumar Gupta & D S Hira, S. Chand publications , “Operations Research”, 7/e, ISBN-13: 978-8121902816, ISBN-10: 9788121902816
6	A. Ravindran, Don T. Phillips, James J. Solberg, “Operations Research: Principles and Practice”, 2nd Edition, January 1987, ISBN: 978-0-471-08608-6
7.	Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operations Research , McGraw-Hill, 2001,Edition7, illustrated,ISBN 0071181636, 9780071181631
8.	Jerry Banks, John S. Carson, Barry L. Nelson, Contributor Barry L. Nelson "Discrete-event System Simulation",Prentice Hall, 1996, Edition 2, illustrated, ISBN 0132174499, 9780132174497

Web References:

Reference No	Reference Name
1	Operations Research, Prof.Kusum Deep, IIT-MADRAS, https://nptel.ac.in/courses/111/107/111107128/
2	Introduction to Operations Research, Prof. G. Srinivasan, IIT-ROORKEE, https://nptel.ac.in/courses/110/106/110106062/
3	Fundamentals of Operations Research, Prof. G. Srinivasan, IIT-MADRAS, https://nptel.ac.in/courses/112/106/112106134/
4	Modeling and simulation of discrete event systems,Prof.P. Kumar Jha, IIT-ROORKEE, https://nptel.ac.in/courses/112107220/
5	Game Theory, Prof. K. S. MallikarjunaRao, IIT-BOMBAY, https://nptel.ac.in/courses/110/101/110101133/
6	Decision Modelling, Prof. BiswajetMahanty, IIT-KHARGPUR, https://nptel.ac.in/courses/110105082/
7	Karmarkar's Method: https://www.youtube.com/watch?v=LWXXhBIlj0o
8	Karmarkar's Method : https://en.wikipedia.org/wiki/Karmarkar%27s_algorithm

Tutorials:

Sr. No.	Topic	Hr
1	Linear programming problem using graphical method	1
2	Linear programming problem using simplex method	1
3	Linear programming problem using Big M method	1
4	Finding the basic feasible solution using Vogel’s Approximation Method	1

5	Finding the optimal solution using Modi Method	1
6	Assignment Problem using Hungarian method	1
7	Travelling salesman Problem using Hungarian method	1
8	Solving Two person zero sum game	1
9	Decision Making Under Uncertainty	1
10	Queuing system - (M/M/1):(FCFS /infinity)	1
11	Queuing system - (M/M/1): (FCFS/N)	1
12	Monte-Carlo Method	1

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCA22	Artificial Intelligence And Machine Learning	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Pre-requisite: Basics of data mining and Mathematical foundations of computerscience-MCA11

Course Objectives The course aim to

Sr.No.	Course Objective
1	Understand different AI concepts
2	Elucidate knowledge of Artificial Intelligence techniques for problem solving
3	Understand Artificial intelligence search strategies and neural networks
4	Provide an insight into the fundamentals of Machine Learning Techniques
5	Become familiar with regression methods, classification methods, clustering methods
6	Become familiar with methods to improve the learnin

Course Outcomes: On the successful completion of the course, students will be able to

Sr.No.	Outcome	Bloom Level
CO1	Interpret Artificial Intelligence concepts intelligence concepts	Understanding
CO 2	Apply Artificial intelligence techniques for problem solving	Applying
CO 3	Analyze the fundamentals of machine learning, the learning algorithms and the paradigms of supervised and un-supervised learning	Analyzing
CO 4	Identify methods to improve machine learning results for better predictive performance	Applying

Module	Detailed Contents	Hrs
1	**Module1:Introduction:** Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, Intelligent Agents, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Reasoning and Logic, Prepositional logic, First order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining **Self-Learning topics: Expert systems**	6
2	**Module2: Search Strategies:** Solving problems by searching, Search- Issues in The Design of Search Programs, Un-Informed Search- BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis **Self-Learning topics: Tabu search**	8
3	**Module3:Artificial Neural Networks** : Introduction, Activation Function, Optimization algorithm- Gradient decent, Networks- Perceptrons, Adaline, Multilayer Perceptrons , Backpropogation Algorithms Training Procedures, Tuning the Network Size **Self-Learning topics: Maxnet algorithm**	6
4	**Module4: Introduction to ML**: Machine Learning basics, Applications of ML,Data Mining Vs Machine Learning vs Big Data Analytics. Supervised Learning- Naïve Base Classifier, , Classifying with k-Nearest Neighbour classifier, Decision Tree classifier, Naive Bayes classifier. Unsupervised Learning - Grouping unlabeled items using k-means clustering, Association analysis with the Apriori algorithm Introduction to reinforcement learning **Self-Learning topics: Density Based Clustering,K-medoid**	4
5	**Module5:Forecasting and Learning Theory :** Non-linear regression, Logistic regression, Random forest, Baysian Belief networks, Bias/variance tradeoff, Tuning Model Complexity, Model Selection Dilemma Clustering **:** Expectation-Maximization Algorithm, Hierarchical Clustering, Supervised Learning after Clustering, Choosing the number of clusters, Learning using ANN **Self-Learning topics: Maximum Likelihood Estimation**	6

6	**Module6:Kernel Machines & Ensemble Methods** Introduction, Optimal Separating Hyperplane, Separating data with maximum margin, Support Vector Machine (SVM), Finding the maximum margin, The Non-Separable Case: Soft Margin Hyperplane, Kernel Trick, Defining Kernels Ensemble Methods : Mixture Models, Classifier using multiple samples of the data set, Improving classifier by focusing on error, weak learner with a decision stump, Bagging , Stacking, Boosting ,Implementing the AdaBoost algorithm, Classifying with AdaBoostBootstrapping and cross validation **Self-Learning topics: SMO Algorithm**	8
7	**Module7:Dimensionality Reduction**: Introduction, Subset Selection, Principal Components Analysis, Multidimensional Scaling, Linear Discriminant Analysis. **Self-Learning topics; Feature selection – feature ranking and subset selection**	2

Reference Books:

Reference No	Reference Name
1	George F Luger, Artificial Intelligence, Fifth Edition-2009, Pearson Education Publications ,ISBN-978-81-317-2327-2
2	Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, 3rd Edition, 2009 .ISBN- 13: 978-0136042594
3	Elaine Rich, Kevin Knight, S.B. Nair, Artificial Intelligence, 3rd Edition, Tata McGraw Hill-2008., ISBN 10: 0070087709 / ISBN 13: 9780070087705
4	Anandita Das ,Artificial Intelligence and Soft Computing for Beginners-,2nd Edition, ShroffPublication, ISBN- 9789351106159
5	Nils J. Nilsson, ―Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers, Harcourt Asia Pvt. Ltd., 2000, ISBN-1-55860-535-5
6	Kumar Satish ,Neural Networks, Second edition Tata McGraw Hill-,2013, ISBN1259006166, 9781259006166
7	EthemAlpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6. (this can be made the text book)
8	Peter Harrington, Machine Learning in Action . Manning Publications , April 2012 ,ISBN 9781617290183
9	Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1.
10	Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 978-81-322-0906-5

11	ShaiShalev-Shwartz and Shai Ben David ,Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, First Edition, ISBN No. 978-1-107-05713-5

Web References:

Reference No	Reference Name
1	nptel.ac.in-A first course in Artificial Intelligence-Deepak Khemani,
2	nptel.ac.in -Introduction to machine learning – BalaramanRavindran, IIT Madras
3	Tutorial point.com/machine_learning_with_python/index.htm

Assessment:

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCA23	Information Security	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Pre-requisite: Computer Networks

Course Objectives: The course aim to

Sr. No.	Course Objective
1	Understand the concepts of Information Security, cryptography and its applications
2	Familiarize various authentication and integrity techniques available
3	Understand firewalls and intrusion detection systems.
4	Familiarize relevant security parameters in the web, internet, database and operating systems

Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Discuss the requirement of information security , private and public key algorithms and to examine the mathematics of cryptography	Understanding
CO 2	Analyze authentication and integrity techniques available	Analyzing
CO 3	Interpret the importance of firewalls and intrusion detection systems and signatures.	Understanding
CO 4	Relate to the security issues and technologies used in the web, internet, database and operating system	Understanding

Module No.	Detailed Contents	Hrs
1	**Introduction** : Introduction to Information Security, principles, services and attacks, functional requirements of security, current trends in security	03

	Self learning topics: Need for security, Security approaches	
2	**Cryptography and Authentication:** **Cryptography:**Concept: Symmetric and Asymmetric Cryptography. Mathematics of cryptography: Modular Arithmetic Additive Inverse, Multiplicative Inverse, Euclidean Algorithm and Extended Euclidean Algorithm. Stream Cipher and Block Cipher, Concept of Confusion and Diffusion. Modes of Operation of Block Cipher: ECB, CBC, OFB, CFB , DES, RSA, Numerical on RSA **Authentication**:Types of authentication, Biometric Authentication and Third Party Authentication using KDC and Kerberos Version 5, Mutual authentication ,reflection attack **Self learning topics:** Variations of DES – 2DES and 3DES , Symmetric and Asymmetric Key Cryptography together	**10**
3	**Digital certificates and integrity** **Digital Signature**:Concept, Compare Digital Signature with Public Key Cryptography, Digital Signature Schema. Public Key Infrastructure (PKI): Private key management, Public Key Cryptography Standards (PKCS). Digital Certificate Creation Steps,X.509 Certificate, Certificate Revocation **Integrity:** Message Integrity, Hash functions Properties Algorithm:MDC,MAC,HMAC,MD5, SHA -512 **Self learning topics:** PKIX model, Data integrity threats	**8**
4	**Internet and web security** SSL, IPSec, Email Security- PGP, Email attacks Web services Security: web app versus web service concept, WS-Security, SOAP web service, SAML assertion, Browser attacks, web attacks targeting users, obtaining user or website data. **Self learning topics:** SET , SSL Vs SET, S/MIME	**8**

5	**Firewall and IDS** **Firewall**: Introduction, Characteristic ,Types :Packet Filter, Stateful and Stateless Packet Filter, Attacks of Packet Filter, Circuit Level and Application Level Firewall, Bastion Host, Firewall Configurations. **Intrusion:**What is Intrusion, Intruders, Intrusion Detection, Behavior of Authorized user and Intruder, Approaches for Intrusion Detection: Statistical Anomaly Detection and Rule based Detection. Audit Record and Audit Record Analysis. **Self learning topics:** Virtual Private Network (VPN)	**6**
6	**Database and OS Security** Introduction to database, Security requirements of database, sensitive data, Database access control, inference, Security in operating systems: Operating System Structure, Security Features of Ordinary Operating Systems, Operating System Tools to Implement Security Functions, Rootkit: Phone Rootkit, Sony XCP Rootkit, TDSS Rootkits. **Self learning topics:** Cryptographic Toolkits, Denial of Service attack	**5**

Reference Books:

Reference No	Reference Name
1	AtulKahate, "Cryptography and Network Security", McGraw Hill
2	Kaufman C., Perlman R., and Speciner, "Network Security", Private Communication in a public world, 2nd ed., Prentice Hall PTR.,2002
3	Cryptography and Network Security, Behrouz A Forouzan
4	Cryptography and Network Security: Principles and Practice, William Stallings
5	Computer Security :William Stallings , Edition 6
6	Security in Computing fifth edition Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies
7	Network Security sand Cryptography: Bernard Menezes, CENGAGE Learning
8	Network Security bible, Eric Cole
9	Cryptography And Information Security, V. K. Pachghare

10	Information Systems Security: Security Management, Metrics, Frameworks and Best practices: Nina Gobole
11	The complete reference Information Security by Mark Rhodes-ousley

Web References:

Reference No	Reference Name
1	https://link.springer.com/content/pdf/10.1007%2F978-1-4302-6383-8_16.pdf
2	docs.oracle.com/cd/B19306_01/server.102/b14220/security.htm
3	https://www.w3.org/Security/security-resource
4	https://www.sophos.com/en-us/labs/security-threat-report.aspx
5	https://www.tutorialspoint.com/cryptography/data_integrity_in_cryptography.htm
6	https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH15-OS8e.pdf

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

5. Weight age of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE241	Image Processing	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Pre-requisite:

- Probability and Statistics
- Linear algebra, Differential equation and Calculus
- Basic Programming Skills

Course Objectives : Course aim to

Sr.No.	Course Objectives
1	Study the fundamental concepts of Digital Image processing and to discuss mathematical transforms .
2	Study image enhancement techniques and explore DCT and DFT techniques
3	Expose students to various image enhancement, restoration methods and morphological operations.
4	Analyze Image Data Compression and morphological Operation
5	Explain various Applications of Image Processing

Course Outcomes:

Sr.No.	Course Outcomes	Bloom Level
CO1	Explain the fundamental concepts of a digital image processing System	Understanding
CO 2	Apply techniques for enhancing digital images	Applying
CO3	Examine the use of Fourier transforms for image processing in the frequency domain	Analyzing
CO4	Compare various Image compression standards and morphological Operation	Analyzing
CO5	Identify various Applications of Image Processing	Understanding

Module	Detailed Contents	Hrs
1	**Introduction to Image Processing Systems:** Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model Vidicon and Digital Camera working principles Brightness, contrast, hue, saturation, mach band effect, **Colour image fundamentals**-RGB, CMY, HSImodels 2D sampling,quantization. **Self Learning Topic:** Image acquisition techniques used in a digital camera, Structure of a 24-bit bmp colour image.	6

2	**Image Enhancement in the Spatial domain:** Spatial domain methods: point processing- intensity transformations, **histogram** processing, image subtraction, image averaging Spatial filtering- smoothing filters, sharpening filters Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter. **Self Learning Topic:** Interpretation of various image attributes by plotting their histograms , Applications of filters in various domains.	**7**
3	**Discrete Fourier Transform:** Discrete Fourier Transform: Introduction , DFT and its properties, FFT algorithms ñ direct, divide and conquer approach, 2-D DFT &FFT**Image Transforms :** Introduction to Unitary Transform, DFT, Properties of **2-D** DFT, FFT, IFFT, Walsh transform, Hadamard Transform, Discrete Cosine Transform, Discrete Wavelet Transform: Haar Transforms, KL Transform **Self Learning Topics:** Signals, Fourier Transform, Color space and Transformation.	**8**
4	**Image Restoration and Image Segmentation:** Image degradation, Classification of Image restoration Techniques, Image restoration Model, Image Blur, Noise Model : Exponential, Uniform, Salt and Pepper, Image Restoration Techniques : Inverse Filtering, Average Filtering, Median Filtering. **The detection of discontinuities** - Point, Line and Edge detections: Prewit Filter, Sobel Filter, Fri-Chen Filter Hough Transform, Thresholding Region based segmentation Chain codes, Polygon approximation, Shape numbers. **Self Learning Topics:** Difference between image enhancement and restoration/ The use of motion in Segmentation.	**8**
5	**Image Data Compression and morphological Operation:** Need for compression, redundancy, classification of image compression schemes, Huffman coding, arithmetic coding, dictionary based compression, transform Based compression, Image compression standards- JPEG &MPEG,vector quantization, wavelet based image compression.**Morphological Operation:** Introduction, Dilation, Erosion, Opening, Closing **Self-Learning Topics:** Image File format, Morphological filters for gray-level images.	**7**
6	**Applications of Image Processing:** Case Study on Digital Watermarking, Biometric Authentication (Face, Finger Print, Signature Recognition), Vehicle Number Plate Detection and Recognition, Object Detection using Correlation Principle, Person Tracking using DWT, Handwritten and Printed Character Recognition, Contend Based Image Retrieval, Text Compression. **Self-Learning Topics:** Industrial applications.	**4**

Reference Books:

Reference No	Reference Name
1	R.C.Gonzalez&R.E.Woods, Digital Image Processing, Pearson Education, 3rd edition, ISBN. 13:978-0131687288

2	S. Jayaraman Digital Image Processing TMH (McGraw Hill) publication, ISBN- 13:978-0-07- 0144798
3	Gonzalez, Woods & Steven, Digital Image Processing using MATLAB, Pearson Education, ISBN-13:978-0130085191
4	William K. Pratt, "Digital Image Processing", John Wiley, NJ, 4th Edition,200
5	Sid Ahmed M.A., "Image Processing Theory, Algorithm andArchitectures", McGraw-Hill, 1995.Umbaugh, "Computer Vision".
6	Anil K.Jain,Fundamentals of Digital Image Processing,Prentice Hall of India,2nd Edition,2004.

Web References:

Reference no	Reference name
1	https:// www.ict.gnu.ac.in › sites › files › subject syllabus pdf
2	https:// www.gtu.ac.in › syllabus › sem7
3	https:// www.nptel.ac.in › content › syllabus_pdf
4	https:// www.ktuweb.com › page_showdoc › dopage=syllabus
5	https://www.cse.iitkgp.ac.in › syllabus
6	https:// www.vit.edu › images › btech_syllabus_entc_16-17
7	https:// www.iitkgp.ac.in › fac-profiles › showprofile
8	https:// www.cse.iitb.ac.in › ~ajitvr › cs663_fall2018

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE242	Internet of Things	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	--	80	100

Pre-requisite: 1. Knowledge of Computer Networks.

2. Basics of Cloud.

Course Objectives: The Course aim to

Sr.No.	Course Objective
1	Explain the basics of IoT, M2M, IoT enabling technologies, characteristics of IoT systems and IoT levels.
2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT.
3	Explain the IoT protocols, IoT security aspects and generic design methodology.
4	Discuss IoT applicability in various domains along with the concept of Web of Thing (WoT) and Cloud of Thing (CoT).

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Compare M2M and IoT; discuss applicability of IoT enabling technologies, characteristics of IoT systems and IoT levels.	Understanding
CO 2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT	Understanding
CO 3	Analyze various protocols for IoT, IoT security aspects and generic design methodology	Analyzing
CO 4	Develop cloud based and web based IoT Model for specific domains.	Applying

Module	Detailed Contents	Hrs
1	**Module: Introduction to IoT and M2M**: Definition & Characteristics of IoT Physical Design of IoT- Things in IoT Logical Design of IoT- IoT Functional Blocks , IoT Communication Models , IoT Communication APIs IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems IoT Levels & Deployment Templates- IoT Level-1 ,IoT Level-2, IoT Level-3 M2M to IoT – The Vision : Introduction From M2M to IoT o A brief background**,** o M2M communication, o Differing characteristics **Self Learning Topics:** IoT Level-4, IoT Level-5, IoT Level-6 M2M to IoT – A Market Perspective M2M to IoT – An Architectural Overview	**6**
2	**Module: IoT Architecture:** Introduction State of the Art o European Telecommunications Standards Institute M2M/oneM2M o International Telecommunication Union Telecommunication sector view o Internet Engineering Task Force architecture fragments o Open Geospatial Consortium architecture Architecture Reference Model o Introduction, o Reference model and architecture, o IoT reference model IoT domain model, Information model, Functional model, Communication model, Safety, privacy, trust, security model o IoTReference Architecture Introduction, Functional view, Information view, Deployment and operational view **Self Learning Topics:** Other relevant architectural views	**12**
3	**Module: IoT Protocols and Security:** IoT Protocols : Protocol Standardization for IoT Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACnet Protocol, Modbus,	**6**

	KNX, Zigbee Architecture, Network layer, APS layer. □ IoT Security: Need for IoT Security,IoTVulnerabilities, Elements of IoT Security, IoT Security best practices, Threat Modeling an IoT system **Self Learning Topics:** Basics of Internet Protocols, Basic understanding of cryptography	
4	**Module: IoT Platform Design Methodology:** □ Purpose and requirement specification □ Process specification □ Domain model specification □ Information model specification □ Service specifications □ IoT level specification □ Functional view specification □ Operational view specification □ Device and component integration □ Application development **Self Learning Topics:** Basics of DFD, UML Modeling	**4**
5	**Module: Domain SpecificIoTs:** □ HomeAutomation o Smart Lighting o Smart Appliances o Intrusion Detection o Smoke/Gas Detectors □ Cities o Smart Parking o Smart Lighting o Smart Roads o Structural Health Monitoring o Surveillance o Emergency Response □ Environment o Weather Monitoring o Air Pollution Monitoring o Noise Pollution Monitoring o Forest Fire Detection o River Floods Detection □ Energy o Smart Grids o Renewable Energy Systems o Prognostics □ Retail o Inventory Management o Smart Payments o Smart Vending Machines □ Agriculture o Smart Irrigation o Green House Control □ Industry	**6**

	o Machine Diagnosis & Prognosis o Indoor Air Quality Monitoring **Self Learning Topics:** Case Study on Logistics and Health & Lifestyle	
6	**Module: Web of Things and Cloud of Things:** • Web of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence. • Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture. **Self Learning Topics:**Basics of Web and Cloud.	**6**

Reference Books:

Reference No	Reference Name
1	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler,VlasiosTsiatsis, Catherine Mulligan, Stefan Aves and StamatisKarnouskos, David Boyle, ELSEVIER
2	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
3	IoT Security for Dummies, Lawrence Miller, John Wiley & Sons Ltd.
4	Practical Internet of Things Security, Brian Russell, Drew Van Duren, PACKT publishing
5	The Internet of Things in the Cloud:A Middleware Perspectiv,By Honbo Zhou
6	Rethinking the Internet of Things A Scalable Approach to Connecting Everything, Francis daCosta, Apress
7	Getting Started with the Internet of Things, CunoPfister
8	The Internet of Things: Connecting Objects,HakimaChaouchi

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE243	Robotic Process Automation	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	--	80	100

Pre-requisite: 1. Software Engineering

2. Basics of Computer Science

Course Objectives: The course aim to

Sr. No.	Course Objective
1	Explain the concepts of Robotic Process Automation
2	Explain the process methodologies for BOT development
3	Apply knowledge BOT development for intelligent automation
4	Explore various RPA tools with their specifications

Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Robotic Process Automation and evolution.	Remembering
CO2	Demonstrate development of BOT with specific tools	Understanding
CO3	Apply RPA implementation cycle considering security and scaling	Applying
CO4	Examine specifications of RPA tools and justify applications of appropriate tool for problem.	Analyzing
CO5	Assess performance of BOTs in context of intelligent automation	Evaluating

Module No.	Detailed Contents	Hrs
1	**Module: Introduction to RPA:** - What is RPA, - Flavors of RPA, - History of RPA, - Benefits of RPA, - Current Status of RPA Utilisation and Value, - Levels of RPA, - Skills Required for RPA, - RPA Lifecycle, - RPA Use Cases **Self Learning Topics:** - Evolution of RPA, - RPA compared to BPA, BPM and BPO,	5
2	**Module: Process Methodologies and Planning:** - Lean, - Six Sigma, - Applying Lean and Six Sigma to RPA, - Planning:ROI for RPA, - Agile technology for RPA - Relationship between RPA and Workload Automation **Self Learning Topics:** Other relevant architectural views	5
3	**Module: BOT Development** - Analysis of Business Process and development of BOT, - Activities, Flowcharts and sequences, Log Message, loops and conditions, - Common UIPath Functions, - Best practices for BOT Development, - Evaluating BOT Performance - Error Handling **Self Learning Topics:** Learning UiPath Studio	8
4	**Module: Deployment, Monitoring and Data Preparation for RPA** - Testing, Monitoring - Type of Data for RPA, - Data Process and Types of Algorithms, - Managing RPA Implementation Cycle **Self Learning Topics:** Security, Scaling for RPA	6

5	**Module: Intelligent Automation & BOT Management** - Cognitive Automation, - Intelligent Process Automation or IPA, - Examples of cognitive RPA - Web Scrapping - Types of BOTs, - Examples of BOTs, **Self Learning Topics:** Difference between RPA BOT and ChatBOTs	**6**
6	**Module: Security of BOT:** - Security Challenges for RPA - Secured BOT Development and Secured BOT Deployment, - secured BOT architecture design, - security requirements through threat modeling **Self Learning Topics:**Risks for RPA.	**2**
7	**Module: RPA Technologies & Case Studies** - RPA Tools: UIPath, BluePrism, WorkFusion, Nice, - Open Source RPA , - Resilient Automation - Case studies of RPA implementation **Self Learning Topic: RPA Best Practice**	**8**

Reference Books:

Reference No	Reference Name
1	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 1st Edition, 2019
2	Mathias Kirchmer, Peter Franz and Danny Bathmaker, "Value-Driven Robotic Process Automation Enabling Effective Digital Transformation" , October 2019
3	Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks and Become an RPA Consultant", May 2018.
4	GerardusBlokdyk, "Robotic Process Automation Rpa A Complete Guide - 2020 Edition", 1st Edition, 5STARCooks, 2019.
5	Alok Mani Tripathi, " Learning Robotic Process Automation", 2018, Packt Publishing
6	Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide", November 2018, Packt Publishing

Web References:

Reference No.	Reference Name
1	https://resources.automationanywhere.com/articles

2	https://www.automationanywhere.com/in/solutions
3	https://www.infobeans.com/robotic-process-automation-lifecycle
4	https://university.automationanywhere.com/rpa-courses/
5	https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future
6	https://university.automationanywhere.com/rpa-learning-trails/business-analyst/
7	https://www.chatbot.com/blog/6-types-of-bots-that-can-serve-your-clients/
8	https://university.automationanywhere.com/?ReturnUrl=%2fcourse%2f1324366%2fmodule%2f3719818%2fScorm%3fLPId%3d0&LPId=0
9	https://university.automationanywhere.com/?ReturnUrl=%2fcourse%2f1324366%2fmodule%2f3719818%2fScorm%3fLPId%3d0&LPId=0
10	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-university-essential-level-prep-courses-mba-students/
11	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-university-essential-level-prep-courses-mba-students/
12	https://university.automationanywhere.com/rpa-learning-trails/technical-support-specialist/
13	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-secure-bot-developer/
14	https://www.onesourcevirtual.com/resources/blogs/technology-and-innovation/prepare-for-robotic-process-automation-with-lean-six-sigma.html

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE244	Computer Vision	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Pre-requisite: *Basic Understanding of Computer Graphics and Image Processing*

Course Objectives: The course aim to

Sr. No.	Course Objective
01	Learn basic concepts and applications of computer vision.
02	Learn image processing techniques
03	Use and implement feature detection mechanism
04	Understand advanced concepts leading to object and scene categorization from images.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Course Outcome	Bloom Level
CO1	Explain Concepts and Applications of Computer Vision	Understanding
CO2	Apply image processing techniques to design Computer Vision applications	Applying
CO3	Implement algorithms of face recognition and motion detection	Analyzing
CO4	Provide solutions to real world computer vision problems	Creating

Module No.	Detailed Contents	Hrs.
1	**Module: Introduction to Computer Vision** Definition of Computer Vision, Easy Vs Hard Problems, Computer Vision System, Components of a vision system, Applications of Computer vision, Image Sources for computer Vision, Image structure and Pixels, Frameworks for Computer Vision	06

	Self Learning Topics: Computer vision in Finance	
2	**Module: Basic Image Handling and Processing** Geometric primitives and transformations, Plotting images, points and lines, Image contours and histograms, Histogram equalization, Interactive annotation, Gray level transforms, Image Transformations, Image Derivatives **Self Learning Topics:**Image Denoising	**07**
3	**Module: Local Image Descriptors and Image Mappings** Line Detection-Hough Transforms, Harris corner detector, Edge Detection, SIFT - Scale-Invariant Feature Transform, Matching Geotagged Images, Homographies, Warping images, Creating Panoramas :Camera Models and Augmented reality, Light effects **Self Learning Topics:**Drawing on Images	**07**
4	**Module: Exploring Structure from Motion** Structure from Motion concepts, Estimating the camera motion from a pair of images, Reconstructing the scene , Reconstruction from many views , Refinement of the reconstruction, Visualizing 3D point clouds, Object Recognition and Bag-of-Words Models **Self Learning Topics:**Object Classification	**07**
5	**Module: Face Detection and Tracking** Face detection, Pedestrian detection, Face recognition, Eigenfaces, Viola-Jones Algorithm, Haar-like Features, Integral Image, Training Classifiers, Adaptive Boosting (Adaboost) **Self Learning Topics:** Measuring features	**07**
6	**Module: Convolutional Nerual Networks for CV** CNN Advantages,Architecture,Layers,TrainingCNNs,Build your own CNN,CNN applications **Self Learning Topics: Dogs and cats case study**	**06**

Reference Books:

Reference No.	Reference Name
1	Szeliski, Richard. Computer vision: algorithms and applications. Springer Science & Business Media, 2010. ISBN:1848829345
2	Solem, Jan Erik. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012.ISBN: 144934193
3	Demaagd, Kurt. Practical Computer Vision with SimpleCV: Making Computers See in Python. 2012.ISBN: 9781449337865

4	Jähne, Bernd, Horst Haussecker, and Peter Geissler, eds. Handbook of computer vision and applications. Vol. 2. San Diego: Academic press, 1999.ISBN: 0123797713
5	Jähne, Bernd, and Horst Haußecker. "Computer vision and applications." A Guide for Students and Practitioners (2000). ISBN:7302269157
6	Baggio, Daniel Lélis. Mastering OpenCV with practical computer vision projects. Packt Publishing Ltd, 2012.ISBN: 1849517827
7	Khan, Salman, et al. "A guide to convolutional neural networks for computer vision." Synthesis Lectures on Computer Vision 8.1 (2018).ISBN: 1681730219

Web References:

Reference No.	Reference Name
1	http://groups.csail.mit.edu/vision/
2	https://medium.com/readers-writers-digest/beginners-guide-to-computer-vision-23606224b720
3	https://vision.in.tum.de/research
4	Deeplearning.ai
5	http://www.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html

Assessment:

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE245	Embedded Systems	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Pre-requisite:

- Computer Organisation & Architecture
- Operating Systems
- C / C++ / Java Programming

Course Objectives : The course aim to

Sr.No.	Course Objective
1	Introduce students to the features, applications of embedded systems
2	Develop an understanding of the design challenges of embedded systems
3	Understand the basic architecture of 8051 microcontroller
4	Introduce students to Embedded C programming
5	Enable students to develop basic programs for embedded systems using Embedded C.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Explain hardware and software design requirements of Embedded Systems	Understanding
CO 2	Discuss the architecture of 8051 processor	Understanding
CO 3	Describe 8051 Processor Addressing modes and instruction sets	Understanding
CO 4	Use Embedded C for writing basic programs for embedded systems	Applying
CO 5	Examine the use of various Embedded C programming constructs for writing programs for embedded systems.	Analysing

Module	Detailed Contents	Hrs
1	**Fundamentals of Embedded Systems :** Introduction, Features, Applications of Embedded Systems, Subsystems in an Embedded System. Design Considerations of Embedded Systems : Design Challenges, Common Design Metrics, Design Trade offs and Performance Classification of Computer Architecture : Basic operation of a computer system, CPU Architecture, Microprocessor, Microcomputer. Introduction to Real Time Operating Systems **Self learning topics;** Embedded systems classifications and their usage.	7
2	**Microcontrollers**: Evolution and Uses in Embedded Systems and its Advantages. Architecture of 8051 Microcontroller : Introduction, Block Diagram, Registers, Internal Memory, Counters, I/O Ports, Basic Concepts in Serial I/O **Self learning topics:** Overview of ATOM / ARM Processor	6
3	**8051 Processor Addressing modes and Instruction Set :** Assembly language programming in 8051, Data Types, Addressing Modes, Arithmetic and Logical Operators Interfacing 8051 with external devices : LED's and SSD. **Self learning topics:** Operating systems used for designing embedded systems	6
4	**Embedded C Programming : Introduction :** Introduction to Embedded C, Difference between C & Embedded C, Programming style, Basic structure of the program. Keywords & Identifiers, Data type & its memory representation, Arrays and strings , Input and Output. **Self learning topics;** Practice programming Exercises	6
5	**Embedded C Programming : Operators and control structures :** Types of Operators, Bitwise Operators Decision making with if statement, If….else statement, Switch statement, and GOTO statement, The While and Do – While statements, For statement **Self learning topics:** Practice programming Exercises	6

6	**Embedded C Programming : Functions :** Why Functions, Types of Functions, A Multi functional program, Return values & their types. **Self learning topics :** Practice programming Exercises	**5**
7	**Case Study** : Use of Embedded systems is designing various commercial applications / appliances : Home Automation Systems, Washing machine etc.	**4**

Reference Books:

Reference No	Reference Name
1	K V K Prasad, "Embedded/Real Time Systmes : Concepts, Design and Programming", Dreamtech Press
2	Steve Furber, "ARM System-on-chip Architecture", 2e, Addison Wesley
3	Tammy Noergaard, "Embedded System Architecture : A comprehensive Guide for Engineers and Programmers", Newnes (Elsevier)
4	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill
5	Raj Kamal, "Embedded Systems : Architecture, Programming and Design", 2e, Tata McGraw Hill
6	K Uma Rao, AndhePallavi, "The 8051 and MSP430 Microcontrollers : Architecture, Programming and Applications, Wiley
7	Bahadure, Chandrakar, " Microcontrollers and Embedded System Design", Wiley
8	Raj Kamal, "Embedded Systems : Architecture, Programming and Design", Tata McGraw Hill.

Web References: ww.nptel.ac.in

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus and may have 4 sub-questions of 5 marks each.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE251	Natural Language Processing	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	1	3	1	4
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	25	80	125

Pre-requisite:

- Probability
- Python programming
- Data structure & Algorithms

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Understand natural language processing and to learn how to apply basic algorithms in this field.
2	Get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3	Implement a rule based system to tackle morphology/syntax of aLanguage
4	Compare and contrast use of different statistical approaches for different types of applications
5	Design a tag set to be used for statistical processing keeping an application in mind, design a Statistical technique for a new application
6	Design an innovative application using NLP components

Course Outcomes: On successful completion of course learner/student will be able to

CO No.	Outcome	Bloom Level
CO1	Understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.	Understanding
CO 2	Understand the information retrieval techniques using NLP	Understanding
CO 3	Apply mathematical techniques that are required to develop NLP applications.	Applying

CO 4	Analyze various NLP algorithms and text mining NLP applications	Analyzing
CO 5	Design real world NLP applications such as machine translation, text categorization, text summarization, information extraction by applying NLP techniques.	Creating

Module No.	**Detailed Contents**	**Hrs**
1	**Module: Introduction** History of NLP, Generic NLP system, levels of NLP , Knowledge in language processing , Ambiguity in Natural language , stages in NLP, challenges of NLP ,Applications of NLP **Self learning topics:** Empirical laws	**4**
2	**Module: Word Level Analysis** Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST , Lexicon free FST Porter stemmer. N –Grams- N-gram language model, **Self learning topics:**N-gram for spelling correction	**8**
3	**Module:Syntax analysis** Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy **Self learning topics:** Conditional Random Field (CRF).	**8**
4	**Module:Semantic Analysis** Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, Robust Word Sense Disambiguation (WSD),Dictionary based approach **Self learning topics:**WordNet	**10**
5	**Module: Text Summarization, Text Classification** Text summarization- LEXRANK , Optimization based approaches for summarization , Summarization evaluation, Text classification **Self learning topics:** NLKT , Naïve Bayes Theorem	**6**

6	**Module: Sentiment Analysis and Opinion Mining** Sentiment Analysis introduction , Sentiment Analysis - Affective lexicons, Learning affective lexicons, Computing with affective lexicons, Aspect based sentiment analysis **Self learning topics:** Named Entity Recognition	**4**

Reference Books:

Reference No	Reference Name
1	Dan Jurafsky and James Martin. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, Second Edition, 2009.
2	Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
3	Christopher D.Manning and HinrichSchutze, ― Foundations of Statistical Natural Language Processing ―, MIT Press, 1999.
4	Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
5	Daniel M Bikel and ImedZitouni ― Multilingual natural language processing applications‖ Pearson, 2013
6	Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) ― The Handbook of Computational Linguistics and Natural Language Processing ― ISBN: 978-1-118-
7	Brian Neil Levine, An Introduction to R Programming
8	Niel J le Roux, SugnetLubbe, A step by step tutorial : An introduction into R application and programming

Web References:

Reference No	Reference Name
1	https://youtu.be/xvqsFTUsOmc
2	https://www.coursera.org/learn/language-processing
3	https://nptel.ac.in/courses/106/105/106105158/
4	https://youtu.be/IIaYk2hIYKk
5	https://www.udemy.com/course/natural-language-processing/?trk=profile_certification_title&utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.

5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Tutorial

Sr. No.	Detailed Content	Hours
1	NLP processing of any one Indian regional language	**4**
2	Web mining using NLP (fetching web pages and extracting the human language data from them) for sentiment analysis	**4**
3	Using NLP to complete analytical tasks such as generating document abstracts	**4**

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE252	Geographic Information System	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	1	3	1	4
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	25	80	125

Pre-requisite: Nil

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Understand the concepts of Geographic Information System.
2	Examine the motive of Vector Data Model
3	Discuss the design of Raster Data Model
4	Demonstrate the Terrain Mapping, View shade and Watershed Analysis outline.
5	Apply knowledge of Geocoding and Dynamic Segmentation
6	Determine the available of Remote Sensing Techniques.

Course Outcomes: On Successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concept of Geographic Information System	Remembering
CO 2	Examine the various aspects of vector data model by survey and discover of concepts.	Analyzing
CO 3	Elaborate and estimate raster data model by designing and developing effective plan.	Creating
CO 4	Demonstrate understanding of the Terrain Mapping, View shade and Watershed Analysis in contrast by explaining main ideas.	Understand
CO 5	Experiment of Geocoding and Dynamic Segmentation by applying facts and techniques.	Applying
CO 6	Present and explain importance of remote sensing by evaluating recommended set of criteria	Evaluating

Module	Detailed Contents	Hrs.
1	**Principles of GIS:** Introduction: Components of GIS, History of GIS, Elements of GIS, Applications of GIS, Integration of GIS with Web and Mobile Technology	6

2	**Vector Data Model:** Representation of Spatial Features, Topology- TIGER, Importance of Topology, Georelational Data Model-Coverage, Coverage Data Structure, Sapefile, Object Based Data Model- Classes and Class Relationships, Interface, Geodatabase, Topology Rules, Representation of Composite Features- TIN, Regions, Routes	**6**
3	**Raster Data Model:** Elements of the Raster Data Model- Cell Value, Cell Size, Cell Depth, Raster Bands, Spatial Reference, Satellite Images- Landsat, SPOT, Digital Globe, Sentinel, Terra Satellite, Digital Elevation Models- Optical Sensor, InSAR, LiDAR. Raster Data Structure- Cell-by-Cell Encoding, Run-Length Encoding, Quadtree, Header File	**6**
4	**Terrain Mapping, Viewshade and Watershed Analysis:** Terrain Mapping- Contouring, Vertical Profiling, Hill Shading, Hypsometric Tinting, Perspective View, Viewshade Analysis- Line-of-Sight Operation, Raster-Based Operation, Raster-Based, TIN-Based, Cumulative, Watershed Analysis- Filled DEM, Flow Direction, Flow Accumulation, Stream Network, Stream Links, Areawide Watershed, Point-Based Watersheds	**6**
5	**Geocoding and Dynamic Segmentation:** Geocoding, Variations of Geocoding, Application of Geocoding- Location Based Services, Business Application, Wireless Emergency Services, Crime Mapping and Analysis, Public Health, Dynamic Segmentation- Routes, Events, Applications of Dynamic Segmentation: Data Management, Data Display, Data Query, Data Analysis	**6**
6	**Principles of Remote Sensing:** **Introduction:** Definitions, concepts and types of remote sensing, evolution, stages and advantages of remote sensing, spatial data acquisition, Electromagnetic spectrum, electromagnetic radiation, wavelength regions of electromagnetic radiation, types **Remote Sensing Technologies:** Thermal Remote Sensing – Thermal radiation principles; Precision remote sensing – spatial, spectral and temporal precision; Passive and Active Microwave Remote Sensing **Applications of Remote Sensing:** Applications of remote sensing in agriculture. Applications of remote sensing in forestry, Applications of remote sensing in oceans and coastal monitoring.	**10**

Reference Books:

Reference No.	Reference Name
1	Remote Sensing and GIS - Bhatta B, Oxford
2	Integrated Coastal and Ocean Management – BilianaCicin-Sain Gunnar Kullenburg, Island Press
3	Remote Sensing and GIS – Anji Reddy, BS Publication
4	Introduction to Geographic Information Systems - Tsung Chang Kang , McGraw-Hill
5	An Introduction to Geographical Information Systems D. Ian Heywood, Sarah Cornelius, Steve Carver, Pearson Prentice Hall, 2006

6	Concepts And Techniques Of Geographic Information Systems 2nd Edition by Chor Pang Lo (Author), Albert K.W. Yeung (Author). PHI

Web References:

Reference No.	Reference Name
1	https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/
2	https://gisgeography.com/satellite-maps/
3	https://www.esri.com/en-us/what-is-gis/overview
4	https://gisgeography.com/gis-applications-uses/
5	http://sparcindia.com/gis-case-studies/
6	https://gisgeography.com/geoprocessing-tools/
7	https://bharatmaps.gov.in/

GIS: Tutorials

Sr. No.	Detailed Contents	Hrs.
1	Subject Instructor/Mentor can form the groups of the students and they can discuss the case studies with the guidance of Instructor/Mentor to understand and explore the GIS Tools and Techniques	**12**
2	Case studies can be chosen in the area like application of GIS in Industrial Establishments, Mining, Forestry and Environment, Power Utilities, Pipeline Utilities, Transportation and Logistics, Water Resources, Agriculture, Governance, Risk Management, Education Healthcare.	
3	Presentations based on various GIS concepts can also be included in discussion to understand the application of GIS in real world.	

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE253	Design and Analysis of Algorithm	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	25	80	125

Pre-requisite: MCAL11 - Data Structures Lab using C/C++

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Analyze asymptotic notations
2	Analyze various problem solving techniques
3	Analyze different algorithmic design paradigms.
4	Interpret approximation algorithms.

Course Outcomes: On Successful Completion of course learner/students will be able to

Sr.No.	Outcome	Bloom Level
CO1	Analyze the time and space complexity of various algorithms.	Analyzing
CO2	Analyze divide and conquer, greedy and dynamic programming strategies.	Analyzing
CO3	Analyze backtracking, branch and bound and string matching algorithm.	Analyzing
CO4	Explain NP hard NP complete problem.	Understanding

Module No.	Detailed Contents	Hrs
1	**Module: Introduction :** Notion of an Algorithm , Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency, Asymptotic Notations and their properties. Analysis Framework, Mathematical analysis for Recursive and Non-recursive algorithms, Substitution method and growth of function.	06
2	**Module:Divide And Conquer**: Divide and Conquer Methodology, Binary Search, Merge sort, Quick	08

	sort, Heap Sort, Multiplication of Large Integers, Closest- Pair and Convex- Hull Problems **Self Learning Topics:** Optimal storage on tape	
3	**Module: Greedy Technique**: Introduction, Control Abstraction for Greedy Algorithms, Fractional knapsack, Minimum cost spanning tree(Kruskal, Prims) , Single source shortest path (Dijkstra's algorithm) **Self Learning Topics:** Huffman Coding	06
4	**Module: Dynamic Programming:** Introduction, Control Abstraction for Dynamic Programming, Knapsack (0/1), Matrix chain multiplication, Longest common subsequence, All pair shortest path (Floyd Warshall) **Self Learning Topics:** DFS and BFS	06
5	**Module: Backtracking And Brach And Bound:** Introduction to Backtracking, n-Queen problem, Graph colouring problem, Hamiltonian cycle. Branch and Bound, LIFO Search and FIFO search, Least cost search, 15 puzzles, Travelling Salesman Problem. **Self Learning Topics:** Subset Sum Problem	08
6	**Module: Approximation Algorithms:** NP Hard and NP –complete problem, set covers, Natural algorithms **Self Learning Topics:** Study of open ended problems	02
7	**Module: String Matching:** Brute force string matching, Knutt-Morris-Pratt algorithm, Rabin-Karp algorithm, Naïve string matching, Finite automata, Boyer Moore algorithm **Self Learning Topics:** Study of applications of string matching	04

Reference Books:

Reference No.	Reference Name
1	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, ―Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012 **ISBN** 978-0-262-03384-8.
2	AnanyLevitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012 **ISBN** 978 0 13 231681 1
3	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran - Computer Algorithms/ C++, Second Edition, Universities Press, 2007 **ISBN**: 9788173716126
4	S. Sridhar ―Design of Algorithms and Analysis, Oxford university press, 2014.
5	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, Reprint 2006
6	Harsh Bhasin, ―Algorithms Design and Analysis, Oxford university press, 2016.
7	Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Edition, 2008, ISBN: 8177585959, Pearson Education.

Tutorials:

Sr.No.	Detailed Contents	Hrs
1	Find time complexity of given code (e.g. using substitution theorem, master theorem etc)	01
2	Problems on recurrence relation	01
3	Comparative analysis of various sorting techniques	02
4	Problem solving on greedy techniques	01
5	Problem solving on dynamic techniques	02
6	Problem solving on backtracking and branch and bound	02
7	Problem solving on string matching	01
8	Case study of trending services (like but not limited to uber, zomato, olx, nature basket, packers and movers etc)	02

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE254	Digital Marketing and Business Analytics	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	AVG			
		20	20	20	25	80	125

Pre-requisite: Nil

Course Objectives: The course aim to

Sr. No.	Course Objective
01	Examine and explore the role and importance Digital Marketing in the current business scenario.
02	Familiarize with the various Digital Marketing Tools.
03	Apply Digital Marketing tools for formulating a Digital Marketing Strategy.
04	Understand Digital Marketing Campaigns using various Tools and measure their effectiveness.

Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Understand the role of Digital Marketing	Remembering
CO2	Demonstrate use of various Digital Marketing Tools.	Understanding
CO3	Discuss key element of Digital Marketing Strategy.	Applying
CO4	Understand use of Digital Marketing Tools for Digital Marketing Campaigns	Analyzing
CO5	Assess / Measure the effectiveness of the Digital Marketing Campaigns.	Evaluating
CO6	Demonstrate practical skills using common digital marketing tools like SEO, SEM, Content Marketing…	Creating

Module No.	Detailed Contents	Hrs.
1	**Module: Fundamentals of Digital Marketing:** Digital Marketing. Digital Marketing Strategy. Skills Required in Digital Marketing, Digital Marketing Plan, **Digital Marketing:** Introduction to Display Marketing, Types of Display Ads, Buying Models, Display Plan, Analytics Tools. Dignified Digital Marketing – Ethics and Data Privacy **Self Learning Topics:** What makes a Good Ad? Programmatic Digital Advertising, YouTube Advertising	04
2	**Module: Search Engine Advertising**	05

	Introduction, Understanding Ad Placement, Understanding AdRanks, Creating First Ad Campaign, Enhance Your Ad Campaign, Performance Reports. **Social Media Marketing** Building a Successful Strategy **Facebook Marketing** Facebook Marketing for Business, Anatomy of an Ad Campaign, Adverts, Facebook Insights, Other Marketing Tools, Other Essentials **Self Learning Topics:** Campaign Management, Running Campaigns, Lead Generation, Qualified Leads	
3	**Module: LinkedIn Marketing** Importance of LinkedIn Presence, LinkedIn Strategy, Sales Leads Generation Using LinkedIn, Content Strategy, LinkedIn Analytics, Targeting, Ad Campaign **Twitter Marketing** Getting Started with Twitter, Building a Content Strategy, Twitter Usage, Twitter Ads, Twitter Analytics, Twitter Tools and Tips for Marketers **Self Learning Topics:**	**09**
4	**Module: Instagram** **Mobile Marketing** Mobile Usage, Mobile Advertising, Mobile Marketing Toolkit, Mobile Marketing Features, Campaign Development Process, Mobile Analytics **Self Learning Topics:** Addressing the Diversity in India through Mobile	**07**
5	**Module: SEO** Search Engine, Concept of Search Engine Optimization (SEO), SEO Phases, On Page Optimization, Off Page Optimization, Social Media Reach, Maintenance **Self Learning Topics:** SEM	**06**
6	**Module: Web Analytics** Data Collection, Key Metrics, Making Web Analytics Actionable, Multi-Channel Attribution, Types of Tracking Codes, Mobile Analytics, Universal Analytics, Competitive Intelligence **Self Learning Topics:** Interpretation of various Charts available in Google Analytics. How to connect Offline with Online.	**08**

Reference Books:

Reference No.	Reference Name
1	Digital Marketing, Seema Gupta, McGraw Hill Education (India) Private Limited
2	Social Media& Mobile Marketing: Includes Online Worksheets Puneet Singh Bhatia ,ISBN: 9788126578078
3	Digital Marketing for Dummies, Ryan Deiss& Russ Henneberry, John Wiley & Son, Inc.
4	Social Media Marketing All-In-One, Jan Zimmerman, Deborah Ng, John Wiley & Sons Inc.

5	Epic Content Marketing, Joe Pulizzi, McGraw Hill Education
6	Youtility, Jay Baer, Gildan Media, LLC
7	Hit Makers : The Science Age of Dice of Popularity in an Age of Distraction, Derek Thompson, Penguin Press
8	The Art of SEO, Eric Enge, Stephan Spencer, Jessie Stricchiola, O'Reilly Media Inc,
9	Digital Marketing 2020, Danny Star,

Tutorial

Sr. No.	Detailed Contents	Hrs
01	Digital Marketing – Case Study : Ariel Fashion Shoot	01
02	Display Advertising – Case Study : Anything for Jetta	01
03	Search Engine Advertising – Case Study : Kotak Services	01
04	Social Media Marketing – Case Study : The Fall and Rise of Maggie	01
05	Facebook Marketing – Case Study : Tata DoCoMo	01
06	Facebook Marketing – Case Study : ICICI Bank – Building India's Most Social Bank on Facebook	01
07	LinkedIn Marketing – Case Study : Mercedes Benz, DELL	01
08	Twitter Marketing – Case Study : Mercedes-Benz (2011)	01
09	Instagram – Case Study : H & M	01
10	Mobile Marketing – Case Study : Philips Airfryer	01
11	SEO – Case Study : Barclays Business Banking SEO Campaign	01
12	Web Analytics – Case Study : Conversion Tracking through URL Builder – A Hotel Brand	01

Note: The Case Studies mentioned above are indicative and not limited to. The Teacher has the flexibility of taking similar Case Studies taking into consideration the current scenario and technological changes.

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE255	Research Methodology	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	1	3	1	4
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	25	80	125

Pre-requisites:

Basic knowledge of Mathematics for Data Analysis, Software, Internet

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Understand Research and Research Process and their types
2	Acquaint students with identifying problems for research
3	Explain the various research strategies and apply them to various research problems

Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate knowledge of research concepts and processes	understanding
CO 2	Perform literature reviews, prepare the key elements of a research proposal	Applying
CO 3	Compare and contrast quantitative and qualitative research	analyzing
CO 4	Define and develop a possible research interest area using specific research design	applying
CO 5	Explain the rationale for research ethics, and its importance	understanding
CO 6	Demonstrate enhanced writing skills	Applying

Module	Detailed Contents	Hrs

01	**Introduction and Basic Research Concepts** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research , Issues and Problems in Research , **Self Learning Topics** : Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**8**
02	**Research types and Design** : Basic Research , Applied Research , Descriptive Research, Analytical Research , Empirical Research ,Qualitative and Quantitative Approaches **Research Design** – Meaning, Types and Significance , Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors **Self Learning Topics** : types of Sampling	**8**
03	**Research Methodology** Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research Problem , Formulation of Research Problem , Review of Literature , Formulation of Hypothesis , Formulation of research Design , Sample Design , Data Collection , Data Analysis , Hypothesis testing and Interpretation of Data , Preparation of Research Report **Self Learning Topics** : types of Hypothesis	**8**
04	**Formulating Research Problem** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization , Interpretation, and analysis Validity Testing **Self Learning Topics** : importance of interpretation	**5**
05	**Ethics :** Ethical Issues , Ethical Committees , Commercialization , copy right , royalty , Intellectual Property rights and patent law , Track Related aspects of intellectual property Rights, Reproduction of published material , Plagiarism, Citation and Acknowledgement ,Reproducibility and accountability. **Self Learning Topics :** Steps of patent filing	**5**
06	**Testing & Report writing** Preparation of the report on conclusion reached , , Suggestions and Recommendation	**5**

Reference Books:

Reference No	Reference Name
1	Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2	Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.

3	Pruzan, Peter , Research Methodology, The Aims, Practices and Ethics of Science , ISBN 978-3-319-27167-5
4	Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors
5	Wadehra, B.L.2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
6	Kumar Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Web References:

https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355.html
https://academicguides.waldenu.edu/library/srmo/tutorials

Research Methodology Tutorial

Sr. No.	Detailed Content	Hrs
1	Defining a Research Problem in the area of interest	1
2	Literature Review of the Research Problem - Case Study	1
3	Research Design of the problem - Case Study	1
4	Sampling Design of the problem - Case Study	1
5	Measurement And Scaling Techniques to be used - Case Study	1
6	Formation of hypothesis Methods Of Data Collection for the research problem - Case Study	1
7	Processing And Analysis Of Data for the research problem - Case Study	2
8	Hypothesis testing - Case Study	1
9	Interpretation & Report Writing - Case Study	1

Assessment:

Continuous Assessment: 20 marks

Following measures can be used for the continuous assessment as

Assignments /Quiz /Case studies /Projects / Any other measure with the permission of the Director/Principal/HOD/Coordinator

The continuous evaluation has to be done throughout the Semester. The faculty can use the flexibility of the mode as per the requirement of the subject.

Test: 20 marks

Assessment consists of one class tests of 20 marks. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of the test shall be one hour.

Internal Assessment: 20 marks

The Internal Assessment marks (out of 20) will be the average of the Class test and the Continuous Assessment.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL21	Artificial Intelligence & Machine Learning	2	1	25	30	20	75

Pre-requisite: Basic understanding of mathematical, data mining concepts and any programming Language.

Lab Course Objectives:

Sr. No.	Course Objective
1	Understand problem solving concepts of artificial intelligence.
2	Impart a thorough understanding of basic machine learning algorithms and its applications.
3	Demonstrate dimensionality reduction techniques for feature extraction and selection.
4	Build model using appropriate machine learning algorithms for real world problems.

Lab Course Outcomes: On the successful completion of the course, students will be able to

Sr. No.	Outcome	Bloom Level
CO1	Apply the basic concepts of artificial intelligence and its applications.	Applying
CO 2	Experiment with basic and ensemble the machine learning algorithms and its applications.	Analyzing
CO 3	Analyze dimensionality reduction techniques for feature extraction and selection.	Analyzing
CO 4	Develop models using appropriate machine learning algorithms for real world problems.	Creating

Description:

Module	Detailed Contents	Hrs
1	**Logic programming with Prolog:** To specify relationships among objects and properties of objects**,** problem solving. **Self Learning Topic: -** Define rules defining implicit relationships between objects.	2
2	**Introduction to Python Programming:** Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.	4

	Self Learning Topic: - Milk, Shogun.	
3	**Supervised Learning:** Linear Regression predicts a real-valued output based on an input value, Logistic regression- the notion of classification, the cost function for logistic regression, and the application of logistic regression, KNN-classification. **Self Learning Topic: -** Evaluation metrics like MSE, Accuracy, Confusion Matrix, Precision, Recall, ROC curve.	4
4	**Dimensionality Reduction:** Features Extraction, Feature selection, Normalization, Transformation, Principal Components Analysis-visualizations of complex datasets. **Self Learning Topic:** - LDA (Linear Discriminant Analysis).	4
5	**Unsupervised Learning:** K-Means clustering algorithm, K-medoid clustering algorithm. **Self Learning Topic:** Other Clustering Algorithms.	2
6	**Classifying data using Support Vector Machines (SVMs):** SVM-RBF kernels. **Self Learning Topic**: -SVM-Kernels-Polynomial kernel.	2
7	**Bagging Algorithm:**Decision Tree,different ensemble techniques like bagging, boosting, stacking and voting, Random Forest- bagging, Attribute bagging and voting for class selection. **Self Learning Topic: -** Extra Trees.	4
8	**Boosting Algorithms:** AdaBoost, Stochastic Gradient Boosting, Voting Ensemble. **Self Learning Topic**: - AdaBoost as a Forward Stage wise Additive Model.	2
9	**Deployment of Machine Learning Models:** simple Web API. **Self Learning Topic**: Python Flask library.	2

Reference Books:

Reference No	Reference Name
1	Aurelian Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition.
2	Paul J. Deitel, Python Fundamentals.
3	Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, 3rd Edition, 2009.
4	EthemAlpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6.
5	Peter Harrington, Machine Learning in Action. Manning Publications, April 2012ISBN 9781617290183.
6	Introduction to Computer Programming using Python, John V Guttag
7	Core Python Programming, R. NageswaraRao

Web References:

Reference No	Reference Name
1	https://talentsprint.com/pages/artificial-intelligence-machine-learning-iiit-h-program/program-details.pdf
2	https://learning.oreilly.com/library/view/learning-robotics using/9781783287536/cover.html
3	http://www.qboticslabs.com
4	https://subscription.packtpub.com/book/big_data_and_business_intelligence
5	https://scikit-learn.org/0.16/modules/generated/sklearn.lda.LDA.html
6	https://machinelearningmastery.com/ensemble-machine-learning-algorithms-python-scikit-learn/
7	https://www.coursera.org/learn/machine-learning#syllabus
8	https://data-flair.training/blogs/python-ml-data-preprocessing/

Suggested list of experiments

Practical No	Problem Statement
1	Implementation of Logic programming using LISP /PROLOG-DFS for water jug problem / BFS for tic-tac-toe problem/ Hill-climbing to solve 8- Puzzle Problem.
2	Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.
3	Implementation of Linear Regression, Logistic regression, KNN- classification.
4	Implementation of dimensionality reduction techniques: Features Extraction and Selection, Normalization, Transformation, Principal Components Analysis.
5	Implementation of K-Means and K-medoid clustering algorithm.
6	Implementation of Classifying data using Support Vector Machines (SVMs).
7	Implementation of Bagging Algorithm: Decision Tree, Random Forest.
8	Implementation of Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble.
9	Deployment of Machine Learning Models.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.

   Experiments 20 marks
   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL22	Soft Skills Development Lab	02	01	50	--	--	50

Pre-requisite: Decent working knowledge of the English language (including Grammar) is a must, keeping in mind that most business/management transactions in India and internationally are conducted in the English language

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Inculcate the essential skills that professionals need to distinguish themselves and make a positive impact on their work and social lives
2	Provide better understanding of corporate culture and to improve their etiquettes, interpersonal skills and professional image
3	Develop holistically and ensure comprehensive learning.

Lab Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Develop interpersonal skills that help in communication, teamwork, leadership and decision making.	Applying
CO 2	Methodically study, formulate and interpret different facets of organizational behavior.	Evaluating
CO 3	Develop holistic leaders and technocrats helping in individual and organizational growth.	Creating

Description:

Module No	Detailed Contents	Hrs
1	**Soft Skills Introduction:** Soft-Skills Introduction What is Soft Skills? Significance of Soft-Skills – Soft-Skills Vs. Hard Skills - Selling Soft- Skills – Components of Soft Skills – Identifying and Exhibiting Soft-Skills **SelfLearning Topics:** Types of Soft, Hard Skills	02
2	**Communication** : Concept and meaning of communication, methods of communication, verbal and non-verbal communication, techniques to improve communication. Communication in a business organization: Internal (Upward, Downward, Horizontal, Grapevine). External Communication, 7 C's of communication. Active Listening, Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening, Intercultural sensitivities, Business etiquette when dealing with people from different nationalities Practical (Role plays, case studies)	03

	Self LearningTopics : Problems/Barriers in communication	
3	**Written/ Business Communication** : Written Communication: Principles of Correspondence, language and style in official letter (full block format, modified block format), Business letters (enquiry to complaints and redressal), Application letter, CV writing, , E-mail etiquette, Documentation of Meetings, Notice, Agenda, Minutes of Meetings. Practical (Practice on CV, Business Letters, Applications, Notice, Agenda, Minutes of Meetings) **Self Learning Topics:** Impact of modern Technology on Business Communication the paperless office, use of modern devices	**04**
4	**Presentation Skills** : Presentation techniques, Planning the presentation, Structure of presentation, Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management. Visual aids. Practical - Presentation by students in groups of maximum 3 on Organizational Behavior topics allocated by faculty. Topics have to cover – 1. Personality: Meaning, Personality Determinants, Traits, Personality types and its, impact on career growth, 2. Individual / Organizational Decision Making. 3.Attitude: Meaning, Components of Attitude, changing attitude and its impact on career growth 4. Perception and Values. 5. Motivation and Leadership: Concept, Importance. 6. Goal setting: SMART (Specific, Measurable, Attainable, Realistic, Timely) Goals, personal and professional goals 7. Time and Self-Management. 8. Learning in a group, Understanding Work Teams, Dynamics of Group Behavior, Techniques for effective participation 9. Etiquette- General & Business Etiquette, Body language 10. Emotional intelligence of self and SWOC 11. Threats v/s Challenges 12. Dos and Donts of a presentation/ meetings Online & offline.(presenter & members) **Self LearningTopics :** Voice modulation, Tone, Pitch,Knowledge and self confidence	**08**
5	**Effective Public Speaking** : Public Speaking, Selecting the topic for public speaking, Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, Delivering the speech,Voice Clarity. Practical (Extempore) **Self LearningTopics :** Preparation, Attire, Posture and Delivery techniques	**03**
6	**Group Discussions** : Group Discussion Skills, Evaluation components, Do's and Don'ts.	**03**

	Practical (Group Discussions) **SelfLearningTopics: --**	
7	**Interview Techniques** : Interview Techniques, Pre-Interview Preparation, Conduct during interview, Verbal and non-verbal communication, common mistakes. Preparation of CV. Practical (Role plays, mock interviews, Telephonic Interviews, Body Language, Facial Expression) **SelfLearningTopics :** Sample communications and exercises, audio-visual presentations	**03**

Reference Books:

Reference No	Reference Name
1	Business Communication (Revised Edition),Rai&Rai , Himalaya Publishing House.
2	Soft skills: an integrated approach to maximise Personality, Chauhan&Sharma,Wiley India publications.
3	Business Communication: A practice oriented approach, Kalia and ShailjaAgarwal.
4	Business Communication – Meenakshi Raman, Prakash Singh, Oxford Publication
5	Stephen Robbins & Judge Timothy: Organization Behavior, Pearson Education
6	K. Aswathappa – Organizational Behavior: Text, cases & games, Himalaya Publishing House.
7	Pareek, Udai, Understanding Organizational Behaviour, Oxford University Press, New Delhi.
8	Taylor & Chandra, "Communication for Business: A Practical Approach," Pearson
9	Doctor & Doctor, "Business Communication," Sheth Publishers.

Sugested list of experiments

Practical No	Problem Statement
1	Role Plays
2	Management Activities/Games
3	Case Studies
4	Presentations
5	Extempore Public Speaking
6	Group Discussions
7	Mock Interviews

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 40 marks
   Attendance 10 marks
2. Practical will be evaluated by the subject teacher and documented according to a rubric

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE231	Image Processing Lab	2	1	25	30	20	75

Pre-requisite: Basic understanding of fundamentals of any programming language

Lab Course Objectives

Sr.No.	Course Objective
1	To Understand basics of Digital Image Processing concepts and implement basic techniques for handling images
2	To understand tools that can be used to implement image processing algorithms
3	To implement various techniques for image enhancement, segmentation and some basic morphological operations

Lab Course Outcomes

Sr.No	Outcome	Bloom Level
CO1	Understand different image file formats and their structure	Understanding
CO 2	Explain how Digital images are manipulated using various image enhancement techniques	Understanding
CO 3	Learn the signal processing algorithms and techniques in image enhancement and image restoration.	Applying
CO 4	Implement digital transforms	Creating
CO 5	Be able to understand and implement certain image compression techniques.	Understanding

Description:

Module	Detailed Contents	Hrs
I	**Image Enhancement** : Spatial domain and Frequency domain techniques **Self Learning Topics:** color image enhancement	4
II	**Discrete Fourier Transform:** To find DFT/FFT forward and Inverse Transform of Image. **Self Learning Topics:** Image transforms	5
III	**Discrete cosine Transform** : To find DCT forward and Inverse Transform of Image. **Self Learning Topics**: Sine Image Transforms	4

IV	**Image Segmentation and Image Restoration** : The detection of discontinuities - Point, Line and Edge detections, Hough Transform, Thresholding, Region based segmentation Chain codes. **Self Learning Topics:** Image segmentation techniques.	**5**
V	**Image Data Compression :** Fundamentals of compression, Basic compression Methods. **Self Learning Topics:** Difference between lossy and lossless compression	**4**
VI	**Morphological Operation** : Morphological operations: Dilation, Erosion, Opening, Closing. **Self Learning Topics:** Erosion, Dilation, Hit or Miss operation.	**4**

Reference Books:

Reference No	Reference Name
1	R.C.Gonzalez & R.E.Woods, Digital Image Processing, Pearson Education, 3rd edition, ISBN. 13:978-0131687288
2	S. Jayaraman Digital Image Processing TMH (McGraw Hill) publication, ISBN- 13:978-0-07- 0144798
3	Gonzalez, Woods & Steven, Digital Image Processing using MATLAB, Pearson Education, ISBN-13:978-0130085191
4	William K. Pratt, "Digital Image Processing", John Wiley, NJ, 4th Edition,200
5	Sid Ahmed M.A., "Image Processing Theory, Algorithm andArchitectures", McGraw-Hill, 1995.Umbaugh, "Computer Vision".
6	Anil K.Jain,Fundamentals of Digital Image Processing,Prentice Hall of India,2nd Edition, 2004.

Web References:

Reference No.	Reference Name
1	https:// www.ict.gnu.ac.in › sites › files › subject syllabus pdf
2	https:// www.gtu.ac.in › syllabus › sem7
3	https:// www.nptel.ac.in › content › syllabus_pdf
4	https:// www.ktuweb.com › page_showdoc › dopage=syllabus
5	https://www.cse.iitkgp.ac.in › syllabus
6	https:// www.vit.edu › images › btech_syllabus_entc_16-17
7	https:// www.iitkgp.ac.in › fac-profiles › showprofile
8	https:// www.cse.iitb.ac.in › ~ajitvr › cs663_fall2018

Suggested list of experiments

Practical No	Problem Statement
1	Program to display image using read and write operation
2	Program to enhance image using image arithmetic and logical operations.
3	Program to implement Image Negative,
4	Program to implement Thresholding of an Image

5	Program to Implement smoothing or averaging filter in spatial domain
6	Program to produce the Histogram, Equalized Histogram, and Equalized image of an input image
7	Program for smooth an image using low pass filter in frequency domain
8	Program for sharpen the image using high pass filter in frequency domain
9	Program to find DFT/FFT forward and Inverse Transform of Image
10	Program to find DCT forward and Inverse Transform of Image
11	Program to find Edges using Prewit/ Sobel/ Fri-chen / Robert operators
12	Program to find edges using canny Edge Detection
13	Program to implement Huffman coding technique for image compression

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 Marks
   Attendance 5 marks
2. Practical will be evaluated by the subject teacher and documented according to a rubrics.

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE232	Internet of Things Lab	02	01	25	30	20	75

Pre-requisite: 1. Knowledge of C and C++ Programming.
2. Basics of Cloud.

Lab Course Objectives: The Course aim to

Sr. No.	Course Objective
1	Learn basic electronic components and to get familiar with arduino software/hardware and arduino simulator.
2	Interface various I/O devices and sensors with arduino.
3	Interface IoT device with cloud.
4	Develop skills required to build real-life IoT based projects.

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Identify basic electronic components and make use of arduino software/hardware and arduino simulator.	Applying
CO 2	Experiment with various I/O devices and sensors with Arduino.	Applying
CO 3	Build IoT application using Cloud.	Creating
CO 4	Develop IoT based projects.	Creating

Description:

Module	Detailed Contents	Hrs
1	**Module: Introduction to Basic Components** : □ Familiarization with Arduino and perform necessary software installation. □ Breadboard Basics □ Programming the Arduino o Arduino, circuits, and code: Bringing everything together **Self Learning Topics:** Basic electronic components such as LED, resistors, battery etc.	2
2	**Module: Switches, LEDs, and More:** □ Programs based on interfacing LED's, Switches/push buttons and Speakers/Buzzer, LCD/ Seven Segment Display with Arduino **Self Learning Topics:** Basics of Switches /push buttons **,** LED, Speakers/Buzzer, LCD/ Seven Segment Display	4
3	**Module: Analog Values** □ Programs based on interfacing LED's, Potentiometer, Photoresistor with Arduino □ Programs using PWM pins of Arduino □ Programs using Serial Monitor of Arduino □ Programs based on interfacing DHT11 temperature sensor □ Programs based on interfacing Passive infrared sensors (PIR), Ultrasonic	6

	of Arduino **Self Learning Topics:** Basic of Analog values, PWM concepts	
4	**Module: Servo Motors:** • Programs based on interfacing LED's, Servo Motor, Potentiometer with Arduino **Self Learning Topics:** Basics of servo motors, potentiometer	**2**
5	**Module: IoT in Cloud:** • Interfacing IoT device with Cloud **Self Learning Topics:** Computer Network and Cloud Concepts	**4**
6	**Module: Mini Project:** • Mini projects such as Home automation, Robots, Wearable projects, art projects etc. **Self Learning Topics:** Real life problem statement	**8**

Reference Books:

Reference No.	**Reference Name**
1	Make: Learn electronics with Arduino, Jodi Culkin and Eric Hagan, Maker Media
2	Programming Arduino: Getting started with sketches, Simon Monk , TMH
3	Getting Started with Arduino: A Beginners Guide, Brad Kendal,
4	Make: Getting Started with Arduino, Massimo Banzi, Michael Shiloh, Makermedia
5	Make: Getting Started with Sensors, KimmoKarvinen, TeroKarvinen, Makermedia
6	Learn Electronics wit Arduino, Don Wilcher, Apress
7	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler VlasiosTsiatsis Catherine Mulligan Stefan Aves and StamatisKarnouskos David Boyle
8	VijayMadisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
9	The Internet of Things in the Cloud:A Middleware Perspectiv,By Honbo Zhou
10	Rethinking the Internet of Things A Scalable Approach to Connecting Everything, Francis daCosta, Apress

Web References:

Reference No	**Reference Name**
1	http://www.tinkercad.com
2	https://www.arduino.cc/
3	https://www.makerspaces.com/15-simple-arduino-uno-breadboard-projects/
4	https://thingspeak.com/

Suggested list of experiments:

- All Programs to be done using Simulation Tool like Tinkercad or any other simulation tool. Interfacing IoT device with cloud using any cloud platform like ThingSpeak, AWS etc.

Practical No	**Problem Statement**
1	Program to blink Arduino onboard LED and To interface external LED with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
2	To interface 5 LED's with Arduino and write a program to blink 6 LEDs, one at a

	time, in a back and forth formation.
3	To interface Push button with Arduino and write a program to turn ON LED when push button is pressed.
4	To interface Push button, Speaker/buzzer with Arduino and write a program to turn ON LED and generate a note or tone when push button is pressed.
5	To interface 2 Push buttons, a Speaker with Arduino and write a program to turn ON LED and generate a 2 different notes on two button keyboard.
6	To interface Seven Segment Display (SSD) with Arduino and write a program to blink SSD.
7	To interface Seven Segment Display (SSD) with Arduino and write a program to print numbers from 1 to 4 on SSD.
8	To interface LCD, push button, potentiometer with Arduino and write a program to display message on LCD when push button is pressed.
9	To interface LCD, push button, potentiometer with Arduino and write a program to display the no. of times (count) the push button is pressed on LCD.
10	To interface LED's, potentiometer with Arduino and write a program to turn on or off more of the LEDs by turning the potentiometer knob.
11	To interface LED, Photo resistor (LDR) with Arduino and write a program to increase and decrease the brightness of the LED based on the amount of light present.
12	To interface LED's with Arduino and write a program to show the fading effect on LED's.
13	To interface DHT11 sensor with Arduino and write a program to display temperature and humidity data on serial monitor.
14	To interface PIR/ Ultrasonic sensor with Arduino and write a program to turn on and off LED depending on motion detection/sound detection.
15	To interface servo motor/DC motor with Arduino and write a program to sweep a servo back and forth through its full range of motion/ to control a DC motor.
16	To interface LED with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification.
17	To interface Temperature sensor with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification.
18	To build a mini project based on interfacing any combination of sensors with Arduino and cloud.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 marks

   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE233	Robotic Process Automation	02	01	25	30	20	75

Pre-requisite: 1. Knowledge of C and C++ Programming.
2. Software Engineering (UML)

Lab Course Objectives:

Sr. No.	Course Objective
1	Identification of Use Cases for creating BOTs
2	Build, Edit and Run BOTs
3	Describe how Automation Anywhere's RPA tool can be used for creating software robots
4	Develop and apply IQ BOTs

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Robotic Process Automation and evolution.	Remembering
CO2	Demonstrate development of BOT with specific tools	Understanding
CO3	Apply RPA commands to automate atsks	Applying
CO4	Summarize this tool as a summation of Robotic Process Automation, Cognitive Analytics, and Workforce Analytics	Evaluating

Description:

Module	Detailed Contents	Hrs
1	**Module: Introduction to GUI of Tool** Demonstrate good understanding of Recorders, Editor, and various Basic Commands to build simple tasks / Bots for automating simple processes, Develop simple BOT, Control Room Features: Control Room Issues & Login, create Creator & Runner in Control Room, run Bot from Control Room, Schedule Bot from Control Room, working with credential managers, credentials vaults in control room **Self Learning Topics:** Use of Web Control Room of AAE. Control Room, demonstrate client, Audit Log in Control Room	2
2	**Module: Automation anywhere Basic Commands:** MESSAGE BOX, Comment & Variables Type, Clipboard, Delay & Wait, Log To File, Launch Website, - Open Program / File, Read From CSV / Text File, Object Cloning with Insert Keystroke, Variable Operation with Loop,	4

	Window Actions, String operation (Before After - Compare - Find), String operation (Join - Length - Lower Case), String Operation (Replace - Reverse - Split), String Operation (Sub String - Trim - Upper Case), error handling **Self Learning Topics:** Play Sound & System	
3	**Module: Automation anywhere Advanced Commands**: FTP / SFTP, Excel Automation, PDF Integration, Send Email, Email Automation, REST Web Service, SOAP Web Service, Database, PGP (Pretty Good Privacy), Manage Windows Control, OCR (Optical Character Recognition) of Analog values, **Self Learning Topics:** PWM concepts, schedulers and triggers	**4**
4	**Module: RPA for Excel Commands:** Automation of excel commands for different real-world business use cases using A2019 Excel Commands and Generation of reports for data analysis, decision making, and other business process automation requirements **Self Learning Topics:** Automation of excel commands	**4**
5	**Module: Working with PDF Documents:** **Self Learning Topics:** Real life problem statement	**2**
6	**Module: Advanced RPA Techniques:** Manipulating web-based components like textbox, IQBotDahsboard, IQBot Commands, Build resiliency within a bot **Self Learning Topics:** Manipulating web-based component such as drop down	**4**
7	**Module: Use of UI Path Tool:** **UIPath Orientation, UI Path Structure, Control Flow, Error Handling** **Self Learning Topics: UI Control Flow**	**3**
8	**Automation of RPA Case study**	**3**

Reference Books:

Reference No.	Reference Name
1	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems By Tom Taulli
2	Value-Driven Robotic Process Automation Enabling Effective Digital Transformation by Mathias Kirchmer, Peter Franz and Danny Bathmaker
3	Learning Robotic Process Automation- Alok Mani Tripathi, Copyright 2018 Packt Publishing

Web References:

Reference No	Reference Name
1	https://www.udemy.com/course/robotic-process-automation/
2	https://www.udemy.com/course/learn-automation-anywhere/
3	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-university-essential-level-prep-courses-mba-students/

4	https://www.udemy.com/course/learn-advanced-rpa-automation-anywhere-with-iqbot-and-wlm/
5	https://www.edureka.co/blog/automation-anywhere-examples
6	https://docs.automationanywhere.com/bundle/enterprise-v11.3/page/enterprise/topics/aae-client/bot-creator/commands/commands.html

Suggested list of experiments:

NOTE: All Programs are designed for RPA tool : Automation Anywhere

Interfacing IoT device with cloud using any cloud platform like ThingSpeak, AWS etc.

Practical No	Problem Statement
1	Use of recorder, editors and basic commands to build simple tasks.
2	Run Bot from Control Room and Schedule Bot from Control Room.
3	Automate action of getting the title of active window.
4	Automate action of closing a notepad window.
5	Automate task of replacing few characters from a string
6	Automate task of copying files from a source folder to destination folder.
7	Extract a table from webpage
8	Automate task of extracting a text from a window and display text
9	Automate task of writing text into Notepad file
10	Extract data from JSON file and display output in message box
11	To automate the task of extracting the data from an Excel File according to some condition and storing the extracted data in another File.
12	To automate the task of extracting the data from multiple PDF documents and storing the data into a CSV file.
13	Manipulate web-based components like textbox, drop down
14	Extract data from website and store itin excel or database
15	Demonstrate Scheduler and trigger
16	Design IQ BOT and resilience BOT
17	Apply UIPath tool for some examples.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 marks
   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE234	Computer Vision Lab	02	01	25	30	20	75

Pre-requisite: *Fundamental Knowledge of Computer Graphics and Image Processing*

Lab Course Objectives:

Sr.No.	Course Objective
1	Learn basic Image Processing techniques used in Computer Vision
2	Illustrate various components used in Computer Vision
3	Implement Motion Tracking and Face Detection
4	Understand applications of CNN in Computer Vision

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Understand Open CV Framework	Understanding
CO 2	Develop applications using basic image processing techniques used in Computer Vision	Applying
CO 3	Design Applications to Detect Motion and Face in an image	Applying
CO 4	Create a Applications using CNN	Creating

Description:

Unit No	Detailed Contents	Hrs
1	**Module: Open CV and Python** Running Python Programs, Frameworks for CV,UnderstandingOpenCV, Programs using OpenCV	02
2	**Module: Basic Image Handling using python** Reading, Writing and Displaying Images, Plotting images, points and lines, Image contours and histograms, Histogram equalization, Interactive annotation, Gray	06

	level transforms, Image Transformations, Image Derivatives **Self Learning Topics:** Image Denoising	
3	**Module: Image Transformations** Program based on: Line Detection-Hough Transforms, Harris corner detector, Edge Detection, SIFT - Scale-Invariant Feature Transform, Matching Geotagged Images, Homographies, Warping images, Creating Panoramas :Camera Models and Augmented reality, Light effects **Self Learning Topics:** Drawing on Images	**06**
4	**Module: Exploring Structure from Motion** Motion Detector Using OpenCV, Motion Detection using Video, Plotting the motion Direction Graph **Self Learning Topics:** Object Classification	**04**
5	**Module: Face Detection and Tracking** Face detection, Pedestrian detection, Face recognition, Eigenfaces, Viola-Jones Algorithm, Haar-like Features, Integral Image, Training Classifiers **Self Learning Topics:** Measuring features	**04**
6	**Module: Convolutional Nerual Networks for CV** Object Detection and Identification using CNN, Building a CNN, Project **Self LearningTopics:Dogs and cats case study**	**06**

Reference Books:

Reference No	Reference Name
1	Solem, Jan Erik. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012.ISBN: 144934193
2	Demaagd, Kurt. Practical Computer Vision with SimpleCV: Making Computers See in Python. 2012.ISBN: 9781449337865
3	Jähne, Bernd, Horst Haussecker, and Peter Geissler, eds. Handbook of computer vision and applications. Vol. 2. San Diego: Academic press, 1999.ISBN: 0123797713
4	Baggio, Daniel Lélis. Mastering OpenCV with practical computer vision projects. Packt Publishing Ltd, 2012.ISBN: 1849517827

Web References:

Reference No	Reference Name
1	http://groups.csail.mit.edu/vision/
2	https://medium.com/readers-writers-digest/beginners-guide-to-computer-vision-23606224b720

3	https://vision.in.tum.de/research
4	Deeplearning.ai
5	http://www.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html
6	http://groups.csail.mit.edu/vision/

Suggested list of experiments

Practical No	Problem Statement
1	Program for Reading, Writing and Displaying Images
2	Program for Changing Color Spaces
3	Program to resize Images
4	Program to Rotate Images
5	Programs using Histogram Equalization
6	Programs for Edge detection
7	Programs for Line Detection
8	Programs using Scale Invariant Feature Transform (SIFT)
9	Programs for Motion Detection
10	Programs for Face Detection
11	Programs to differentiate objects

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 20 marks

   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE235	Embedded Systems Lab	02	01	25	30	20	75

Pre-requisite: Basic understanding of C / C++ and Python Programming.

Lab Course Objectives

Sr.No.	Course Objective
1	Understand basics of Embedded Systems and methods for programming.
2	Understand tools that can be used to write and execute programs for 8051 microcontrollers.
3	Implement some basic programs in Embedded C for 8051 microcontroller.
4	Execute some basic interfacing methods.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Understand the programming environment of the 8051microcontroller	Understanding
CO 2	Explain how microcontrollers can be programmed using embedded C programming	Understanding
CO 3	Learn execution of Embedded C programming using simulators	Applying
CO 4	Implement some basic hardware interfacing programs for 8051 / ARM / Raspberry Pi / Arduino	Analyse

Description:

Module	Detailed Contents	Hrs
1	**Introduction to Kiel or any other Simulator:** Introduction to Keil or any other simulator for executing Embedded C programs	2
2	**Embedded C Programming:** Introduction to Basics of Embedded C Programming, Program Structure and execution Methodology, Basic programs in Embedded C : Variable and Constant Declaration and	4

	Basic Input Output, Arrays	
3	**Embedded C Programming : Operators and Control Structures:** Basic programs on Operators and Control Structures	**5**
4	**Embedded C Programming : Functions** : Basic Programs to demonstrate the use of Functions.	**5**
5	**8051 Interfacing:** Basic Programs for interfacing various I/O ports and other devices with 8051 microcontroller.	**6**
6	**Raspberry Pi / Arduino platforms:** Introduction to basic interfacing methods on Raspberry Pi / Arduino or similar platforms using C / C++ / Java / Python	**4**

Reference Books:

Reference No	Reference Name
1	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill
2	Raj Kamal, "Embedded Systems : Architecture, Programming and Design", 2e, Tata McGraw Hill
3	K Uma Rao, AndhePallavi, "The 8051 and MSP430 Microcontrollers : Architecture, Programming and Applications, Wiley
4	Bahadure, Chandrakar, " Microcontrollers and Embedded System Design", Wiley
5	Raj Kamal, "Embedded Systems : Architecture, Programming and Design", Tata McGraw Hill.
6	Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition

Web References:

Reference No.	Reference Name
1	www.nptel.ac.in
2	www.keil.com
2	www.arduino.cc
3	www.raspberrypi.org

Suggested list of experiments

Practical No	Problem Statement
1	Program for basic Input/output.
2	Program to declare, initialize and use basic data types.
3	Program to implement control structures : If-Else
4	Program to implement control structures : While Loop
5	Program to implement control structures : for Loop
6	Program to implement Functions
7	Program to read and write a byte to a Pin of 8051

8	Program to continuously toggle an LED connected to an output pin of 8051
9	Program to display numbers on a Seven Segment Display connected to 8051
10	Program to generate time delay
11	Introduction to Raspberry Pi / Arduino processor kits and its interfaces
12	Program for interfacing LED / LCD Panel using Python / C++ / Java on Raspberry Pi / Arduino
13	Program for interfacing a DC Motor / Switches using Python / C++ / Java on Raspberry Pi / Arduino

Experiment No. 1 to 10 can be performed using simulators / emulators like Keil / Proteus / Mbed Studio. Experiment No. 11 to 13 can be performed using any of the kits available.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.

   Experiments 20 Marks

   Attendance 5 marks

2. Practical term work will be evaluated by the subject teacher and documented accordingly.

End Semester Practical Examination:

Practical and oral examination will be conducted by the University based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL24	Advanced Web Technologies	04	02	50	30	20	100

Pre-requisite:

1) Understanding of Object Oriented Programming concepts
2) Basic knowledge of web technologies

Lab Course Objectives:

Sr.No.	Course Objective
1	Understand advanced windows and web development techniques using dot NET
2	Use Microsoft ADO.NET to access data in web Application
3	Impart understanding of Web Techniques and Design Web Services
4	Learn advanced web framework MVC with razor

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Develop Web applications using various controls and programming techniques.	Applying
CO 2	Implement Data Binding applications using ADO.NET	Analyzing
CO 3	Solve identity management problems in web Applications application using session management and AJAX concepts.	Evaluating
CO 4	Create modern web applications using Web Services and MVC5	Creating

Description:

Module No	Detailed Contents	Hrs
1	**Module: Basics of C#** Windows Forms Application, Classes and Objects, UI Controls, Inheritance, Interfaces, Abstract Classes **Self-Learning Topics**: Indexers and Strings Manipulations	4
2	**Module: Introduction to ASP.NET** Design Simple web pages(Data types, variables, operators,ASP.net Objects), Basic Server side controls, Working with CrossPage, Postback And Autopostback ,Advanced Web server controls (validation, Calendar, AdRotator, Navigation, File upload),Build an	12

	Applications using Angular JS,JQuery and NodeJS, Websites using Master Pages (creating master and content pages) **Self-Learning Topics**: Themes and skins	
3	**Module: Database Programming in ASP.NET** Connected and disconnected Architecture of ADO.NET , Commands, Datasets, Data Readers, Data Adapters, Working with Stored Procedures, Data bound controls (DataList, DetailsView, FormView, GridView, ListView, Repeater), LINQ with ASP.NET,LINQ Introduction, Mapping data model to an Object model, Introducing query syntax, Entity Framework **Self-Learning Topics**: Charts and Data Pagers	**10**
4	**Module: Session Management and AJAX** Client Side State Management - View State, Query String, Cookie, Hidden Fields ,Server Side State Management Various State Management Techniques - Profiles, Session State, Application State, cache ,ASP.NET Applications with AJAX , AJAX Controls, Testing an ASP.NET Ajax application, Global.asax and Web Config,Caching **Self-Learning Topics**: Web Parts	**8**
5	**Module: Web Services and WCF** Creating and Consuming a XML Web Service-Simple and Database ,Creating and Consuming a WCF service – Simple and Database **Self-Learning Topics**: Caching Web service responses	**6**
6	**Module: ASP.NET MVC** Designing MVC application, Creating a Simple Data-Entry Application with validations, Using Automatically Implemented Properties, Using Object and Collection Initializers, Using Extension Methods, Using Lambda Expressions, Programs based on MVC Pattern, FORMS AND HTML HELPERS, Define and access the model type , Reduce duplication in views, Specify a default layout, Pass data values to the view from the controller , Generate different content based on data values, Add a namespace to a view **Self-Learning Topics**: Xamarin application	**12**

Reference Books:

Reference No	Reference Name
1	Spaanjaars, Imar. Beginning ASP. NET 4.5. 1: in C# and VB. John Wiley & Sons, 2014. ISBN: 1861009038
2	Evjen, Bill, Scott Hanselman, and Devin Rader. Professional ASP. NET 3.5 SP1 Edition: In C# and VB. John Wiley & Sons, 2011. ISBN: 0470187573
3	Freeman, Adam. "Pro asp. netmvc 5 platform." Pro ASP. NET MVC 5 Platform. Apress, Berkeley, CA, 2014. ISBN: 1430265418
4	Allen, K. Scott, et al. Professional ASP. NET MVC 5. Wrox Press, 2014. ISBN: 1118794753
5	Walther, Stephen. ASP. Net 4.5 Unleashed. Pearson Education India, 2012. ISBN: 067233688X
6	Nagel, Christian, Jay Glynn, and Morgan Skinner. Professional C# 2008 John Wiley & Sons, 2014. ISBN: 0470191376
7	MacDonald, Matthew. ASP. NET: The Complete Reference. McGraw-Hill, Inc., 2002. ISBN: 0072125764
8	Schildt, Herbert. C# 4.0: the complete reference. Tata McGraw-Hill Education, 2010.

Web References:

Reference No	Reference Name
1	https://docs.microsoft.com/en-us/aspnet/core/?view=aspnetcore-3.1
2	ttps://docs.microsoft.com/en-us/aspnet/mvc/overview/getting-started/introduction/getting-started
3	https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/
4	https://www.w3schools.com/asp/default.ASP
5	en.wikipedia.org › wiki › Web_service
6	https://docs.microsoft.com/en-us/aspnet/core/mvc/views/razor?view=aspnetcore-3.1

Suggested list of experiments

Practical No	Problem Statement
1	Design UI based applications using basic Windows forms Controls
2	Design Applications using Classes and Objects
3	Design Applications using Inheritance and Abstract Classes
4	Design a Web Application for an Organization with Regisration forms and advanced controls
5	Create website using master page concept.
6	Build an angular web application.
7	Design a webpage to demonstrate a connection oriented architecture.
8	Design a webpage to demonstrate a disconnected architecture.
9	Create a webpage that demonstrates the use of data bound controls of ASP.NET.
10	Design a webpage to demonstrate the working of a simple stored procedure.
11	Design a webpage to demonstrate the working of parameterized stored procedure.
12	Design a webpage to display the use of LINQ.
13	Build websites to demonstrate the working of entity framework in dot net.
14	Design Web Applications using Client Side Session Management
15	Design Web Applications using Server Side Session Management Techniques
16	Design Web Application to produce and Consume a web Service
17	Design Web Application to produce and Consume a WCF Service
18	Design MVC based Web applications.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments.
   Experiments 40 marks
   Attendance 10 marks
2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on the suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL25	User Interface Lab	02	01	25	30	20	75

Pre-requisite: Basic knowledge of Web Technologies and Software Engineering.

Lab Course Objectives

Sr.No.	Course Objective
1	Understand the importance of User Interface Design (UI) Process.
2	Analyze how to design Effective and Efficient User Interfaces for intended users.
3	Learn techniques for Prototyping and Evaluating User Experience.
4	Apply the concept of Good UI and User Experience (UX).

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Interpret user needs and context of User Interface design Specification	Analyzing
CO2	Demonstrate the tools and techniques for designing informing models	Applying
CO3	Develop high fidelity prototype for end to end solution.	Applying
CO4	Apply best practices for evaluating user experience.	Applying

Description:

Module	Detailed Contents	Hrs
1	**The UI life cycle:** Introduction to UI life cycle and UI tools. **Self Learning Topics:** phases and importance of UI life cycle	4
2	**Requirement gathering:** Include the business purpose and user needs. **Self Learning Topics:** Understand the user, types of users, requirement gathering techniques, contextual enquiry.	2
3	**Analysis:** User analysis,Task analysis,Domain analysis **Self Learning Topics:** Identifying the types of tasks, design objects model, contextual analysis.	4
4	**Design:** Scenario, Storyboard designs. **Self Learning Topics: Principles of good design, Mental model**	4
5	**Build and test the low fidelity prototype:** Build a prototype. Paper prototype, Wireframe Prepare a briefing for test users.(test the prototype) **Self Learning Topics: Types of prototypes**	4

6	**Implementation:** Working implementation of the chosen project. Light weight page loading, optimal design. **Self Learning Topics:** Implementation tool, user friendly design.	**6**
7	**Testing:** Evaluate the interface with a small user test and write a final reflection **Self Learning Topics : Testing Techniques**	**2**

Reference Books:

Reference No	Reference Name
1	Norman, Donald , *The Design of Everyday Things*,Basic Books, ISBN 978-0-465-06710-7
2	Steve Krug, Don't Make Me Think, Revisited: A Common Sense, New Riders,ISBN ,Third edition, 978-0-321-96551-6
3	Golden Krishna,The Best Interface Is No Interface, New Riders, First Edition, ISBN*978-0-133-89041-9*.
4	Theo Mandel, The Elements of User Interface Design, Wiley, First Edition, 978-0471162674
5	Wilbert O. Galitz, The Essential Guide to User Interface Design : An Introduction to GUI Design Principles and Techniques, Wiley , Second Edition, 978-8126502806
6	Rex Hartson and Pardha S Pyla, The UX Book, Morgan Kaufmann, 9780123852410

Web References:

Reference No	Reference Name
1	http://jjg.net/ia/elements.pdf
2	http://www.boxesandarrows.com
3	https://www.nngroup.com/articles/

List of Experiments:

1	**Introduction to UI life cycle and UI tools.**
2	**Project Proposal and Requirement Gathering (Choose the project)** The project should be a web, desktop, or mobile interface. If the chosen project is a mobile application, note that it must at least be possible to simulate the project, since one of the prototypes will be such a simulation that can be evaluated.
3	**Analysis** **Problem statement:** Briefly state the problem(s) that the project will seek to solve. Take the user's point of view. Consider what the user's goals are, and what obstacles lie in the way. **Output :** □ Write up a user analysis, task analysis (identify three tasks of the chosen problem), and domain analysis clearly, concisely, and completely. □ Design a persona. □ A problem object model or entity-relationship diagram.

4	**Design** **Creation of Scenario** Write a scenario that involves all three of the tasks identified for the chosen project. **Output:** □ Explain the Scenario □ Sketch the scenario (use any tool or hand sketches) □ Draw a mental model.
5	**Prototype** Creating a Paper Prototype and High Fidelity prototype (Wire Frame)usingFigma tool. **Output** □ Paper prototype □ Wireframe.
6	**Implementation** The code should be optimal and user friendly.
7	**Usability Evaluation of the Design** Testing of User Interface from Third Party(**Test scripts)** **Output** □ Test Script

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on any two case studies or mini projects based on the above syllabus.

   Experiments 20 marks

   Attendance 5 marks

2. Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL26	Networking with Linux	02	01	25	30	20	75

Pre-requisite: Linux, Computer Networks

Lab Course Objectives

Sr.No.	Course Objective
1	Train to install Network Simulation tool on Linux
2	Familiarize to a Network Simulation Tool
3	Design various network topologies using Network Simulation tool
4	Analyze network traffic using network sniffing software

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate installation and configuration of Network simulator	Understanding
CO 2	Construct network topologies using Network Simulator	Applying
CO 3	Analyze network traffic using network sniffing software	Analyzing
CO 4	Design and develop solutions to complex network problems using Network Simulator and Network Software	Creating

Description:

Module No.	Detailed Contents	Hrs
1	**Introduction to Network Simulation and sniffing software** • Installation of NS3 on Linux • Installation of NetAnim • Installation of Wireshark **Self learning:** Linux Operating System Commands for installation	6
2	**Client Server Network topology using NS-3** • Program to Create simple topology • Programs to different types of topologies • Program for complex topologies • Program for client server networks **Self learning:Network** Programming in Java	10
3	**Animating the Network** • Introduction to NetAnim • Animation a network using NetAnim **Self learning: Other Animation tools available with NS3**	4
4	**Analyzing Network traffic** • Monitoring the Network using WireShark **Self learning: Parameters used for analyzing Network Traffic**	2
5	**Real time problem Solving** • Mini Project of Creating Complex Networks using NS3, NetAnim and WireShark **Self learning: Integrating NS3,NetAdmin and Wireshark**	4

Reference Books:

Reference No	Reference Name
1	Learning Network Programming with Java by Richard M. ...
2	Java Network Programming, Third Edition, by Elliotte Rusty Harold.Oreily Pub
3	TCP/IP Sockets in Java, Second Edition: Practical Guide for Programmers (The Practical Guides)2nd Edition by Kenneth L. Calvert , Michael J. ...

Web References:

Reference No	Reference Name
1	https://www.nsnam.org/docs/release/3.9/manual.pdf
2	https://www.nsnam.org/tutorials/NS-3-LABMEETING-1.pdf
3	https://www.nsnam.org/wiki/Installation
4	https://www.nsnam.org/releases/ns-3-30/download/
5	https://www.nsnam.com/2014/08/installing-netanim-software-for-ns3-in.html
6	https://www.wireshark.org/download.html
7	https://www.wireshark.org/docs/wsug_html_chunked/ChBuildInstallWinInstall.html
8	https://www.howtogeek.com/104278/how-to-use-wireshark-to-capture-filter-and-inspect-packets/

Suggested list of experiments

Practical No	Problem Statement
1	Installation of NS-3 in Linux
2	Installation of NetAnim
3	Installation of WireShark
4	Program to simulate traffic between two nodes
5	Program to simulate star topology
6	Program to simulate bus topology
7	Program to simulate mesh topology
8	Program to simulate hybrid topology
9	Program to simulate UDP server client
10	Program to simulate DHCP server and n clients
11	Program to simulate FTP using TCP protocol
12	Animate a simple network using NetAnim in Network Simulator
13	Animate Three way handshake for TCP connection using NetAnim
14	Program to assign IPv4 Addresses in NS3
15	Analyze the network traffic using WireShark
16	Analyze the performance parameters of network using Wire Shark

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments, mini project has to be assessed internally.

   Experiments 20 marks
   Attendance 5 marks

Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP21	Mini Project – 1 B	02	01	50	-	--	50

Pre-requisite: NIL

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquaint with the process of applying basic computer applications and provide solutions to the problems in various application domains.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate the ability to produce a technical document.	Understanding
CO2	Apply software project management skills during project work.	Applying
CO3	Build small groups to work effectively in team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating

Guidelines for Mini Project:

1. Students shall form a group of 2 to 3 students.
2. Students should do survey and identify needs, which shall be converted into problems in consultation with the faculty Supervisor/Guide/HOD/Internal Committee of faculties. The project contact hours shall be allotted in the time table and 2 hours workload shall be considered for the guide/ supervisor.
3. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein the group can record weekly work progress, Guide/Supervisor can verify and record notes/comments.
5. Faculty may give inputs during mini project activity; however, focus shall be on self-learning.

6. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with Guide/ Supervisor.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Mini Project:

I) Term work (25 Marks):

- The progress of the mini project to be evaluated on a continuous basis.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks shall be as below;
  - Marks awarded by guide/supervisor based on log book : 10
  - Self contribution and use of skill set in project : 10
  - Quality of Project report : 05

II) Mini Project Internal Examination (25 Marks):

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- The students shall present a seminar on Mini project and demonstrate their understanding of need/problem.
- Mini Project shall be evaluated through a presentation and demonstration of working model by the student project group to a panel of examiner at Institute level.
- Mini Project shall be assessed based on following points:
  - Quality of survey/ need identification.
  - Clarity of Problem definition based on need.
  - Innovativeness in solutions.
  - Feasibility of proposed problem solutions and selection of best solution.
  - Cost effectiveness.
  - Societal impact.
  - Full functioning of working model as per stated requirements.
  - Effective use of skill sets.
  - Contribution of an individual as a member or leader.
  - Clarity in written and oral communication.

AC :11.05.2017

Item No. 4.176

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Master of Computer Applications: MCA

Second Year with Effect from **AY 2017-18**
Third Year with Effect from **AY 2018-19**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

From Co-ordinator's Desk:

To meet the challenge of ensuring excellence in Master Program in Computer Applications (M.C.A.: referred as Master of Computer Applications) education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. Inline with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that,

Each Board of Studies shall prepare some Program Educational Objectives(PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of Master of Computer Applications (MCA) education.

Semester based Credit and grading system enables a much required shift in focus from teacher centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Choice Based Credit and Grading System are implemented for First Year of Master of Computer Applications (M.C.A.) from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year and Third Year of M.C.A. in the academic year's 2017-2018 and 2018-2019 respectively.

Dr. S. K.Ukarande

Co-ordinator,
Faculty ofTechnology,
Member AcademicCouncil
University of Mumbai,Mumbai

Preamble:

The MCA Choice based syllabus is designed considering various modes of effective teaching-learning and assessment that reflect in its interdisciplinary approach required for advanced application course. This integrated teaching methodology allows understanding of interaction between the different business areas required for IT enabled industries. This methodology also allows students to develop multiple skills such as critical logic analysis, numerical ability, Database programming, Algorithmic optimization with testing, networking, report writing, communication skill, presentation skills,independent research,and working with real-life case studies. These skills further enable the students to take a full, active and responsible role in the IT enabled industries.

The syllabus is directional in wide scope and allows the much desired flexibility to keep speed with the ever growing body of knowledge and explorations in IT enabled industriesconsidering human side of enterprise. The course structures are carefully designed so that students get superiority in dealing with diverse situations when they step into the corporate world.

I would like to extend my thanks to Industries like IBM India Pvt. Ltd., Accenture,RBS India Pvt.Ltd., Myglamm, N.I.C. etc for their valuable inputs to strength the scope and contents of the syllabus. I would also like to extend my thanks to all M.C.A. Faculty members for their contribution in designing an outcome based curriculum.

Dr.Dhananjay R.Kalbande

Chairman- Ad-hoc Board of Studies of Computer Application,
Member- Academic Council,
University of Mumbai, Mumbai.

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA301	Database Management systems	04	--	--	04	--	--	04
MCA302	Java programming	04	--	--	04	--	--	04
MCA303	Information Security	04	--	--	04	--	--	04
MCA304	Operation Research	04	--	--	04	--	--	04
MCA305	Software Testing and Quality Assurance	04	--	--	04	--	--	04
MCAL301	Database Management systems and Software Testing Lab	--	06	--	--	03	--	03
MCAL302	Java Programming and Unified Modeling Language Lab	--	06	--	--	03	--	03
MCAPR 301	Mini Project	--	--	--	--	--	--	02
Total		**20**	**12**	**--**	**20**	**06**	**--**	**28**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
MCA301	Database Management systems	20	20	20	80	--	--	--	100
MCA302	Java programming	20	20	20	80	--	--	--	100
MCA303	Information Security	20	20	20	80	--	--	--	100
MCA304	Operation Research	20	20	20	80	--	--	--	100
MCA305	Software Testing and Quality Assurance	20	20	20	80	--	--	--	100
MCAL301	Database Management systems and Software Testing Lab	--	--	--	--	25	50	25	100
MCAL302	Java Programming and Unified Modeling Language Lab	--	--	--	--	25	50	25	100
MCAPR 301	Mini Project	--	---	---	---	25	--	25	50
Total		**100**	**100**	**100**	**400**	**75**	**100**	**75**	**750**

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA401	Data Mining and Business Intelligence	04	--	--	04	--	--	04
MCA402	Advanced Web Technology	04	--	--	04	--	--	04
MCA403	Computer Graphics	04	--	--	04	--	--	04
MCA404	Elective 1	04	--	--	04	--	--	04
MCA405	Elective 2	04	--	--	04	--	--	04
MCAL401	Advanced Web Technology and Data Mining and Business Intelligence Lab	--	06	--	--	03	--	03
MCAL402	Computer Graphics and Image Processing Lab	--	06	--	--	03	--	03
MCAL403 Activity Lab	Soft Skill Development	--	02	--	--	02	--	02
Total		**20**	**14**	**--**	**20**	**08**	**--**	**28**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
MCA401	Data Mining and Business Intelligence	20	20	20	80	--	--	--	100
MCA402	Advanced Web Technology	20	20	20	80	--	--	--	100
MCA403	Computer Graphics	20	20	20	80	--	--	--	100
MCA404	Elective 1	20	20	20	80	--	--	--	100
MCA405	Elective 2	20	20	20	80	--	--	--	100
MCAL401	Advanced Web Technology and Data Mining and Business Intelligence Lab	--	--	--	--	25	50	25	100
MCAL402	Computer Graphics and Image Processing Lab	--	--	--	--	25	50	25	100
MCAL403 Activity Lab	Soft Skill Development	--	--	--	--	50	--	--	50
Total		**100**	**100**	**100**	**400**	**100**	**100**	**50**	**750**

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Elective for Semester IV

SEM IV – Elective I	
Course Code	**Course Name**
MCA4041	Entrepreneurship Management
MCA4042	Business Infrastructure and Management
MCA4043	ERP
MCA4044	Ethics and CSR
SEM IV – Elective II	
Course Code	**Course Name**
MCA4051	Digital Forensics
MCA4052	Simulation and Modelling
MCA4053	Next Generation Networks
MCA4054	AI and Soft Computing

SEMESTER III

Subject Code	Subject Name	Credits
MCA301	**Database Management Systems**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA301	**Database Management Systems**	**04**	--	--	**04**	--	--	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA301	**Database Management Systems**	**20**	**20**	**20**	**80**	--	--	--	**100**

Pre-requisites:

Basic Knowledge of data structures

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO301.1	Emphasize on basic concepts to organize, maintain and retrieve information from a DBMS.
CEO301.2	Cover the principles of database systems and recognize how they are used in developing data-intensive applications.
CEO301.3	To study an effective and efficient database system with the help of the rising trends of parallel and distributed databases.

Course Outcomes: At the end of the course, the students will be able to

MCA301.1	Understand various database concepts and apply them in real life applications.
MCA301.2	Determine the manner in which data can be stored, organized and manipulated in a database system.
MCA301.3	Apply various indexing and optimization techniques to process queries.
MCA301.4	Analyze and design database applications using suitable database techniques.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Overview of DBMS**	Overview of Database management System, File systems versus DBMS, Advantages of DBMS, View of data: Data Abstraction, Instances and Schemas, Data Models, Database Languages , Structure of DBMS, Role of DBA	**06**
2	**Database Design using ER Model and Relational Model**	**Overview of design process:** Entity Relationship Model, Constraints, Entity relationship Diagram, Entity Relationship Design Issues, Weak Entity Sets, Extended ER features **The Relational Model:** Concepts of Relational Models, Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying Relational data, Logical Database Design: ER to Relational with Case Studies	**06**
3	**Normalization**	Informal Design Guidelines for Relational Schema, Functional Dependencies **Normal forms:** First, Second, Third Normal Form and BCNF.Introduction to De-normalization. Inference Rules for Functional Dependencies, Equivalence of Sets of Functional Dependencies, Minimal Set of Functional Dependencies, Properties of Relational Decomposition-Dependency Preservation, Lossless Join.	**08**
4	**Indexing**	**Overview of indexing**: Clustered Indexes, Primary and Secondary Indexes, Index Data Structures **Tree structured indexing**: Intuition for Tree Indexes, Indexed Sequential Access Methods, B+ Trees, Search, Insert, Delete, Duplicate **Hash Based Indexing**: Static Hashing, Extensible Hashing, Linear Hashing, Extensible Vs Linear Hashing	**10**
5	**Query Evaluation and** **Transaction Management**	Overview of Query Processing and Query Optimization, Query Evaluation Plans.Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability. **Concurrency Control**: Lock-Based Protocol, Timestamp-Based, Multi-version Schemes, Deadlock Handling **Recovery: F**ailure Classification, Log Based Recovery	**10**
6	**Parallel and distributed Databases**	**Parallel Databases:** Architecture for Parallel Databases, Parallel Query Evaluation **Distributed Databases:** Types of Distributed Databases, Distributed DBMS Architecture, Storing Data in a Distributed DBMS, Distributed Transaction, Distributed Concurrency Control, Distributed Recovery	**08**
7	**Object database systems**	Structured Data Types, Operations on Structured Data, Inheritance, Objects, Oids and Reference Types, Object oriented versus Object relational	**04**

References:

- Korth, Silberchatz, Sudarshan, "Databse system Concepts", McGraw Hill,2006
- Raghu Ramakrishnan, Johannes Gehrke,"Database Management Systems", Third Edition, McGraw Hill2003.
- Elmasari and Navathe, Benjamin Cummins ,"Fundamental of Database System", Pearson Education,2009
- C. J. Date ,"An Introduction to Database Systems", 8/e,Pearson Education,2002
- Rob Coronel ,"Database Systems Design, Implementation and Management", Cengage Publication,2009
- AtulKahate, "Database Management System" Pearson Education. 2006

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA302	**Java Programming**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut.	Total
MCA302	**Java Programming**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCA 302	**Java Programming**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic understanding of any Object Oriented Programming Language.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO302.1	Understand fundamentals of object-oriented programming in Java.
CEO302.2	Study various Java programming constructs.
CEO302.3	Learn application development using Java Components.

Course Outcomes (CO): At the end of the course, the students will be able to

MCA302.1	Solve computational problems using basic constructs.
MCA302.2	Find a solution for real world problems using Java
MCA302.3	Develop Web Applications using Server Side Programming.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1.	**Fundamentals of Java Programming**	Features of Object-oriented Programming, History of Java, Features of Java, JVM Architecture, Differences between C++ and Java,Data types, variable, expressions, operators, control structures, arrays	**03**
2.	**Object and Classes**	Classes, Instance variables, Methods, Constructors, Access Specifiers, Abstract Classes and Wrapper Classes, Autoboxing and Unboxing, Inheritance, Polymorphism, Method Overriding, Use of Static, final, super and this keyword, Garbage collection and finalize method, string and mutable string, Inner Classes	**04**
3.	**Packages and Interfaces**	Package concept, Creating user defined package, Access control protection, Defining interface, Implementing interface.	**02**
4.	**Generics and Collections**	Generics - Generic Class, Creating Generic Classes, Generic Methods, Bounded Type, Collections- Collections and Generics, Collection Classes-Links, Vector, Linked Lists, Maps, HashMap, WildCards, LambdaExpressions - Lambda Type Inference, Lambda Parameters, Lambda Function Body, Returning a Value From a Lambda Expression, Lambdas as Objects	**05**
5.	**Exception Handling**	Exception handling fundamentals, Exception types, Exception as objects, Exception hierarchy, Exception Keywords - Try, catch, finally, throw, throws, Creating User defined Exceptions, Assertion, Annotations	**04**
6.	**Multi-threading**	Java thread model, Life Cycle of Thread, Working with Thread class and the Runnable interface, Thread priorities, ThreadGroup class, Inter thread communication, Synchronization.	**04**
7.	**File handling**	Input streams and Output streams, FileInputStream and FileOutputStream, Binary and Character streams, Buffered Reader/ Writer, Object serialization and Deserialization.	**04**
8.	**Event handling and GUI programming**	Comparison of AWT and SWING, Applet class, Applet API hierarchy , Life cycle of Applet, Delegation Event Model, Event handling mechanisms, Swing components, Swing Component Hierarchy- Basic and Advanced Components, JApplet, Layout managers, Adapter class, Inner class.	**05**
9.	**Database Programming**	JDBC architecture, Types of drivers, Java.sql package, Establishing connectivity and working with connection interface, Working with statement interface, Working with PreparedStatement interface, Working with ResultSet interface, Working with ResultSetMetaData interface.	**05**
10.	**Web development using Servlets**	Introduction to servlets, Servlet vs CGI, Servelet API overview, Servlet Life cycle, Generic servlet, HTTPServlet, ServletConfig, ServletContext, Handling HTTP Request and response –GET / POST method, request dispatching, Using cookies, Session tracking..	**06**
11.	**Web development using JSP**	Introduction to JSP, JSP Architecture, JSP Directives, JSP scripting elements, Default objects in JSP, JSP Actions, JSP with beans and JSP with Database, Error handling in JSP, Session	**06**

		tracking techniques in JSP, Introduction to custom tags, JSTL tags in detail	
12.	**Introduction to Spring Frameworks**	Introduction to Spring Framework, Spring Architecture, Spring Aspect of Object Oriented Concepts – Join Point and Point Cuts.	**04**

References:

- The complete reference JAVA2, Herbert schildt. Tata McGraw Hill
- Programming with Java A Primer, E. Balaguruswamy Tata McGraw Hill
- Core Java for beginners, Sharanam Shah and Vaishali Shah, SPD
- Java 6 Programming Black Book, Wiley –Dreamtech
- Web Enabled Commercial Application Development using java 2.0, Ivan Byaross
- Java Server Programming java EE6, Black book, Dreamtech press.
- Core Servlets and Java Server Pages :Vol I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson
- Java 6 Programming, Black Book, Dreamtech Press.
- Java Enterprise in a Nutshell, 3rd Edition A Practical Guide, Jim Farley, William Crawford, O'Reilly
- Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD
- Spring in Action, Craig Walls, 3rd Edition, Manning

Web References:

- https://docs.oracle.com

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA303	**Information Security**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA303	**Information Security**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCA 303	**Information Security**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Computer Networks, Databases

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO303.1	Understand information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
CEO303.2	Study cryptography and key encryption techniques used today.
CEO303.3	Comprehend relevant security parameters in the internet, web, database systems and applications

Course Outcomes (CO): At the end of the course, the students will be able to

MCA303.1	Understand the requirement of information security and a clear understanding of its importance
MCA303.2	Be familiar with information security threats and countermeasures, and familiar with information security designs using available secure solutions
MCA303.3	Use the database security mechanisms, intrusion detection systems, formal models of security, cryptography, network ,web security

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction**	Principles of Security, Attacks, Services and Mechanisms, Integrity check, digital Signature, authentication.	**03**
2	**Cryptography**	Private Key Cryptography: Block Encryption, DES Algorithm, Problems with DES, Variations of DES, IDEA Algorithm, Uses of Secret key Cryptography; ECB, CBC, OFB, CFB Public Key Encryption : RSA Symmetric and Asymmetric Key Cryptography together	**08**
3	**Authentication**	Types of Authentication- Password-based authentication, address-based authentication, cryptographic authentication, smart cards, biometrics, mutual authentications, reflection attacks, Message Digest : MD5 ,SHA,MAC ,HMAC, Digital Certificate process, KDC-working, multi domain KDC, Kerberos	**10**
4	**Internet Security**	Transport Layer Security: SSL, SET Email Security : PGP, S/MIME, Comparison, IP security : IPSec, Web Services Security : XML, SOAP, WSDL and UDDI, SSl, WS-Security, SAML, Ws-Trust, WS-Security Policy	**08**
5	**Intrusion Prevention andDetection**:	Introduction, Intrusion Detection Systems , Prevention versus Detection, Types of Intrusion Detection systems, DOS attacks, Flooding Attacks, DdoS Attack Prevention/Detection, Defenses Against Denial-of-Service Attacks, Malware Detection	**06**
6	**Database Security**	The Need for Database Security, Database Access Control, Inference, Statistical Databases , Database Encryption,	**05**
7	**Firewalls**	Characteristics, Packet filters, Application Level Gateways, Circuit Level Gateways, Firewall Architectures, Trusted System,	**06**
8	**IEEE 802.11 Wireless LAN Security**	Background, Authentication: Pre- WEP Authentication, Authentication in WEP, Authentication and key agreement in 802.11i, Confidentiality and Integrity: Data protection in WEP, Data protection in TKIP and CCMP	**06**

References:

- AtulKahate, "Cryptography and Network Security", McGraw Hill
- Network Security sand Cryptography: Bernard Menezes, CENGAGE Learning
- Cryptography and Information Security, V. K. Pachghare PHI Learning Pvt. Ltd.
- M. Stamp, "Information Security: Principles and Practice," 2nd Edition, Wiley, ISBN: 0470626399, 2011.
- W. Stallings, "Computer Security: Principles and Practice," 2nd Edition, Prentice Hall, ISBN: 0132775069, 2011.
- Kaufman C., Perlman R., and Speciner, "Network Security", Private Communication in a public world, 2nd ed., Prentice Hall PTR.,2002
- Computer Security, 3rd Edition, Dieter Gollmann, December 2010, Wiley Publications

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA304	**Operation Research**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA304	**Operation Research**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA304	**Operation Research**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic knowledge of Mathematics and Statistics.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO304.1	Study formulation, analysis and solving science, engineering and business problems.
CEO304.2	Study mathematics and mathematical modelling using computers to forecast the implications of various choices.
CEO304.3	Study the selection of the best alternatives from the available choices.

Course Outcomes (CO): At the end of the course, the students will be able to

MCA304.1	Apply Operations research methodology to a broad range of problems in business and industry.
MCA304.2	Use mathematics and mathematical modelling using computers to forecast the implications of various choices.
MCA304.3	Solve optimization problems.
MCA304.4	Think of new methods for solving optimization problems.

Syllabus

Sr No	Module	Detailed Contents	Hrs
1	**Nature of Operation Research**	History ,Nature of Operation Research ,Impact of Operation Research, Application Areas	**01**
2	**Overview of Modeling Approach**	Formulating the problem, Constructing a mathematical model, Deriving a solution, Testing a model and the solution, Establishing control over the solution, Implementation issues	**02**
3	**Linear Programming**	Introduction ,Graphical solution**,** Graphical sensitivity analysis, The standard form of linear programming problems**,** Basic feasible solutions, Simplex algorithm, Artificial variables, Big M and two phase method, Solution to Problems based on Degeneracy, Alternative optima, Unbounded solution, Infeasible solutions.	**12**
4	**Dual Problem**	Relation between primal and dual problems, Dual simplex method, Sensitivity analysis.	**05**
5	**Transportation Problem**	Starting solutions. North-west corner Rule – least cost methods – Vogel's approximation method, MODI Method, Minimization and Maximization problem	**05**
6	**Assignment Problem &Travelling Salesman Problem**	Assignment Problem: Hungarian method (Minimization and Maximization) Traveling Salesman Problem: Branch & Bound technique, Hungarian method	**05**
7	**Sequencing Problem**	Two machines n jobs , three machines n jobs, n machines m jobs	**03**
8	**PERT and CPM**	Arrow network ,Time estimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and slack time**,** Critical path**,** Probability of meeting scheduled date of completion of project**,** Calculation of CPM network **,**Various floats for activities**,** Project crashing.	**06**
9	**Replacement Theory**	Replacement of items that deteriorate, Replacement of items that fail group replacement and individual replacement.	**04**
10	**Integer Programming**	Branch and Bound Algorithm, Cutting plane Algorithm	**06**
11	**Game Theory**	Two person Zero sum games, Solving simple games.	**03**

References:

- Operation Research-An Introduction: Taha H. A., McMillan Publishing Company, NY
- Introduction to Operation Research: Hillier F., and Lieberman G.J, Holden Day
- Operations Research : P. K. Gupta & Hira, S. Chand
- Operations Research Applications and Algorithms: Waynel L. Winston Thomson
- Mathematical Programming Techniques: Kambo, N.S., McGraw Hill
- Operations Research- Principles and Practice: Ravindran, Wiley Production
- Operations Research: L E Prasad, Cengage Learning

- Optimization Methods: K.V. Mital& Mohan New Age
- Operations Research: KantiSwaroop, Gupta P.K. Man Mohan, Sultan Chand and Sons
- Operation Research: S.D. Sharma
- Principles of Operation Research (with applications to managerial decisions) – H.M Wagher,PHI, New Delhi

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA305	**Software Testing and Quality Assurance**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA305	**Software Testing and Quality Assurance**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA305	**Software Testing and Quality Assurance**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Students should have knowledge of Software Engineering theory.

Course Educational Objectives (CEO): At the end of the course, the students will be able to:

CEO305.1	Study importance of Software Testing in Software Development
CEO305.2	Explore appropriate Software Testing Techniques for finding bugs in Software.
CEO305.3	Study various Software Testing Tools and Quality Assurance Methods.

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA305.1	Solve the problems using Software Testing techniques and Approaches.
MCA305.2	Apply various Software testing Techniques to find bugs in software.
MCA305.3	Use open source software Testing Tools.
MCA305.4	Apply various Software Quality Assurance Techniques to ensure the quality in software.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Basics of Software Testing**	Humans, Errors & Testing, Correctness Vs Reliability, Testing & Debugging, Principles of Testing, Test Metrics	**04**
2	**Testing in the Software Life Cycle & Test Levels**	The General V-Model, W-Model, Component Test, Integration Test, System Test, Acceptance Test, Generic types of Testing- Functional, Non Functional, Testing software structure, Regression Testing	**08**
3	**Static Testing**	Structured Group Examinations - Reviews, Static Analysis - Control Flow Analysis & Data Flow Analysis, Tools for Static Testing	**04**
4	**Dynamic Analysis**	Black Box Testing- Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique, User Documentation Testing, Domain Testing, White Box-Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage	**08**
5	**Test Management**	Test Planning, Test Management, Test Process, Test Reporting, Incident Management – Test Log, Incident Reporting, Classification, Status	**08**
6	**Test Automation**	Design and Architecture for Automation, Test Automation- Design and Architecture for Automation, Generic Requirements for test Tool/Framework, Criteria for selecting test tools, Testing of Object Oriented Systems	**08**
7	**Software Quality**	Five Views of software quality, ISO 9126 Quality Characteristics, ISO 9000:2000 & Latest Software Quality Standards, SQA Planning: SQA plan, Organizational Level Initiatives.	**05**
8	**Software Measurement & Metrics**	Measurement during Software Life Cycle Context, Defect Metrics, Metrics for software Maintenance & Requirements, Measurement Principles, Case study for Identifying Appropriate Measures & Metrics for Projects	**07**

References:

- Software Testing Foundations, Andreas Spillner, Tilo Linz, Hans Schaefer, Shoff Publishers and Distributors
- "Foundations of Software Testing", by Aditya P. Mathur – Pearson Education custom edition 2000.
- "The ART of Software Testing", by GlenfordJ. Myers, Wiley India, Second Edition
- "Software Testing: Principles and Practices", by Srinivasan D and Gopalswamy R, PearsonEd, 2006.
- "Software Testing & Quality Assurance Theory & Practice" By KshirasagarNaik&PriyadarshiTripathi, Wiley Student Edition.
- "Software Quality Assurance Principles & Practice", by Nina S. Godbole, Narosa.

- Stephan H.Kan, “Metric and Model in Software Quality Engineering”, Addison Wesley, 1995.
- Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Fifth Edition ,McGraw Hill, 2001
- “Advanced Software Testing”, Vol. 2, Rex Black, SPD.

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAL301	**Database Management systems and Software Testing Lab**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAL301	**Database Management systems and Software Testing Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCAL301	**Database Management systems and Software Testing Lab**	**--**	**--**	**--**	**--**	**25**	**50**	**25**	**100**

Pre-requisites:
Basic Knowledge of SQL and Software Engineering concepts

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOL301.1	Make the students understand basic and relatively advanced issues in modern database management, information storage and retrieval.
CEOL301.2	Study various database techniques in developing data-intensive applications.
CEOL301.3	Explore the need of software testing in current industry scenario, understanding and knowledge of foundations, techniques and tools in area of software.
CEOL301.4	Understand the essential characteristics requirements and usage of Automation tools.

Course Outcomes (CO): At the end of the course, the students will be able to

MCAL301.1	Design database systems using available tools.
MCAL301.2	Develop applications using basic and modern database techniques as per organization requirements.
MCAL301.3	Demonstrate software testing tools
MCAL301.4	Create test design documents and test reports

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**DDL and DML**	**Data Definition Language:** Create, Alter, Drop, Rename, Truncate **Data Manipulation Language:** Insert, Update, Delete, Select	**06**
	Constraints	Not Null, Unique Key, Primary Key, Foreign Key, Check, adding and Dropping a Constraint	**02**
2	**Data Control Language and Transaction Control**	Grant, Revoke, Roles Commit, Rollback	**02**
3	**SQL SELECT Statements**	Column Alias, Concatenation Operator, Arithmetic Operators, ComparisonConditions, Logical Conditions, ORDER BY Clause	**04**
4	**Functions And Subquery**	Single Row Functions, Character Functions, Number Functions, Date Functions, Conversion Functions, Aggregate functions **Subquery:** Types of Subquery, Group by and Having Clause	**06**
5	**Joins and other concepts**	Equijoins, Non-Equijoins, Self Joins, Left Outer Joins, Right Outer Joins, Full Outer Joins, Natural Joins **Other Concepts:** View, Index	**06**
6	**PL/SQL Practical**	**Programming:** Variables, Identifiers, Comment, PL/SQL Block Structure **IF Statements:** Simple IF Statements, Compound IF Statements IF-THEN-ELSE Statements **Loop:** Basic Loop, WHILE Loop, FOR Loop	**06**
7	**Cursor and Trigger**	**Cursor:** Types of Cursor, Explicit Cursor Attributes **Trigger:** Trigger, Statement Trigger, Row Trigger, Using Conditional Operations.	**06**
8	**Functions, Procedures and packages**	Create Function, Function with Arguments, Executing Function, Dropping Function **Procedures:** Block Structure of Subprogram, Types of Subprograms, Procedurewith Parameters, Executing Procedures, Dropping Procedures **Packages:** Package Specification, Package Body, Creating Package, Execution,Dropping Package	**06**
9	**Parallel and distributed database**	**Implementation of different types of Partitions**: Range, Hash, List. **Distributed Database:** Horizontal, Vertical fragmentation	**04**
10	**Object Oriented database**	Implementation ofAbstract Data Type, Inheritance, Reference	**04**
11	**Manual Testing**	• Study of Reviews (Writing Test cases, Testing Framework, Test Document) • Construction of CFG & Deriving Test Cases • Implementation of Test Cases using Unit Testing, Integration & System Testing	**04**

12		• Implementation of Test Cases using Equivalence Class Partitioning, Boundary Value Analysis. • State Transition Test, Cause Effect Graphing and Decision Table Technique.	**04**
13	**Automation Testing**	• Study of Automation Tools. • Building Test Cases. • Using Base URL to Run Test Cases in Different Domains	**06**
14		• Selenium commands-selenese • Matching Text Patterns • Performance Testing Concepts :Load Testing, Stress Testing	**06**
15		• Web Driver Implicit & Explicit Wait • Cross Browser Testing • API Testing	**06**

Note: Automation software testing practical's can be performed using open source tool like selenium.

Reference Books:

- Joel Murach, "Murach's oracle PL /SQL" Joel Murach's publication Murachs and Assocites
- Sharnam shah, Vaishali Shah, "Oracle for Professionals"Publication SPD-Shroff Publishers and Distributors 2011
- RiniChakrabarti, ShilbhadraDasgupta, KLSI, "Advanced Data Base Management System Publication DreamTech
- Chakravarti ,"Advance Data Base Management System", Wiley -Dreamtech
- RajshekharSundaram, "Oracle 10g Programming: A Premier", Publication Pearson Education 2009
- Peter Rob and Coronel, "Database Principals fundamentals of Design, Implementation and Management", Publication Cengage Learning 2011.

Subject Code	Subject Name	Credits
MCAL302	**Java Programming and Unified Modeling Language Lab**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAL302	**Java Programming and Unified Modeling Language Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCAL302	**Java Programming and Unified Modeling Language Lab**	--	--	--	--	**25**	**50**	**25**	**100**

Pre-requisites:

Basic understanding of programming fundamentals and software engineering.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOL302.1	Understand, developing, testing and debugging Java programs.
CEOL302.2	Study UML tools
CEOL302.3	Explore object-oriented design using UML

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAL302.1	Develop a simple software application using the object oriented approach.
MCAL302.2	Design and develop a Java Web Applications.
MCAL302.3	Apply UML tools for object oriented software modeling.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs.
1	**Fundamentals of Java Programming**	Program on creation of classes and using different types of function. Program using constructor/method overloading Program on passing Object as parameter to a function Program using static and final variable and methods	02
2	**Objects and Classes**	Program to perform different operations on Array and String Program using Interface and Inheritances. Program using Wrapper class to cover auto boxing and un boxing	04
3	**Packages and Interfaces**	Programs based on creating and using packages along with access control specification. Programs based on defining, creating and implementing interfaces.	04
4	**Generics, Collections and Lambda Expression**	Programs based on Generics, Collections and Lambda Expression	04
5	**Exception Handling**	Programs based on exception handling mechanism covering all keywords. Programs based on creating own exceptions.	04
6	**Multi-threading**	Programs based on Multithreading approach, thread priorities, Inter thread communication, and Synchronization.	04
7	**File Handling**	Programs based on Input streams and Output streams, FileInputStream and FileOutputStream, Binary and Character streams, Buffered Reader/ Writer, Object serialization and Deserialization.	04
8	**Event handling and GUI programming**	Programs based on designing GUI Interface. Programs based on creating an applets, use of containers, components, event handling, layout managers, Adapter classes, Inner class etc.	04
9	**Database Programming**	Programs based on database connectivity using MS-Access/ Oracle/ MySQL as a backend covering all the database operations.	04
10	**Web development using Servlets**	Programs based on handling request and response –GET / POST method, Programs based on cookies	04

		and Session tracking.	
11	**Web development using JSP**	Programs demonstrating JSP Syntax and semantics. Programs based on directives and error objects. Programs based on session tracking.	**04**
12	**Introduction to Spring Frameworks**	Basic programs based on Spring framework	**03**
13	**Introduction to UML**	UML Overview, The Nature and purpose of Models	**01**
14	**Modeling Requirements: Use Cases**	Capturing a System Requirement, Use Case Relationships, Use Case Overview Diagrams	**02**
15	**Modeling System Workflows: Activity Diagrams**	Activity Diagram Essentials, Activities and Actions, Decisions and Merges, Doing Multiple Tasks at the Same Time, Time Events, Objects, Sending and Receiving Signals, Starting an Activity, Ending Activities and Flows, Partitions (or Swimlanes), Managing Complex Activity Diagrams	**02**
16	**Modeling a System's Logical Structure: Introducing Classes and Class Diagrams Modeling a System's Logical Structure: Advanced Class Diagrams**	What is a Class?, Getting Started with Classes in UML, Visibility, Class State: Attributes, Class Behavior: Operations, Static Parts of Your Classes Class Relationships, Constraints, Abstract Classes, Interfaces, Templates	**02**
17	**Bringing Your Classes to Life: Object Diagrams**	Object Instances, Links, Binding Class Templates	**01**
18	**Modeling Ordered Interactions: Sequence Diagrams**	Participants in a Sequence Diagram, Time, Events, Signals, and Messages, Activation Bars, Nested Messages, Message Arrows, Bringing a Use Case to Life with a Sequence Diagram, Managing Complex Interactions with Sequence Fragments,	**02**
19	**Focusing on Interaction Links: Communication Diagrams** **Focusing on Interaction Timing: Timing Diagrams**	Participants, Links, and Messages, Fleshing out an Interaction with a Communication Diagrams, Communication Diagrams Versus Sequence Diagrams What Do Timing Diagrams Look Like?, Building a Timing Diagram from a Sequence Diagram, Applying Participants to a Timing Diagram, States, Time, A Participant's State-Line, Events and Messages, Timing Constraints	**02**

20	**Completing the Interaction Picture: Interaction Overview Diagrams**	The Parts of an Interaction Overview Diagram, Modeling a Use Case Using an Interaction Overview	**01**
21	**Managing and Reusing Your System's Parts: Component Diagrams**	What is a Component?, A Basic Component in UML, Provided and Required Interfaces of a Component, Showing Components Working Together, Classes That Realize a Component, Ports and Internal Structure, Black-Box and White-Box Component Views	**02**
22	**Modeling an Object's State: State Machine Diagrams**	Essentials, States, Transitions, States in Software, Advanced State Behavior, Composite States, Advanced Pseudostates, Signals, Protocol State Machines	**02**
23	**Modeling Your Deployed System: Deployment Diagrams**	Deploying a Simple System, Deployed Software: Artifacts, What Is a Node?, Hardware and Execution Environment Nodes, Communication Between Nodes, Deployment Specifications, When to Use a Deployment Diagram	**02**
24	**UML tools and techniques for web-based/object oriented Applications**	UML Tools, Different UML Notations for Web application	**02**
25	**Creation of documentation such as SRS, SDS from UML diagrams. Generation of code from UML model.**	Basic Concept, Generating by Templates, Using Batches, Installing and Uninstalling Templates	**02**
26	**Mini Project**	A Mini – Project based on Java Programming and UML using an integrated approach. (Maximum Two students in a Group).	**10**

Reference Books:

- The complete reference JAVA2, Herbert schildt. Tata McGraw Hill
- Programming with Java A Primer, E.Balaguruswamy Tata McGraw Hill
- Core Java for beginners, Sharanam Shah and vaishali shah, SPD
- Java 6 Programming Black Book, Wiley –Dreamtech
- Web Enabled Commercial Application Development using java 2.0, Ivan Byaross
- JDBC, Servlet, and JSP Black Book, Santosh Kumar, Dreamtech
- Java Server Programming java EE6, Black book, Dreamtech press.
- Core Servlets and Java Server Pages :Vol I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson
- Java 6 Programming, Black Book, Dreamtech Press.
- Spring in Action, Craig Walls, 3rd Edition, Manning
- The Unified Modelling Language Reference manual, Second Edition, James Rambaugh, Iver Jacobson, Grady Booch, Addition- Wesley

- Learning UML 2.0, Kim Hamilton, Russell Miles, O'Reilly
- The Unified Modeling Language User Guide Second edition, Grady Booch, James Rumbaugh, Ivar Jacobson , Addison Wesley (2005)
- Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI (2005)
- Designing Flexible Object-Oriented Systems with UML, Charles Richter, Sams

Web References:

1. https://docs.oracle.com
2. http://staruml.sourceforge.net/docs/user-guide(en)/ch08.html
3. https://www.ibm.com/support/knowledgecenter/SS6RBX_11.4.3/com.ibm.sa.oomethod.doc/topics/c_Web_app_Extensions_WAE.html

Subject Code	Subject Name	Credits
MCAPR301	**Mini Project**	**02**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
MCAPR301	**Mini Project****	**--**	**--**	**--**	**--**	**--**	**--**	**02**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCAPR301	**Mini Project**	**--**	**--**	**--**	**--**	**25**	**-**	**25**	**50**

Pre-requisites:

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOPR301.1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
CEOPR301.2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
CEOPR301.3	Study designing small projects in a multidisciplinary environment.

Course Outcomes (CO): At the end of the course, the students will be able to

MCAPR301.1	Design, implement and evaluate a mini-project.
MCAPR301.2	Gain project management skills.
MCAPR301.3	Work effectively in small groups on medium scale computing projects.
MCAPR301.4	Demonstrate the ability to produce a technical document

Sample Guidelines for Preparing and Documenting the Project Report

Sr. No.	Module	Detailed Contents
1	**Introduction**	• Introduction of the project(SRS) • Problem definition • Objective of Project • scope of Project
2	**System Study**	• Existing System • Disadvantages of Existing system • Proposed System • Use Cases

3	**Analysis & Design**	• Software/hardware Requirement Specification
		  o Software requirement
		  o Hardware requirement
		• GANTT Chart
		• Flowchart/ DFD/ER/UML diagram(any other project diagram)
		• Module design and organization

4	**Testing & Validation**	• Test cases and Report (based on manual & automation testing)

5	**User Manual**	• Explanation of Key functions
		• Method of Implementation
		  o Forms
		  o Output Screens

6	**Conclusion**	• Project Conclusion & Future enhancement

- **Rubrics should be followed for evaluation.**

- **References for report documentation**
  1. Author Name, Title of Paper/ Book, Publisher's Name, Year of publication
  2. Full URL Address

** Mini Project will be performed by students during summer vacation of Even Semester of first year (SEM II) Mini project will be evaluated in SEM III. Evaluation of the mini project will be internal 25 marks as TW and 25 marks as oral examination conducted by External Examiner (Institute Level)

.

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA401	Data Mining and Business Intelligence	04	--	--	04	--	--	04
MCA402	Advanced Web Technology	04	--	--	04	--	--	04
MCA403	Computer Graphics	04	--	--	04	--	--	04
MCA404	Elective 1	04	--	--	04	--	--	04
MCA405	Elective 2	04	--	--	04	--	--	04
MCAL401	Advanced Web Technology and Data Mining and Business Intelligence	--	06	--	--	03	--	03
MCAL402	Computer Graphics and Image Processing	--	06	--	--	03	--	03
MCAL403 Activity Lab	Soft Skill Development	--	02	--	--	02	--	02
Total		**20**	**14**	--	**20**	**08**	--	**28**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
MCA401	Data Mining and Business Intelligence	20	20	20	80	--	--	--	100
MCA402	Advanced Web Technology	20	20	20	80	--	--	--	100
MCA403	Computer Graphics	20	20	20	80	--	--	--	100
MCA404	Elective 1	20	20	20	80	--	--	--	100
MCA405	Elective 2	20	20	20	80	--	--	--	100
MCAL401	Advanced Web Technology and Data Mining and Business Intelligence	--	--	--	--	25	50	25	100
MCAL402	Computer Graphics and Image Processing	--	--	--	--	25	50	25	100
MCAL403 Activity Lab	Soft Skill Development	--	--	--	--	50	--	--	50
Total		**100**	**100**	**100**	**400**	**100**	**100**	**50**	**750**

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Elective for Semester IV

SEM IV – Elective I	
Course Code	**Course Name**
MCA4041	Entrepreneurship Management
MCA4042	Business Infrastructure and Management
MCA4043	ERP
MCA4044	Ethics and CSR
SEM IV – Elective II	
Course Code	**Course Name**
MCA4051	Digital Forensics
MCA4052	Simulation and Modelling
MCA4053	Next Generation Networks
MCA4054	AI and Soft Computing

SEMESTER IV

Subject Code	Subject Name	Credits
MCA401	**Data Mining and Business Intelligence**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA 401	**Data Mining and Business Intelligence**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 401	**Data Mining and Business Intelligence**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Basic knowledge of data base concepts

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO401.1	Acquire the knowledge of various concepts and tools behind data warehousing and mining data for business intelligence
CEO401.2	Study data mining algorithms, methods and tools
CEO401.3	Identify business applications of data mining

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA401.1	Use conceptualization of BI techniques
MCA401.2	Apply data warehouse concepts for data analysis and report generation
MCA401.3	Develop industry level data mining skills using software tools
MCA401.4	Make use of relevant theories, concepts and techniques to solve real-world BI problems

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Business Intelligence-**	Introduction and overview of BI-Effective and timely decisions, Data Information and knowledge, BI Architecture, Ethics and BI. BI Applications- Balanced score card, Fraud detection, Telecommunication Industry, Banking and finance, Market segmentation.	**06**
2	**Prediction methods and models for BI**	Data preparation, Prediction methods-Mathematical method, Distance methods, Logic method, heuristic method-local optimization technique, stochastic hill climber, evaluation of models	**06**
3	**BI using Data Warehousing**	Introduction to DW, DW architecture, ETL Process, Top-down and bottom-up approaches, characteristics and benefits of data mart, Difference between OLAP and OLTP. Dimensional analysis- Define cubes. Drill- down and roll- up – slice and dice or rotation, OLAP models- ROLAP and MOLAP. Define Schemas- Star, snowflake and fact constellations.	**08**
4	**Data Mining and Preprocessing**	Data mining- definition and functionalities, KDD Process, Data Cleaning: - Missing values, Noisy data, data integration and transformations. Data Reduction: - Data cube aggregation, dimensionality reduction- data compression, Numerosity reduction- discretization and concept hierarchy.	**06**
5	**Associations and Correlation**	Association rule mining:-support and confidence and frequent item sets, market basket analysis, Apriori algorithm, Incremental ARM, Associative classification- Rule Mining.	**06**
6	**Classification and Prediction**	Introduction, Classification methods:-Decision Tree- ID3, CART, Bayesian classification- Baye'stheorem(Naïve Bayesian classification),Linear and nonlinear regression.	**08**
7	**Clustering**	Introduction, categorization of Major, Clustering Methods:- partitioning methods- K-Means. Hierarchical- Agglomerative and divisive methods, Model- based- Expectation and Maximization.	**08**
8	**Web mining and Text mining**	Text data analysis and Information retrieval, text retrieval methods, dimensionality reduction for text. Web Mining: - web content, web structure, web usage.	**04**

References:

- Business Intelligence data mining and optimization for decision making- by Carlo Vercellis ,wiley publication.
- Adaptive business Intelligence by ZbigniewMichlewicz, martin Schmidt, matthewmichalewicz, constantinChiriac
- Data Mining concepts and techniques second edition by Jiawei Han and MichelineKamber.
- Data Mining:" Introductory and Advanced topics" , Pearson Education, by M.Dunham
- Data warehousing Fundamentals by PaulrajPonnian, John Willey
- Data mining for Business intelligence: concepts, techniques and applications in Microsoft Excel by G. Shumeli, N R Patel, P.C Bruce, Wiley

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA402	**Advanced Web Technologies**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA402	**Advanced Web Technologies**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 402	**Advanced Web Technologies**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

- Basic Understanding of Object Oriented Programming
- Basic Understanding of Web Technologies

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO402.1	Study the architecture of Dot Net framework
CEO402.2	Understand the basic principles of C# development
CEO402.3	Learn advanced windows and web development techniques using dotNET

Course Outcomes (CO): At the end of the course, the students will be able to

MCA402.1	Create UI applications using C#
MCA402.2	Design and develop secure web applications using asp.net according to industry standards
MCA402.3	Define and create custom web services

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Dot Net and C#**	**Introduction to Dot Net Framework** Architecture of Dot NET Framework, CLR-Working and Features,CTS,CLS,Assemblies-Types,Structure and Metadata,GAC **C# Basics** Data Types(Value Types and Reference Types),Control Structures,Operators and Expressions, Arrays	**08**
2	**OOP C#**	**Classes and Objects** Instance Variables, Methods, Constructors, Properties, Access Specifiers,Static members and methods **Inheritance** Levels of Inheritance,Constructor and Inheritance,Polymorphism,Interfaces,Abstract classes,Delegates,Indexers,Sealed Classes,Exception handling **Collections and Generics** Bounded and Unbounded Collections,Generic Programming-Generic classes, Functions, Constraints on Generic Programming	**10**
3	**Databases and C#**	**File Handling** Text Files, Binary Files, String Processing, Serialization and Deserialization **ADO.Net** Connected and Disconnected,Architecture of ADO.Net,Commands,Datasets,Data Readers, Data Adapters,Working with Stored Procedures **LINQ and the ADO.NET EntityFramework** LINQ Introduction, Mapping Your Data Model to an Object Model, Introducing Query Syntax	**08**
4	**Asp.Net Web Applications**	Life cycle of Asp.Net web pages, Role of client side scripting, postback posting and cross page posting, asp.net compilation model, asp.net HTML Controls,Server Controls(basic controls,Calendar,AdRotator,FileUpload,ValidationControls	**08**
5	**Data and State Management in ASP.NET**	ASP.NET Websites with Themes and MasterPages, Data Source Controls, Data Bound Controls, ASP.NET State Management-Client Side and Server Side. ASP.NET and AJAX	**10**
6	**Web Services**	XML,Web Services Architecture, UDDI,SOAP and its Format,WSDL,Create and Consuming XML Web Service-Simple and Databases, WCF- Architecture,End Points, Types of Contracts, Web Applications and Security	**08**

References:

- Beginning Visual C# 2012 Programming, Karli Watson, Jacob Vibe Hammer, Jon D. Reid, Morgan Skinner, Daniel Kemper, Christian Nagel,ISBN: 978-1-118-31441-8,Wrox Publication
- Professional C# 2008,Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner,ISBN: 978-1-118-64321-1 ,Wrox Publication
- Beginning ASP.NET 4.5: in C# and VB,ImarSpaanjaars, ISBN: 978-1-118-31180-6,Wrox Publication
- Professional ASP.NET 4.5 in C# and VB,Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, Scott Hunter (Foreword by), ISBN: 978-1-118-31182-0,Wrox Publication
- Murach's ASP.NET 4 Web Programming with C# 2010, Anne Boehm,JoelMurrach,SPD, Murrach Books
- Murach's C# 2015,Anne Boehm and Joel Murach,ISBN 978-1-890774-94-3,Murrach Books
- Murach"s ADO. Net 4 Database Programming with C# 2010 4th Edition
- Pro C# 5.0 and the .NET 4.5 Framework – Andrew Trolsen, APress
- Advance .NET Technology second edition by ChiragPatel- DreamTech Press

Web References:

- MSDN: Learn to Develop with Microsoft Developer Network: https://msdn.microsoft.com/

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA403	**Computer Graphics**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA403	**Computer Graphics**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 403	**Computer Graphics**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic Mathematics

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO403.1	Understand the concepts of output primitives of Computer Graphics.
CEO403.2	Learn 2 D and 3 D graphics Techniques.
CEO403.3	Study various Image Processing techniques

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA403.1	Demonstrate the algorithms to implement output primitives of Computer Graphics.
MCA403.2	Apply 2 D transformation techniques.
MCA403.3	Analyze 3 D transformation techniques.
MCA403.4	Apply image processing techniques.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Computer Graphics**	Introduction to Computer Graphics,Elements of Computer Graphics ,Graphics display systems.	**02**
2	**Output primitives & its Algorithms**	Points and Lines, Line Drawing algorithms :DDA line drawing algorithm, Bresenham's drawing algorithm ,Circle and Ellipse generating algorithms : Mid-point Circle algorithm ,Mid-point Ellipse algorithm ,Parametric Cubic Curves :Bezier curves .Fill area algorithms: Scan line polygon fill algorithm ,Inside-Outside Tests, Boundary fill algorithms, Flood fill algorithms	**15**
3	**2D Geometric Transformations & Clipping**	Basic transformations, Matrix representation and Homogeneous Coordinates, Composite transformation,shear & reflection. Transformation between coordinated systems. Window to Viewport coordinate transformation,Clipping operations – Point clipping Line clipping : Cohen – Sutherland line clipping, Midpoint subdivision,Polygon Clipping:Sutherland – Hodgeman polygon clipping ,Weiler – Atherton polygon clipping	**12**
4	**Basic 3D Concepts & Fractals**	3D object representation methods: B-REP, sweep representations, CSG, Basic transformations,Reflection,shear. Projections – Parallel and PerspectiveHalftone and Dithering technique. Fractals and self-similarity: Koch Curves/snowflake, Sirpenski Triangle	**06**
5	**Introduction to Image Processing**	Fundamental Steps in Digital Image Processing ,Components of an Image Processing System ,Basic Concepts in Sampling and Quantization, Representing Digital Images, Spatial and Gray-Level Resolution	**05**
6	**Image Enhancement Techniques**	Image Enhancement in the Spatial Domain: Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, and Power Law Transformations. Piecewise-Linear Transformation Functions: Contrast stretching, Gray-level slicing, Bit plane slicing. Introduction to Histogram, Image Histogram and Histogram Equalization, Image Subtraction, and Image Averaging	**12**

References:

- Donald Hearn and M Pauline Baker, Computer Graphics C Version -- Computer Graphics, C Version, 2/E, Pearson Education.
- David F. Rogers, James Alan Adams, Mathematical elements for computer graphics , McGraw-Hill, 1990
- Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing (3rd Edition), Pearson Education.
- S. Sridhar-Digital image Processing, Second Edition, Oxford University Press
- Anil K. Jain -Fundamentals of digital image processing. Prentice Hall, 1989

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Elective Subjects

Elective-I
MCA404

Subject Code	Subject Name	Credits
MCA4041	**Entrepreneurship Management**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4041	**Entrepreneurship Management**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4041	**Entrepreneurship Management**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

- Basic knowledge of Project Management & IT in Management.
- Knowledge of Financial Accounting & Management.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4041.1	Be familiar with Entrepreneurship basics, Skills and Qualities of Entrepreneurs.
CEO4041.2	Understand how to design effective and efficient Business Plan for intended users.
CEO4041.3	Understand and Learn various approaches for Woman Entrepreneurship, Business Management and Development.

Course Outcomes (CO): At the end of the course, the students will be able to

MCA4041.1	Understand the concepts and fundamentals of Entrepreneurship.
MCA4041.2	Analyse the process of Business Idea generation and converting the idea into a Business Model.
MCA4041.3	Identify the Role of Small Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise.
MCA4041.4	Understand the exit strategies and Social Responsibilities.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Foundation of Entrepreneurship**	Concept, Meaning and Definition of Entrepreneur and Entrepreneurship, Importance and Significance of Growth of Entrepreneurial Activity, Concept of Entrepreneur, Traits, Characteristics, Skills and Qualities of Entrepreneurs, Classification and Types of Entrepreneurs, Entrepreneur vs Professional Manager.	**08**
2	**Creating and Starting the Venture**	**Business Idea:** New Business Idea, Pre-selection Process, Sources of Business Idea, Preliminary Research, Business Idea Evaluation, Other Analysis. **Business Plan:** Use of Business Plan, Creating a Business Plan, Types of Business Plan, Description of Business, Management Team, Marketing Plan, Finance, Risk and Contingencies.	**10**
3	**Small Business Enterprise**	Role of Small Scale Industries (SSI), Concept and Definition of Small Scale Industries, Government policy and Development of SSI in India, Growth and Performance of SSI in India, Problems for SSI. **Institutions Supporting Small Scale Enterprise**:Central Level, State Level and Other Agencies, Industry Association. **Setting up a Small Business Enterprise:** Identifying the Business Opportunity**,** Business Opportunity in **O**ther Sectors, Formulating of setting SSI.	**14**
4	**Women Entrepreneurship**	Women Entrepreneurship Defined, Environment, Challenges in the path of Women Entrepreneurship, Strategies for the Development of Women Entrepreneurship, Empowerment of Woman by Entrepreneurship, Grassroots Entrepreneurship through Self Help Groups (SHGs), Institutions supporting Women Entrepreneurship in India, Women Entrepreneurship in India, Case Studies of Successful Women Entrepreneurs.	**08**
5	**Growing and Managing the Venture**	Growth Strategies, Economic Implication of growth, Implications of Growth for the firm, Overcoming Pressures on existing Financial & Human Resources, Overcoming Pressures on Management of Employees & Entrepreneurs' Time, Implication of Firm Growth to the Entrepreneur.	**06**
6	**Exit Strategies and Social Responsibility**	Reasons for Existing, Long-Term Preparation, Short-Term Preparation, Introduction of Social Responsibility, Corporate Social Responsibility(CSR), Dimensions of CSR.	**06**

References

- Vasant Desai, The Dynamics of Entrepreneurial Development and Management, 2015, Himalaya Publishing House.
- Rajeev Roy, Entrepreneurship, Oxford University Press Edition Fourth.

- Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, Sixth Edition, The Mc Graw Hill Company.
- PoornimaCharantimath, Entrepreneurship Development- Small Business Enterprise, Pearson.
- Vasant Desai, Entrepreneurship and Small Business Management, 2009, Himalaya Publishing House.
- Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
- Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
- Entrepreneurial Development: S.S. Kanka, S. Chand & Company.

Web References:

- www.msme.gov.in
- www.womenentrepreneursindia.com
- www.msmetraining.gov.in

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA4042	**Business Infrastructure and Management**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA 4042	**Business Infrastructure and Management**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4042	**Business Infrastructure and Management**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Knowledge of Internet, Web and Network Systems

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4042.1	Study fundamentals of conducting business over the Internet
CEO4042.2	Familiarize with the Infrastructure, Ethics of electronic-business
CEO4042.3	Explore different kinds of business values and managing the change in digital market

Course Outcomes (CO): At the end of the course, the students will be able to

MCA4042.1	Adopt to transform traditional business into an e-business.
MCA4042.2	Identify the Infrastructure and Security issues related to e-business
MCA4042.3	Understand the current scenarios of digital world and applications of it

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**The world of E – Business**	What Is E-Business?, Characteristics Of E-Business, Categories Of E-Business (B2B, C2B, B2C, C2C), Elements Of E-Business, E-Business Roles And Challenges, E-Business Requirements, Impact Of E-Business, Inhibitors Of E-Business.	**04**
2	**E-business Strategies**	What Is E-Business Strategies, Strategic Positioning, Levels Of E-Business Strategies, The Changing Competitive Agenda: Business And Technology Drivers, The Strategic Planning Process, Strategic Alignment, The Consequences Of E – Business: Theoretical Foundations, Success Factors For Implementation Of E – Business Strategies.	**06**
3	**E-Business Models**	Pressure Forcing Business Changes, Business Models – Definition, Classification Of Business Models, Networked Business Models.	**06**
4	**The digital firm – Electronic business / Electronic commerce**	**Electronic Business, Electronic Commerce And The Emerging Digital Firm:** Internet Technology And The Digital Firm, New Business Models & Value Propositions **Electronic Commerce:** Categories Of Electronic Commerce, Customer – Centered Retailing, **Windows On Management:** Customer Communities Become Product Development Tools, B2B Electronic Commerce, New – Efficiencies And Relationships, **Window On Organization:**Covisint: The Vision And The Reality, E – Commerce Payment Systems. **Electronic Business & The Digital Firm:** How Intranets Support Electronic Business, Intranets & Group Collaboration, Intranet Applications For E – Business, Supply Chain Management & Collaborative Commerce. **Management Challenges And Opportunities:** Unproven Business Models, Business Process Change Requirements, Legal Issues, Trust, Security & Privacy, MIS In Action: Manager's Toolkit: Digitally Enabling The Enterprise: Top Questions To Ask, Make IT Your Business.	**10**
5	**Digital / Electronic Markets & Solutions**	Electronic Markets Defined, Functions Of Electronic Markets, How Do Electronic Markets Differ From Traditional Market?, Effects Of Electronic Markets, Electronic Market Success Factors, E – Market Technology Solutions.	**06**
6	**E-Business technological Infrastructure and Management**	Technical e-Business Challenges, Basic Infrastructure, Web Technologies and Application, Collaborative Technology, The role of enterprise Information Systems in e-Business. **The new IT Infrastructure for the Digital Firm:** Enterprise Networking and Internetworking, Standards and connectivity for the Digital Integration, Technology and Business Standards. **Support Technology for Electronic Business:** Web Server and Electronic Commerce servers, How to Integrate the wireless Web into Business strategy, Customer Tracking and Personalization Tools, Web content Management Tools, Web site Performance	**12**

		Monitoring Tools, Web Hosting Services, The Challenge of Managing the IT Infrastructure and Solutions.	
7	**Ethical & Social Issues in the digital firm**	**Understanding ethical and social issues related to systems:** Model For Thinking About Ethical, Social And Political Issue, Moral Dimensions Of The Information Age, Key Technology Trends That Raise Ethical Issue. **Ethics in an information society:** Basic Concepts:Responsibility, Accountability And Liability, MIS In Actions: Manager's Toolkit: How To Conduct An Ethical Analysis, Candidate Ethical Principles, Professional Codes Of Conduct, Some Real World Ethical Dilemmas. **The moral dimensions of information Systems:** Information Rights: Privacy & Freedom In The Internet Age, **Window On Organizations:** Privacy For Sale, Property Rights: Intellectual Property, Accountability, Liability And Control, System Quality: Data Quality And System Errors, Quality Of Life: Equity, Access And Boundaries, **Window On Management:** Alberta Narrows Its Digital Divide, Management Actions: Corporate Code Of Ethics, Make IT Your Business.	**08**

References:

- Michael P. Papazoglou , Pieter M.A. Ribbers "E-Business Organizational and Technical Foundations,Wiley India Edition.
- Waman S Jawadekar, Management Information Systems- A Digital-Firm perspective ,4th edition,TMH
- H Albert Napier,Ollie rivers,Stuart Wagner, JB Napier 2ed, "Creating a Winning E Business"Cengage Learning India Edition.
- Kenneth C Laudon, Jane P.Laudon "Managing The Digital Firm , Eighth Edition, Pearson Education.
- Kenneth C Laudon, Carol GuercioTraver "e-commerce Business, technology, Society",4ed,Pearson
- Dave Chaffey" E-Business and E-commerce Mnagement"3ed,Pearson.

Assessment:

Internal:

Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests. Besides this, students in a group of 3 or 4 have to present a case study compulsorily related to electronic / digital Business likee-chaupal/e-governance /e-tourism/e-Learning/e-real estate/e-Media/ Impact of e-Business on society etc.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA4043	**Enterprise Resource Planning**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4043	**Enterprise Resource Planning**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4043	**Enterprise Resource Planning**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Knowledge of Information Technology, Business System Management, Software and Networking

Course Educational Objectives (CEO): At the end of the course, the students will be able to

MCA4043.1	Study technical aspects of Enterprise Resource Planning **(**ERP) with its lifecycle.
MCA4043.2	Identify the functionality in an ERP system
MCA4043.3	Understand tools and methodology used for designing ERP for an Enterprise

Course Outcomes (CO): At the end of the course, the students will be able to

MCA4043.1	Conceptualize the basic structure of ERP
MCA4043.2	Identify implementation strategy used for ERP
MCA4043.3	Apply design principles for various business module in ERP
MCA4043.4	Apply different emerging technologies for implementation of ERP

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Enterprise Resource Planning (ERP)**	Information System and Its Components, Value Chain Framework, Organizational Functional Units, Evolution of ERP Systems, Role of ERP in Organization, Three-Tier Architecture of ERP system	**08**
2	**ERP Implementation Lifecycle**	Project Preparation, Initial Costing, Requirement Engineering, ERP Solution Selection, Technical Planning, Change Management and Training Plan, Implementation and Deployment Planning, Configuration, Custom Coding, Final Preparation, Go-live	**08**
3	**ERP and Related Technologies**	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), Electronic Data Interchange (EDI)	**08**
4	**ERP Manufacturing Perspective**	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management	**06**
5	**ERP Modules**	Finance, Plant Maintenance, Quality Management, Materials Management,	**08**
6	**Benefits of ERP**	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability	**06**
7	**Introduction to ERP tools**	OpenERP JD Edwards-Enterprise One Microsoft Dynamics-CRM Module SAP	**08**

References:

- Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
- Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
- Enterprise Resource Planning - Ravi Shankar & S. Jaiswal ,Galgotia.
- Enterprise Resource Planning : Concepts and Practices by Vinod Kumar Garg, N. K. Venkitakrishnan
- ERP a Managerial Perspective by S Sadagopan
- Guide to Planning ERP Application, AnnettaClewwto and Dane Franklin, McGRaw-Hill, 1997
- The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
- E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota
- Enterprise Resource Planning, A Managerial Perspective by Veena Bansal, PEARSON

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any four from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA4044	**Ethics & CSR**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4044	**Ethics & CSR**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA4044	**Ethics & CSR**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic knowledge of Organizational behavior& Corporate Governance

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4044.1	Acquire knowledge of Ethics in the modern era
CEO4044.2	Understanding of Ethical decision making approaches.
CEO4044.3	Understand the scope and complexity of Corporate Social responsibility in the global and Indian context.

Course Outcomes (CO): At the end of the course, the students will be able to

MCA4044.1	Understand ethical theories and ethics in profession.
MCA4044.2	Analyze global issues in ethics
MCA4044.3	Apply Ethical Code, Audit and living in real world.
MCA4044.4	Analyze Corporate Social Responsibility and its framework.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Basic Concepts in Ethics & Ethical Theories**	Introduction, Terminology, Personal Ethics, Professional Ethics, Life skills, Basic Ethical Principles, Moral Development,Theories-Piaget's Theory, Kohlberg's Theory, Elliot Turiel's Theory, Gilligan's Theory, Comparison of Moral Development Theories. Classification of Ethical Theories, Some basic Theories	**10**
2	**Global Issues in Ethics**	Introduction, Current Scenarios, Business Ethics, Environmental Ethics, Computer Ethics, Media Ethics, Bioethics, Research Ethics, Intellectual Property Rights, Professionals & Ethics.	**08**
3	**Ethical Codes**	Need for Ethical Codes, Sample codes, Codes from Other Professions, Corporate Codes, Implementation of codes, Limitations of codes.	**08**
4	**Ethics Audit & Ethical Living**	Need for Ethics audit, Ethics Profiles of Organizations, Considerations for Ethics Audit, Ethics standards and Benchmarking, Procedure for Ethics audit, Ethics audit Report.Ethical Living, Ethical living for Professionals.	**08**
5	**Understanding Corporate Social Responsibility (CSR), Evolutions of Company & CSR Role of various institutions in CSR**	Introduction, Understanding CSR, History of CSR in India. Theories of corporate Governance, Importance of CSR in Corporate Governance, The Social Impact. Introduction, Role of Government, Role of NGO'S & Not-for-profit Organizations, Role of Educational Institutions, Role of the Media.	**10**
6	**Framework for rating CSR & Global CSR.**	Understanding CSR ratings, available Accepted Rating Frameworks, Structure of BITC CR Index, Rating Criteria and basic structure of the rating process. Study of Sample Rating Framework for Corporate. Multinational companies, challenges of multinationals, country specific CSR Initiatives.	**08**

References:

- Professional Ethics,R.Subramanian, Oxford Higher Education.
- Corporate Social Responsibility, MadhumitaChatterji, Oxford Higher Education
- Business Ethics and Corporate Governance, A.C. Fernando, Pearson 2nd Edition
- Corporate Ethics, Governance, and Social Responsibility: Precepts and Practices ,Fernando, Pearson

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Elective-II
MCA405

Subject Code	Subject Name	Credits
MCA4051	**Digital Forensics**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4051	**Digital Forensics**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4051	**Digital Forensics**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Information Security

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4051.1	Understand the fundamental of forensics
CEO4051.2	Have in depth knowledge of relationship between IT and Forensics
CEO4051.3	Study different aspects of digital evidences

Course Outcomes: At the end of the course, the students will be able to:

MCA4051.1	Develop computer forensic awareness
MCA4051.2	Utilizing the knowledge for investigations in order to solve computer crime
MCA4051.3	Perform best practices for incidence response
MCA4051.4	Apply computer forensic tools for investigation

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction**	Introduction of Cyber Crime, Computer roles in Crime, Introduction to Digital Forensics and its uses. Forensics Evidence, Collection, Processing and the phases of forensics investigation, Types of Computer Forensics	**06**
2	**Data Recovery**	Encryption and Decryption, Recovery deleted files, Identifying false images and Steganography methods for media data including text, image and audio data	**08**
3	**Digital Evidence Controls**	Uncovering attacks that evade detection by event viewer and task manager. Memory image acquisition techniques and their limitations	**08**
4	**Network Forensics**	Different attacks in network, collecting and analyzing network based evidence in windows and Unix environment, Email forensics for standard protocols	**06**
5	**Mobile Phone and Android Forensics**	Crime and mobile phones, evidences, forensic procedures, files present in SIM Card, Device data, External memory dump and evidences in memory card, Android forensic fundamental, Data extraction techniques, screen lock bypassing techniques	**08**
6	**Cloud Forensics**	Fundamentals of cloud forensics, Cloud crimes, Uses of cloud forensics and its challenges, Interaction of Email system with local and cloud storage	**08**
7	**Real forensic Case and Its Tools**	Processing a complete forensic case and preparing a forensic report and Introduction of some forensic tools- Helix, FTK, Autopsy and FIRE	**08**

Reference:

- Digital Forensics with open source tools. Cory Altheide and Harlan Carvey, ISBN: 978-1-59749-586-8,Elsevier Publications, April 2011
- Digital Evidence and Computer crime 3rd Edition: Forensics Science, Computers and the Internet by Eoghan Casey, 2011
- Computer Forensic and Cyber Crime: An Introduction 3rd Edition by Marjie T. Britz, 2013
- Network Forensics: Tracking Hackers through Cyber Space, Sherri Davidoff, Jonathan Ham Prentice Hall 2012
- Android Forensics: Investigation and Security by Andrew Hogg, Publisher – Synergy
- Practical Mobile Forensics: Satish Bommisetty,RohitTamma and Heather Mahalik, Pack Publishing LTD 2014, ISBN-978-1-78328-831-1

Web References:

1. Computer Forensics World http://www.computerforensicsworld.com/
2. Computer Forensic Services http://www.computer-forensic.com
3. Digital Forensic Magazine http://www.digitalforensicsmagzine.com
4. Journal of Digital Forensic Practice http://www.tandf.co.uk/15567281

5. http://cloudtimes.org/2012/11/05/the-basics-of-cloud-forensics/

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA4052	**Simulation & Modelling**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4052	**Simulation and Modelling**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4052	**Simulation and Modelling**	Test1 (T1)	Test2 (T2)	Average of (T1 & T20					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Overview of Probability, Statistics and Discrete Mathematics and basics of Computers.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4052.1	Understand the basic system concepts and definitions of the types of system.
CEO4052.2	Provides techniques to model and simulate each system.
CEO4052.3	Ability to analyze the system and make use of information to improve its performance.

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA4052.1	Apply functional modeling to model the activities of a static system.
MCA4052.2	Understand the behavior of a dynamic system and create a model for a dynamic system.
MCA4052.3	Simulate the real systems

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Simulation**	What is modeling and Simulation: History, Application areas, Advantages and Disadvantages, Role of modeling and simulation for Problem solving, Types of simulation models and examples: static (Monte Carlo simulation and its application to industries), dynamic (Bank), deterministic (arrivals at scheduled appointment time), stochastic (random arrivals and service time), Discrete event simulation (queuing system), continuous (communication and traffic system). Steps in simulation study. Uses of simulation with examples(Experimentation, experience, ethics, human interaction).	**04**
2	**Description and solutions of simulation examples**	Simulation of Queuing system (G/G/1, D/D/1 ,…, M/G/1, M/M/1) characteristics, notation, Measures of performance of Queuing system, example of single channel of Queue, the Able Baker call center problem.Simulation of inventory system (News Paper seller problem), Other examples: Reliability problem, Use of random normal numbers for simulation, project simulation, Lead Time Demand, Job Shop Model.	**12**
3	**Simulation Models using Random Numbers and Variates**	Simulation Examples based on statistical distributions. Discrete distributions, Continuous distributions, Poisson process.Random- Number Generation: Properties of Random Numbers, Generation of Pseudo- Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers. Random Variate Generation:Inverse Transformation Technique –Uniform Distribution, Exponential Distribution, Weibull Distribution. Convolution Method for Erlang Distribution, Acceptance-Rejection Technique – Poisson Distribution.	**12**
4	**Input and Output Analysis**	**Input Models with Data:** Data Collection, Identifying the Distribution with Data - Parameter Estimation, Goodness of Fit Tests: Chi-Square Test, Kolmogorov-Smirnov Test. Selecting Input Models without Data , Time-Series Input Models **Output Analysis:** Stochastic Nature of Output Data - Types of Simulation with respect to Output Analysis- Measures of Performance and their Estimation (Point Estimation, confidence Interval Estimation). Output Analysis for Terminating Simulations (Confidence Interval Estimation)Output Analysis for Steady-State Simulation.(Error estimation)	**12**
5	**Verification and Validation**	Model Building, Verification and Validation; Verification of Simulation Models - Calibration and Validation of Models:- Face Validity, Validation of Model Assumptions, Validating Input-Output Transformations - Input-Output Validation using Historical Input Data, Input-Output . Validation using a Turing	**06**

		Test. Optimization via simulation examples.	
6	**Modelling and Simulation of Real World Problems**	Simulation of manufacturing systems, Simulation of computer systems, Simulation of supermarket. Simulation of Transportation model, business model, Medical models, Social Science models.	**06**

Reference:

- J. Banks, J. S.Carson II and B. L. Nelson,, "Discrete-Event System Simulation", 2nd Edition, Prentice Hall of India, New Delhi, 1995.
- Simulation & Modelling- Jain, Wiley -Dreamtech
- J. A. Sokolowski, C.M. Banks, "Principles of Modeling and Simulation: A multidisciplinary Approach", John Wiley & Sons Publications, edited 2011.
- Averill M.Law and W.DavidKelton, "Simulation Modeling& Analysis", 2nd Edn., Tata McGraw Hill, 1991.
- Geoffrey Gardon, "System Simulation", 2nd Edn.,Printice Hall of India, 1992.
- NarsinghDeo, " System Simulation with Digital Computers", Prentice Hall of India, 1979.

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA4053	**Next Generation Networks**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA4053	**Next Generation Networks**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4053	**Next Generation Networks**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Computer Networks

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4053.1	Relate the paradigm shift from circuit switched network to packet switched network.
CEO4053.2	Understand the core technologies, and architectures of the Next Generation Networks
CEO4053.3	Summarize technology options for Multi-Service Networks

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA4053.1	Evaluate the importance of packet switching for NGN
MCA4053.2	Analyze and differentiate various architectures of a next generation network (NGN)
MCA4053.3	Comprehend the multiple services offered by NGN

Syllabus

Sr. No	Module	Detailed Contents	Hrs
1	**Introduction**	Changes, Opportunities and Challenges, Technologies, Networks, and Services, Requirements for NGN, Next Generation Network Concept, Next Generation Society	**08**
2	**Next Generation Technology**	Technologies influencing change, IP Networks (Migration from circuit Switching to Packet Switching), building blocks for NGN, Wireline NG Technologies: Fiber to Premises, Long-Haul Managed Ethernet, Wireless NG Technologies: Broadband Bluetooth & ZigBee, Long Term Evolution, VOIP, Multi service Flexible Networks architecture. VPNs, ITU - NGN Architecture, Numbering, naming and addressing in NGN	**10**
3	**IMS and Convergence Management**	IMS Architecture, IMS Services : Push to Talk over cellular Service , IMS Based FMC Services	**08**
4	**IPTV &HbbTV**	Introduction, Architecture of NGN Based IPTV, NGN Based IPTV Services, Protocols Used for IPTV, HbbTV (Hybrid Broadcast Broadband TV) Services, HBB–NEXT, Multiple-User Environment	**08**
5	**Next Generation Multiservice Technology**	MPLS , MPLS services and components , MPLS &QoS, overview of VPN, layer2 VPN, layer 3 VPN	**08**
6	**NGN Services**	Software- Based Business Services, High- Definition Voices, Three Dimensional Television, Mobile and Manages Peer-to Peer Service, Converged/ Personalized / Interactive Multimedia Services, Grand-Separation for Pay-per-Use Service, Consumer and Business-Oriented Apps Storefront	**10**

Reference:

- Thomas Plavyk, "Next generation Telecommunication Networks, Services and Management", Wiley & IEEE Press Publications, 2012
- Next Generation Networks – NGN, Module 1: ITU NGN standards and architectures
- NGN Architecture: Generic Principles, Functional Architecture, and Implementation Keith Knightson, Consultant, Naotaka Morita, NTT Corporation, Thomas Towle. Lucent Technologies — Bell Laboratories, IEEE Communications Magazine • October 2005
- Azhar Sayed , Monique Morrow MPLS and Next Generation Networks:Foundations for NGN andEnterprise Virtualization**",** Cisco Press

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA 4054	**Artificial Intelligence and Soft Computing**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA 4054	**Artificial Intelligence and Soft Computing**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA 4054	**Artificial Intelligence and Soft Computing**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Students should have knowledge of SET theory, SET relations and Probability.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO4054.1	Identify and describe problems that are amenable to solution by AI methods.
CEO4054.2	Study appropriate soft computing techniques for problem solving
CEO4054.3	Study optimization techniques based on soft computing approach

Course Outcomes (CO): At the end of the course, the students will be able to

MCA4054.1	Understand various AI concepts
MCA4054.2	Solve the problems using neural networks techniques.
MCA4054.3	Apply fuzzy logic techniques to find solution of uncertain problems.
MCA4054.4	Analyze the genetic algorithms and their applications

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to AI**	**Artificial Intelligence** : Role of AI in engineering, AI in daily life, Intelligence and Artificial Intelligence, Different task domains of AI, Programming methods, Limitations of AI **Intelligent Agent:** Agent, Performance Evaluation, task environment of agent, Agent classification, Agent architecture	**05**
2	**Problem Solving**	**Problems, problem spaces and search:** Define the problem as a state space search, Production systems, Problem characteristics, Production system characteristic, Issues in design of search program **Search Techniques:** DFS, BFS, Hill Climbing	**06**
3	**Knowledge Representation**	**Knowledge Representation**: Need to represent knowledge, Knowledge representation with mapping scheme, Properties of good knowledge-based system, Knowledge representation issues, AND-OR graph, Types of knowledge	**09**
4	**Concepts of Soft Computing**	**Soft Computing:** Hard computing Vs Soft Computing, Soft computing constituents – ANN, Fuzzy Logic, GA Applications of Soft Computing	**02**
5	**Neural Network**	**Artificial Neural Network:** Introduction,Fundamental Concept, Artificial Neural Network, Brain vs. Computer - Comparison Between Biological Neuron and Artificial Neuron, Basic Models of Artificial Neural Network **Supervised Learning Network**-Linear Separability, Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network. **Unsupervised Learning Networks**- MaxNet	**12**
6	**Fuzzy Logic**	**Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets:**Introduction to Fuzzy Logic, Classical Sets (Crisp Sets),Fuzzy Sets **Classical Relations and Fuzzy Relations:** Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relations **Membership Functions:** Introduction, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments **Defuzzification:** Introduction, Lambda-Cuts for Fuzzy Sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relations, Defuzzification Methods	**10**
7	**Fuzzy Inference System**	**Fuzzy Inference System**: Truth Values and Tables in Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules (Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Inference Systems (FIS)- Construction and Working Principle of FIS, Methods of FIS, Overview of Fuzzy Expert System	**04**
8	**Genetic Algorithm**	**Genetic Algorithm**: Basic concepts, Difference between genetic algorithm and traditional methods, Simple genetic algorithm, Working principle, Procedures of GA, Genetic operators-reproduction, Mutation, crossover.	**04**

References:

- Artificial Intelligence, 3rd Edition, Elaine Rich, Kevin Knight, S.B. Nair, Tata McGraw Hill.
- Artificial Intelligence and Soft Computing for Beginners- Anandita Das, ShroffPublication.
- Dr. S. N. Sivanandam and Dr. S. N. Deepa,"Principles of Soft Computing "John Wiley
- S. Rajsekaran& G.A. VijayalakshmiPai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
- Kumar Satish, "Neural Networks" Tata McGraw Hill
- Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
- Search, Optimization & Machine Learning by *David* E. *Goldberg*.

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAL401	**Advanced Web Technology and Data Mining and Business Intelligence Lab (AWT and DMBI Lab)**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAL401	**Advanced Web Technology and Data Mining and Business Intelligence Lab**	--	**06**	--	--	**03**	--	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCAL401	**Advanced Web Technology and Data Mining and Business Intelligence Lab**	--	--	--	--	**25**	**50**	**25**	**100**

Pre-requisites:

- Basic Knowledge of Object Oriented Programming concepts
- Basic Understanding of Database Systems

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOL401.1	Learn advanced windows and web development techniques using dotNET
CEOL401.2	Understand Business Intelligence and Data Mining techniques
CEOL401.3	Prepare Business Intelligence applications using Web Technologies.

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAL401.1	Develop Windows forms applications and Web Applications using Dot NET Technologies
MCAL401.2	Apply Data warehousing and mining techniques.
MCAL401.3	Design and implement web enabled BI application for industry.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Dot Net and C#**	• Basic Windows Forms Applications • Windows Forms Applications using Control Structures and Operators • Advanced Windows Forms Controls	**04**
2	**OOP C#**	• Programs using Classes and Objects • Programs based on Inheritance • Programs using Static and Constant • Programs using Interfaces • Programs using Abstract Classes • Programs on Collections • Designing Generic Classes and Methods	**10**
3	**Databases and C#**	• Text File Handling • Text Editing Application • Binary File Handling • Database Connectivity in Connected Manner • Database Connectivity in Disconnected Manner • LINQ with Object Data Source • LINQ with DataSet	**08**
4	**Asp.Net Web Applications**	• Web Applications using Web Server Controls • Web Applications using advanced Web Server Controls • ASP .NET Applications using Web Forms • ASP.NET Applications using MVC	**08**
5	**Data and State Management in ASP.NET**	• ASP.Net Web Applications managing States • Web Applications using SQL Data Source • Web Applications using Connected and Disconnected database Connectivity • Web Applications using ADO.NET Entity Framework • Web Applications using jquery and database Connectivity • Web Applications using ASP.NET Ajax • Websites using Master Pages and Themes	**10**
6	**Web Services**	• Creating and Consuming a XML Web Service-Simple and Database • Creating and Consuming a WCF service – Simple and Database • Designing Secure Web Application • Deploying web Site	**06**
7	**Data Warehousing**	**Data Warehousing using Oracle** • Setting Up and Starting Warehouse Builder • Introducing OWB Architecture and Configuration • Defining Source Metadata • Ensuring Data Quality Using Data Profiling • Defining Staging Metadata and Mapping Tables • Deriving Data Rules and Running Correction Mappings	**06**

		• Defining a Relational Dimensional Model • Handling Slowly Changing Dimensions **OLAP with Oracle** • Analytical Queries • Grouping Functions • Windowing Functions • RollUp and Cube	
8	**Data Mining**	**Data Mining Using Weka/R Miner** • Introducing Weka/R Miner • The Data Mining Process • Using Classification Models • Using Regression Models • Using Clustering Models • Performing Market Basket Analysis • Performing Anomaly Detection • Deploying Data Mining Results	**08**
9	**BI Tools**	**Open Source BI Tools** • Preparing Reports • Preparing Dashboards • Preparing Balanced ScoreCards • Analysis of Reports	**08**
10	**Mini Project**	**Mini Project** A Mini Projects based on Data Mining and Business Intelligence Techniques using advanced Web Technologies.	**10**

References:

- Beginning Visual C# 2012 Programming, Karli Watson, Jacob Vibe Hammer, Jon D. Reid, Morgan Skinner, Daniel Kemper, Christian Nagel,ISBN: 978-1-118-31441-8,Wrox Publication
- Professional C# 2008,Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, ISBN: 978-1-118-64321-1,Wrox Publication
- Beginning ASP.NET 4.5: in C# and VB,ImarSpaanjaars, ISBN: 978-1-118-31180-6,Wrox Publication
- Professional ASP.NET 4.5 in C# and VB,Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, Scott Hunter (Foreword by), ISBN: 978-1-118-31182-0,Wrox Publication
- Murach's ASP.NET 4 Web Programming with C# 2010, Anne Boehm,Joel Murrach,SPD, Murrach Books
- Murach's C# 2015,Anne Boehm and Joel Murach,ISBN 978-1-890774-94-3,Murrach
- Murach"s ADO. Net 4 Database Programming with C# 2010 4th Edition
- Pro C# 5.0 and the .NET 4.5 Framework – Andrew Trolsen, APress
- Advance .NET Technology second edition by ChiragPatel- DreamTech Press

Web References:

- MSDN: Learn to Develop with Microsoft Developer Network: https://msdn.microsoft.com/
- www.weka.org, www.oracle.comwww.pentahobi.com

Subject Code	Subject Name	Credits
MCA L402	**Computer Graphics and Image Processing Lab**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut.	Total
MCA L402	**Computer Graphics and Image Processing Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA L402	**Computer Graphics and Image Processing Lab**	**--**	**--**	**--**	**--**	**25**	**50**	**25**	**100**

Pre-requisites:

- Understanding of Object Oriented Programming Language
- Knowledge of Algorithms

Course Educational Objectives (CEO): At the end of the course, the students will be able to:

CEOL402.1	Understand the concepts of output primitives of Computer Graphics.
CEOL402.2	Learn 2 D and 3 D graphics Techniques.
CEOL402.3	Study various Image Processing techniques

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAL402.1	Implement the algorithms to draw output primitives of Computer Graphics.
MCAL402.2	Implement 2D transformations
MCAL402.3	Implement 3D transformations
MCAL402.4	Implement various image processing techniques.

Syllabus:

Sr. no	Module	Detailed Contents	Hours
01	**Introduction**	Introduction to graphics coordinates system and demonstration of simple inbuilt graphic functions	2
02	**Output primitives & its Algorithms**	Implementation of line generation A. A. DDA line B. Bresenhams line C. application of Line drawing algos.	6
03	**Output primitives & its Algorithms**	Implementation of circle drawing A. Midpoint circle B. application of Circle drawing algos.	4
04	**Output primitives & its Algorithms**	Implementation of ellipse drawing A. Midpoint Ellipse	4
05	**Output primitives & its Algorithms**	Implementation of curve drawing A. Bezier Curve	2
06	**Output primitives & its Algorithms**	Implementation of filling algorithms A. Boundary fill B. Flood fill C. Scan line D. application of Circle drawing algos.	8
07	**2D Geometric Transformations & Clipping**	Implementation of two dimensional transformations A. Translation, Rotation & Scaling B. Shear & Reflection	6
08	**2D Geometric Transformations & Clipping**	Implementation of clipping algorithms A. Cohen Sutherland Line clipping B. Midpoint Subdivision C. Sutherland Hodgeman Polygon Clipping	10
09	**Basic 3D Concepts & Fractals**	Implementation of 3D Transformations (only coordinates calculation)	2
10	**Basic 3D Concepts & Fractals**	Implementation of fractal generation A. Koch curve/Snowflake B. Sirepenski Triangle	6
11	**Introduction of Animation**	Implementation of animation programs (using basic inbuilt Graphical functions)	4
12	**Image Enhancement Techniques**	Implementation of Basic Intensity Transformations A. Image negative B. Log transformation C. Power law Transformation	6
13	**Image Enhancement Techniques**	Implementation of Piecewise-Linear Transformation Functions A. Contrast Stretching B. Grey level Slicing C. Bit plane slicing	8
14	**Image Enhancement Techniques**	Implementation of histogram equalization A. Image histogram & histogram	10

		Equalization B. Image Subtraction C. Image averaging	

Reference:

- Donald Hearn and M Pauline Baker, Computer Graphics C Version -- Computer Graphics, C Version, 2/E, Pearson Education.
- David F. Rogers, James Alan Adams, Mathematical elements for computer graphics , McGraw-Hill, 1990
- Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing (3rd Edition), Pearson Education.
- S. Sridhar-Digital image Processing, Second Edition, Oxford University Press
- Anil K. Jain -Fundamentals of digital image processing. Prentice Hall, 1989

Subject Code	Subject Name	Credits
MCAL403 Activity Lab	**Soft Skills Development**	**02**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCAL403 Activity Lab	**Soft Skills Development**	--	**02**	--	--	**02**	--	**02**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA L403 Activity Lab	**Soft Skills Development**	--	--	--	--	**50**	--	--	**50**

Pre-requisites: ----

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOL403.1	To provide essential professional skills needed to make a positive impact on work and social lives
CEOL403.2	Understand the corporate culture and adapt to various situations
CEOL403.3	Improve their etiquettes, interpersonal skills and professional image

Course Outcomes (CO): At the end of the course, the students will be able to

MCAL403.1	Develop skills in communication, business correspondence, presentations, group discussions and interviews
MCAL403.2	Apply valuable strategies and interpersonal skills thereby making themselves more productive and better capable to lead others
MCAL403.3	Understand the importance of teamwork and learn to perform to the best of their ability, both individually and as team players

Syllabus

Sr. No	Module	Detailed Contents	Hrs
1	**Soft Skills Introduction**	Soft-Skills Introduction What are Soft Skills? Significance of Soft-Skills – Soft-Skills Vs. Hard Skills - Selling Soft- Skills – Components of Soft Skills – Identifying and Exhibiting Soft-Skills	**01**
2	**Communication**	Concept and meaning of communication, methods of communication, verbal and non-verbal communication, barriers to communication, techniques to improve communication. Communication in a business organization: Internal (Upward, Downward, Horizontal, Grapevine). External Communication, 7 C's of communication. Active Listening, Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening Practical (Role plays, case studies)	**02**
3	**Written Business Communication**	Written Communication: Principles of Correspondence, language and style in official letter (full block format, modified block format), Business letters (enquiry to complaints and redressal), Application letter, CV writing, , E-mail etiquette, Documentation of Meetings, Notice, Agenda, Minutes of Meetings. Practical (Practice on CV, Business Letters, Applications, Notice, Agenda, Minutes of Meetings)	**04**
4	**Presentation Skills**	Presentation techniques, Planning the presentation, Structure of presentation, Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management. Visual aids. Practical - Presentation by students in groups of maximum 3 on Organizational Behavior topics allocated by faculty. Topics have to cover – 1. Personality: Meaning, Personality Determinants, Traits, Personality types and its, impact on career growth, 2. Personality and Values, Perception and Individual Decision Making. 3. Diversity in Organizations 4. Attitude: Meaning, Components of Attitude, changing attitude and its impact on career growth 5. Motivation 6. Goal setting: SMART (Specific, Measurable, Attainable, Realistic, Timely) Goals, personal and professional goals 7. Time Management. 8. Learning in a group, Understanding Work Teams, Dynamics of Group Behavior, Techniques for effective participation 9. Leadership 10. Emotional intelligence	**10**
5	**Effective Public Speaking**	Public Speaking, Selecting the topic for public speaking, Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, Delivering the speech Practical (Extempore)	**03**
6	**Group Discussions**	Group Discussion Skills, Evaluation components, Do's and Don'ts. Practical (Group Discussions)	**03**
7	**Interview**	Interview Techniques, Pre-Interview Preparation, Conduct during	**03**

	Techniques	interview, Verbal and non-verbal communication, common mistakes. Practical (Role plays, mock interviews)	

Reference:

- Business Communication (Revised Edition),Rai& Rai , Himalaya Publishing House.
- Soft skills: an integrated approach to maximise Personality, Chauhan &Sharma,Wiley India publications.
- Business Communication: A practice oriented approach, Kalia and Shailja Agarwal.
- Business Communication – Meenakshi Raman, Prakash Singh, Oxford Publication
- Stephen Robbins & Judge Timothy: Organization Behavior, Pearson Education
- K. Aswathappa – Organizational Behavior: Text, cases & games, Himalaya Publishing House.
- Pareek, Udai, Understanding Organizational Behaviour, Oxford University Press, New Delhi.

Assessment:

Internal:

Internal term workwould consist of

1. A written examination of 20 marks
2. Continuous evaluation of 30 marks would be done by internal faculty on the basis of student participation in all practical activities during entire semester.

Program Structure for
Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Semester V

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA501	Wireless and Mobile technology	04	--	--	04	--	--	04
MCA502	Advanced Distributed Computing	04	--	--	04	--	--	04
MCA503	User Experience Design	04	--	--	04	--	--	04
MCADLE504	Elective 1 (Departmental level)	04	--	--	04	--	--	04
MCAILE505	Elective 2 (Institutional Level)	04	--	--	04	--	--	04
MCAL501	Mobile Application and User experience Design Lab	--	06	--	--	03	--	03
MCAL502	Open Source System For ADC Lab	--	06	--	--	03	--	03
MCAPR501	Mini Project	--	--	--	--	--	--	02
Total		**20**	**12**	**--**	**20**	**06**		**28**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test 1	Test 2	Avg					
MCA501	Wireless and Mobile technology	20	20	20	80	--	--	--	100
MCA502	Advanced Distributed Computing	20	20	20	80	--	--	--	100
MCA503	User Experience Design	20	20	20	80	--	--	--	100
MCA DLE504	Elective 1 (Departmental level)	20	20	20	80	--	--	--	100
MCA ILE505	Elective 2 (Institutional Level)	20	20	20	80	--	--	--	100
MCA L501	Mobile Application and User experience Design Lab	--	--	--	--	25	50	25	100
MCA L502	Open Source System For ADC Lab	--	--	--	--	25	50	25	100
MCAPR501	Mini Project	--	--	--	--	25	--	25	50
Total		**100**	**100**	**100**	**400**	**75**	**100**	**75**	**750**

Program Structure for

Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Elective for Semester V

SEM V – Elective 1- Department Level Elective	
Course Code	**Course Name**
MCADLE5041	Big Data Analytics
MCADLE5042	Machine Learning
MCADLE5043	Internet of Things
MCADLE5044	Multimedia System Design
SEM V – Elective 2 - Institute Level Elective	
Course Code	**Course Name**
MCAILE5051	Intellectual property Rights and Patents
MCAILE5052	Research Methodology
MCAILE5053	Management Information System
MCAILE5054	Green Computing

SEMESTER V

Subject Code	Subject Name	Credits
MCA501	**Wireless and Mobile Technology**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract	Tut	Total
MCA501	**Wireless and Mobile Technology**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1(T1)	Test2(T2)	Average of T1 & T2					
MCA 501	**Wireless and Mobile Technology**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic knowledge of networks and communication

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO501.1	Learn the concepts of wireless communication and mobile networks
CEO501.2	Identify different wireless technologies and its applications
CEO501.3	Acquire knowledge on generation of cellular networks and its standards used

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA501.1	Understand the concept of cellular communications, advantages and its limitations
MCA501.2	Compare the various wireless technologies and its applications
MCA501.3	Apply the appropriate technology in the applications

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Wireless Technology Fundamentals**	Introduction to Mobile and wireless communications, Overview of radio transmission frequencies, Signal Antennas, Signal Propagation, Multiplexing – SDM,FDM, TDM,CDM, Modulation – ASK,FSK,PSK, Advanced FSK, Advanced PSK, OFDM, Spread Spectrum – DSSS,FHSS, Wireless Transmission Impairments – Free Space Loss, Fading, Multipath Propagation, Atmospheric Absorption, Error Correction – Reed Solomon, BCH, Hamming code, Convolution Code (Encoding and Decoding)	**08**
2	**Wireless Networks**	Wireless network, Wireless network Architecture, Classification of wireless networks – WBAN, WPAN, WLAN, WMAN, WWAN. IEEE 802.11, IEEE 802.16, Bluetooth – Standards, Architecture and Services	**06**
3	**Cellular wireless Networks**	Principles of cellular networks – cellular network organization, operation of cellular systems, Handoff. Generation of cellular networks – 1G, 2G, 2.5G, 3G and 4G.	**06**
4	**Mobile communication systems**	GSM – Architecture, Air Interface, Multiple Access Scheme, Channel Organization, Call Setup Procedure, Protocol Signaling, Handover, Security, GPRS – Architecture, GPRS signaling, Mobility management, GPRS roaming, network, CDMA2000-Introduction, Layering Structure, Channels,Logical Channels, Forward Link and Reverse link physical channels, W-CDMA – Physical Layers, Channels, UMTS – Network Architecture, Interfaces, Network Evolution, Release 5, FDD and TDD, Time Slots, Protocol Architecture, Bearer Model Introduction to LTE	**12**
5	**Mobile Network Layer**	Mobile IP – Dynamic Host Configuration Protocol, Mobile Ad Hoc Routing Protocols– Multicast routing	**06**
6	**Mobile Transport Layer**	TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP , TCP over 2.5 / 3G wireless Networks	**07**
7	**Application Layer**	WAP Model- Mobile Location based services -WAP Gateway – WAP protocols – WAP user agent profile, Caching model-wireless bearers for WAP - WML – WMLScripts – WTA.	**07**

References

1. Mobile Communications, Second Edition, Jochen Schiller, Pearson Education
2. Wireless Communications & Networks, Second Edition, William Stallings, Pearson Education
3. Wireless Communications and Networks, 3G and Beyond, Second Edition, ITI SahaMisra, McGraw Hill Education
4. Wireless Network Evolution 2G to 3G, Vijay K. Garg, Pearson Publications.
5. Wireless and Mobile Network Architectures, Yi Bang Lin, ImrichChlamtac, Wiley India.
6. Wireless and Mobile Networks, Concepts and Protocols, Dr. Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, Wiley India

7. Multi-Carrier and Spread Spectrum Systems - From OFDM and MC-CDMA to LTE and WiMAX, Second Edition, K. Fazel, S. Kaiser, wiley publications
8. Wireless and Mobile All-IP Networks, Yi-Bing Lin, Ai-Chun Pang, Wiley Publications

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA502	**Advance Distributed Computing**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA502	**Advance Distributed Computing**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 502	**Advance Distributed Computing**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Computer Networks, Operating Systems

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO502.1	Introduce advance distributed concepts.
CEO502.2	Emphasize on design techniques and constraints of distributed computing
CEO502.3	Emphasize on analysis of cloud computing, its security and its storage

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA502.1	Distinguish between distributed computing and parallel computing
MCA502.2	Understand concepts of SOA.
MCA502.3	Demonstrate different cloud technologies
MCA502.4	Designing security and storage in cloud technologies.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Distributed Computing Concepts**	Basic concepts of distributed systems, distributed computing models, software concepts, issues in designing distributed systems, client server model **Inter Process Communication** Fundamental concepts related to inter process communication including messagepassing mechanism, a case study on IPC in MACH, concepts of group communication and case study of group communication CBCAST in ISIS, API for Internet Protocol. **Remote Communication** Remote Procedural Call (RPC), Remote Method Invocation (RMI),a case study on Sun RPC, a case study on JAVA RMI.	**11**
2	**Clock synchronization**	Introduction ofclock synchronization, global state mutual Exclusion algorithms, election algorithms.	**02**
3	**Distributed Shared Memory**	Fundamental concepts of DSM, types of DSM, various hardware DSM systems, Consistency models, issues in designing and implementing DSM systems.	**06**
4	**Distributed System Management and Object based System**	Resource management, process management, fault tolerance, code migration, CORBA: Overview of CORBA, Communication, Processes, Naming, and Synchronization.	**09**
5	**Introduction to Parallel Computing**	Parallel computing, scope of parallel computing, Abstract model of serial & parallel computation, pipelining, data parallelism, control parallelism, scalability, topologies in processor organization, parallel computing design consideration, parallel algorithms & parallel architectures, applications of parallel computing.	**08**
6	**Advances in Distributed Computing**	Service-Oriented Architecture, Elements of Service-Oriented Architectures, RPC versus Document Orientation, Major Benefits of Service- Oriented Computing, Composing Services, Goals of Composition, Challenges for Composition, Spirit of the Approach.	**04**
7	**Fundamentals of Cloud computing, cloud Security and Storage**	Evolution of Cloud Computing ,cluster computing Grid computing, Grid computing versus Cloud Computing, Key Characteristics of cloud computing. **Cloud models:** Benefits of Cloud models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Shared Private Cloud, Dedicated Private Cloud, Dynamic Private Cloud, Savings and cost impact, Web services delivered from cloud, Platform as a service, Software as a service,Infrastructure as a service. **Cloud Security Fundamentals and Storage** Privacy and security in cloud, Security architecture, Data security, Identity and access management, security challenges, Storage basics, Storage as a service providers, aspects of data security.	**12**

References:

1. Distributed OS by Pradeep K. Sinha , PHI
2. Distributed Computing by Dr. SunitaMahajan , Seema Shah, Oxford University Press
3. Distributed Operating Systems by Tanenbaum S, Pearson Education
4. Introduction to Parallel Computing (2nd Edition) AnanthGrama ,George Karypis, Vipin Kumar , Anshul Gupta.
5. Parallel and Distributed systems (2nd Edition)Arun Kulkarni, Nupur Prasad Giri,Nikhilesh Joshi, BhushanJadhav, Wiley publication
6. Cloud Computing Unleashing Next Gen Infrastructure to Application(3rd Edition)By Dr. Kumar Saurabh, wiley Publication

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCA503	**User Experience Design**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCA503	**User Experience Design**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCA 503	**User Experience Design**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
System Analysis & Design,Software Engineering and Project Management,UML.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO503.1	Develop interest in User Experience Engineering (UXE) Process
CEO503.2	Understand how to design Effective and Efficient User Interfaces for intended users
CEO503.3	Learn tools and techniques for Prototyping and Evaluating User Experiences

Course Outcomes (CO): At the end of the course, the students will be able to:

MCA503.1	Understand and create interest in User Experience Design(UXD)
MCA503.2	Analyze the framework and methodological approach for user experience design.
MCA503.3	Apply prototyping and problems solving techniques related to user experience design.
MCA503.4	Design real life application with end-to-end understanding of User experience practices.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to UX Design**	What is UX, Ubiquitous interaction, Emerging desire for usability, From usability to user experience, Emotional impact as part of the user experience, User experience needs a business case, Roots of usability.	**06**
2	**The UX Design - life cycle**	Introduction, A UX process lifecycle template, Choosing a process instance for your project, The system complexity space, Meet the user interface team, Scope of UX presence within the team, More about UX lifecycles.	**06**
3	**The UX Design Process – Understand Users**	Introduction, The system concept statement, User work activity gathering, Look for emotional aspects of work practice, Abridged contextual inquiry process, Data-driven vs. model-driven inquiry, History. , Contextual Analysis, Extracting Interaction Design Requirements, Constructing Design-Information Models.	**12**
4	**The UX Design Process**	Information ,Architecture and Interaction Design and Prototyping Introduction, Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching, More about phenomenology, Mental Models and Conceptual Design, Wireframe, Prototyping	**10**
5	**The UX Design Process**	UX Evaluation and Improve UX Goals, Metrics and Targets, UX Evaluation Techniques.- Formative vs summative ,types of formative and informal summative evaluation methods, types of evaluation data, some data collection technics, variations in formative evaluation results, informal summative dada analysis, formative data analysis , feedback to process ,evaluation report	**12**
6	**UX methods for Agile Development**	Introduction, Basics of agile SE method , drawbacks of agile SE method from the UX perspective, A synthesized approach to integrate UX	**06**

References

- The UX Book by Rex Hartson and PardhaPyla, MK Publication
- Smashing UX Design by Jesmond Allen and James Chudley**,** John Wiley & Sons
- A Project Guide to UX Design by Russ Unger and Carolyn Chandler, O'reillyRies, Series Editor
- Agile Experience Design by Lindsay Ratcliffe and Marc McNeill , Pearson
- Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler, Rosenfeild Media
- Human Computer Interaction by Alan Dix, New riders
- Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden, Morgan Kaufmann
- Don't Make Me Think, Revisited by Steve Krug, New riders
- The User Experience Team of One by Leah Buley, Rosenfeild Media
- The Elements of User Experience by Jesse James Garrett, New riders

- Sketching User Experiences: The Workbook by Saul Greenberg, SheelaghCarpendale, Nicolai Marquardt and Bill Buxton, Morgan Kaufmann, workbook edition

Web References:

- http://wireframe.vn/books/

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Electives I:
Department Level
Electives(MCADLE504)

Subject Code	Subject Name	Credits
MCADLE5041	**Big Data Analytics**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCADLE5041	**Big Data Analytics**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCADLE5041	**Big Data Analytics**	Test1 (T1)	Test2(T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Database Management Systems, SQL

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEODLE5041.1	Provide fundamental techniques and principles of Big Data Analytics
CEODLE5041.2	Identify the tools required to manage and analyze Big Data
CEODLE5041.3	Understand the data analytics techniques required to solve complex real world problems

Course Outcomes (CO): At the end of the course, the students will be able to:

MCADLE5041.1	Develop and maintain reliable, scalable systems using Apache HADOOP
MCADLE5041.2	Write Map Reduce based application
MCADLE5041.3	Differentiate between conventional SQL and NoSQL
MCADLE5041.4	Analyze and develop Big Data solutions using HIVE and PIG

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction**	Distributed file system and its issues, Introduction to big data, big data characteristics, types of big data, traditional vs. big data approach, big data applications	**08**
2	**Hadoop**	Why Hadoop? Hadoop architecture, Hadoop components HDFS and YARN, comparison between YARN 1 and YARN 2 architecture, HDFS federation : Name Node, Data Node, Resource Manager, Job Tracker, Task Tracker Hadoop Ecosystem : Scoop, HIVE, PIG, Flume, Zookeeper, HBASE Hadoop installation in pseudo distribution mode, running HDFS commands	**10**
3	**Map Reduce**	Understanding Map Reduce, Map Task, Reduce Task, speculative execution, partioner and combiner in Map Reduce Running sample Map Reduce Program: Word Count. Algorithm using Map Reduce : -matrix vector multiplication, -grouping and aggregation -relational algebra operations	**10**
4	**NoSQL**	What is NoSQL? NoSQL - Case study, data architecture pattern: key value, column family, document store. HBASE overview, HBASE data model, row oriented vs. column oriented storage, HBASE architecture, HBASE shell commands	**08**
5	**HIVE**	HIVE : background, architecture, warehouse directory and meta-store, HIVE query language, loading data into table, HIVE built-in functions, joins in HIVE, HIVE installation, HiveQL: querying data, sorting and aggregation	**08**
6	**PIG**	PIG : background, architecture, PIG Latin Basics, PIG execution modes, PIG processing – loading and transforming data, PIG built-in functions, filtering, grouping, sorting data Installation of PIG and PIG Latin commands	**08**

Reference:

- Tom White, "HADOOP: The definitive Guide", O Reilly 2012
- Chris Eaton, Dirk deroos et al., "Understanding Big Data", McGraw Hill, 2012.
- Big Data Analytics – RadhaShankarmani and M. Vijayalakshmi Wiley Texbook Series
- Hadoop in Action - Chuck Lam Dreamtech Press
- Hadoop in Practice - Alex Holmes Dreamtech Press

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCADLE5042	**Machine Learning**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCADLE5042	**Machine Learning**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
MCADLE5042	**Machine Learning**	Test1 (T1)	Test2(T 2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Understanding of basic computer science concepts, data structures and good understanding of Mathematical Concepts is required.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEODLE5042. 1	Understand Machine Learning and its techniques.
CEODLE5042. 2	Study regression, classification with AdaBoost and clustering methods.
CEODLE5042. 3	Understand support vector machine, Dimensionality reduction, Anomaly Detection, Recommender Systems

Course Outcomes (CO): At the end of the course, the students will be able to

MCADLE5042.1	Analyze the Machine Learning techniques.
MCADLE5042.2	Apply regression, classification with AdaBoost and clustering methods to real world applications.
MCADLE5042.3	Describe support vector machine, Dimensionality reduction, Anomaly Detection, Recommender Systems

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Understand Machine Learning**	Introduction to Machine Learning, Overview of Machine Learning, Key Terminology and task of ML, Applications of ML, Software Tools, Introduction to Big Data and Machine Learning, Hypothesis space, Estimate hypothesis accuracy, Hypothesis testing	**06**
2	**Supervised Learning- Classification**	Introduction to Supervised Learning: Classification, Decision Tree Representation- Appropriate problem for Decision Learning, Decision Tree Algorithm, Hyperspace Search in Decision Tree Naive Bayes- Bayes Theorem , Classifying with Bayes Decision Theory , Conditional Probability, Bayesian Belief Network	**08**
3	**Supervised Learning- Regression**	Regression: Linear Regression- Predicting numerical value, Finding best fit line with linear regression, Regression Tree- Using CART for regression Logistic Regression - Classification with Logistic Regression and the Sigmoid Function	**08**
4	**Support Vector Machine**	Introduction : Separating data with maximum margin, Finding the maximum margin, Effective optimization with SMO algorithm	**08**
5	**Improving classification with the AdaBoost**	Classifier using multiple samples of the data set, Improving classifier by focusing on error, weak learner with a decision stump, Implementing the AdaBoost algorithm, Classifying with AdaBoost	**08**
6	**Unsupervised Learning**	Clustering: Learning from unclassified data –Introduction to clustering, K- Mean Clustering, Expectation-Maximization Algorithm(EM algorithm),Hierarchical Clustering, Supervised Learning after clustering	**08**
7	**Additional Core Techniques**	Dimensionality reduction- Dimensionality reduction techniques, Principal component analysis, Anomaly Detection, Recommender Systems	**06**

Reference:

- Machine Learning in Action By Peter Harrington By Manning
- Machine Learning, T. Mitchell, McGraw-Hill, 1997.
- Introduction to Machine LearningBy EthemAlpaydin,MIT Press
- Understanding Machine Learning From Theory to Algorithms By ShaiShalev-Shwartz and Shai Ben David, Cambridge University Press
- Data Mining Concepts and Techniques, J. Han and Kamber

Web References:

- http://www.infoworld.com/article/2853707/robotics/11-open-source-tools-machine-learning.html#slide12
- http://www.ibm.com/developerworks/library/os-recommender1/

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCADLE5043	**Internet of Things**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCADLE5043	**Internet of Things**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA DLE5043	**Internet of Things**	Test1 (T1)	Test2(T 2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:
Computer Networks

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEODLE5043. 1	Understand the concepts of IOT
CEODLE5043. 2	Study IoT Architecture
CEODLE5043.3	Understanding the technologies used to build IoT applications.

Course Outcomes (CO): At the end of the course, the students will be able to

MCADLE5043.1	Identify the use of IoT from a global context.
MCADLE5043.2	Design application using IoT.
MCADLE5043.3	Analyze the IoT enabling Technologies
MCADLE5043.4	Determine the real world problems and challenges in IoT .

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**M2M to IoT**	**M2M to IoT** – The Vision, Introduction: **M2M** ,IoT, From M2M to IoT,M2M towards IoT – the global context, Differing characteristics, M2M value chains, IoT value chains,An emerging industrial structure for IoT, The international-driven global value chain and global information monopolies ,M2M to IoT – An Architectural Overview-,Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, Standards considerations	**10**
2	**IoT Architecture**	**IoT Architecture** – State of the Art Introduction,State of the art, Architecture Reference Model, Introduction, Reference model and architecture, IoT reference model, IoT Reference Architecture, Introduction, Functional view, Information view, Deployment and operational view, Other relevant architectural views	**08**
3	**IoT Enabling Technologies**	**IoT Enabling Technologies** -- Wireless Sensor Networks , Cloud Computing ,Big Data Analytics, Communication Protocols,Embedded Systems	**08**
4	**Real-World Design Constraints**	**Real-World Design Constraints**-Introduction,Technical design constraints – hardware , Data representation and visualization,Interaction and remote control	**04**
5	**Open – Source Prototyping Platforms for IoT**	**Open – Source Prototyping Platforms for IoT**- Basic Arduino Programming Extended Arduino Libraries,Arduino – Based Internet Communication, Raspberry PI,Sensors and Interfacing	**08**
6	**Data Management**	**Data Management**, Business Process in IoT, IoT Analytics, Creative Thinking Techniques, Modification,Combination Scenarios, Decentralized and Interoperable ,Approaches, Object – Information Distribution,Architecture, Object Naming Service (ONS), Service Oriented Architecture, Network of Information, Etc.	**08**
7	**Domain specific**	**Domain specificHome Automation** - Smart Lighting ,Smart Appliances , Intrusion Detection , Smoke/Gas Detectors **Energy**-Smart Grids ,Renewable Energy Systems ,Prognostics **Health & Lifestyle** -Health & Fitness Monitoring ,Wearable Electronics **Agriculture** - Smart Irrigation ,Green House Control **Retail**- Inventory Management , Smart Payments ,Smart Vending Machines **Cities** -Smart Parking ,Smart Lighting ,Smart Roads ,Structural Health Monitoring ,Surveillance ,Emergency Response	**06**

References:

- From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler VlasiosTsiatsis Catherine Mulligan Stefan Avesand StamatisKarnouskosDavid Boyle
- VijayMadisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
- Getting Started with the Internet of Things by CunoPfister
- The Internet of Things: Connecting Objects by HakimaChaouchi
- FrancisdaCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Assessment:

Internal:
Assessment consists of two tests (T1 and T2).The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCADLE5044	**Multimedia System Design**	**04**

Subject Code	Subject Name :	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCADLE5044	**Multimedia System Design**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCADLE5044	**Multimedia System Design**	Test1 (T1)	Test2(T 2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Prerequisite:
Computer Graphics

Course Educational Objectives (CEO): At the end of the course students will be able to

CEODLE 5044.1	Study various multimedia system design components.
CEODLE 5044.2	Understand compression and decompression techniques and different image formats.
CEODLE 5044.3	Interpret storage and retrieval technologies, Project planning and costing.

Course Outcomes (CO): At the end of the course, the students will be able to

MCADLE 5044.1	Perceive multimedia architecture and its latest applications.
MCADLE 5044.2	Implement compression, decompression techniques and different formats for image, audio and video.
MCADLE 5044.3	Plan and develop multimedia projects

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Fundamentals of Multimedia Systems Design**	An Introduction Multimedia Systems, Design Fundamentals, Elements of multimedia, Multimedia system architecture - High resolution graphics display, IMA Architectural Framework, Network architecture for multimedia systems , Defining objects for Multimedia systems: Text, Images, Audio and video	**07**
2	**Multimedia Input and Output Technologies**	Key Technology Issues, Touch screen, Pen Input, Video and Image Display Systems, Print Output Technologies, Image Scanners, Digital Voice and Audio, Video Images and Animation, Full Motion Video.	**11**
3	**Multimedia File format and standards**	RTF, TIFF,RIFF, MIDI, JPEG DIB, AVI, MIDI audio, JPEG & MPEG standards, MIDI Vs Digital Audio, Analog display standards ,Digital display standards, Digital video	**10**
4	**Compression and Decompression Techniques**	Introduction to coding and compression techniques- Lossy and Lossless , Entropy encoding, Run length encoding, Huffman coding, JPEG compression process, Discrete Cosine Transform, Video compression- MPEG-1, MPEG-2, MPEG-4, Audio Compression-MPEG, Adaptive differential pulse code modulation,	**12**
5	**Storage and retrieval technologies**	Magnetic Media Technology, RAID-Level-0 To 5, Optical Media, WORM optical drives	**06**
6	**Planning and costing**	Idea Analysis, Pretesting, Task Planning, Prototype Development, Alpha Development, Beta Development, Delivery, Scheduling, Estimating	**06**

References:

- Multimedia Systems Design Paperback –PrabhatK.Andleigh, KiranThakrar , Pearson Education India, 2015
- Multimedia: Making it Work, Seventh Edition, TayVaguhan, McGraw Hill Professional, 2008
- Fundamentals of Multimedia 2005 by Li and Ze – Nian ,Mark s Drew, PHI
- Multimedia Systems, John F. Koegel Buford, Pearson Education

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Electives II:
Institute Level Electives
(MCAILE505)

Subject Code	Subject Name	Credits
MCAILE5051	**Intellectual Property Rights and Patents**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAILE 5051	**Intellectual Property Rights and Patents**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA ILE5051	**Intellectual Property Rights and Patents**	**20**	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic understanding of morals/ethics, social values and technical writing.

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOILE5051.1	Understand basics of intellectual property.
CEOILE5051.2	Relate the knowledge of Intellectual Property Laws of India as well as International treaty procedures.
CEOILE5051.3	Get acquaintance with Patent search and patent filing procedure and applications.

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAILE5051.1	Understand Intellectual Property assets.
MCAILE5051.2	Assist individuals and organizations in capacity building.
MCAILE5051.3	Distinguish information across organizations.
MCAILE5051.4	Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to IPR**	**Introduction:** Concepts and meaning of Intellectual property, IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Semiconductor Integrated Circuits Layout-Design, Plant variety protection, Geographical indications, Transfer of technology etc. **Indian Scenario of IPR**: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India.	**10**
2	**Ownership and Enforcement of IPR**	**Enforcement of Intellectual Property Rights:** Introduction, Extent of problem, Factors that create and sustain counterfeiting/piracy, International Organizations, Agencies, and treaties active in IPR enforcement (e.g. INTA,WIPO,WTO, Madrid Protocol, Paris convention, NAFTA,TRIPS). **Ownership of intellectual property rights:** Ownership, Changes of Ownership	**08**
3	**Emerging Issues and Management of IPR**	**Emerging Issues of IPR:** IPRrelationship with software and technology, Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc. **Management of IPR:** Introduction, Overall management of IPRs ,Management of non-registrable rights	**06**
4	**Copyrights**	Introduction and law, Types of copyright, Ownership and duration of copyright, Marking, Moral rights, Other relevant law, Copyright use and misuse, Exceptions to copyright infringement – fair dealing, Taking action against infringers, Criminal liability, Copyright licenses, Copyright internationally – general and non-technical works, Technical copyright, Copyleft, Managing copyright	**08**
5	**Trademarks**	Introduction to trade marks, Registrable trademarks, Unregistered trademarks, 'get-up' and 'passing-off', Criminal provisions and counterfeiting, Avoid being sued, Trade marks in other countries, Domain names	**07**
6	**Patents**	Introduction, Process to get a patent, Filing a patent application, Patent applications in India and other countries, Search Patents on Indian Patent Office Website	**08**
7	**Confidential information**	Introduction, Confidential disclosure, Employees, Confidential computer programs, Unwanted confidences, Managing confidential information, Know-how and show-how, Legal remedies, Confidentiality in other countries, Summary of confidentiality	**05**

References:

- Vivien Irish, Second Edition, Intellectual Property Rights for Engineers, IET
- Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
- Deborah E. Bouchoux, Fourth Edition, Intellectual Property The Law of Trademarks, Copyrights, Patents, and Trade Secrets, CENGAGE Learning.
- Wipo intellectual property handbook
- Hyde W. Cornish, First Edition, Intellectual Property Right, Global Vision Publishing House
- P. Narayanan, Third Edition, Intellectual, Property Law, Eastern Law House.

Web References:

- http://www.ipindia.nic.in/
- http://ipindiaservices.gov.in/publicsearch/
- http://www.ipindia.nic.in/writereaddata/Portal/IPOAct/1_32_1_patent_act_1977-3-99.pdf
- http://www.icai.org

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAILE5052	**Research Methodology**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAILE 5052	**Research Methodology**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA ILE5052	**Research Methodology**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Basic knowledge of Mathematics for Data Analysis, Software, Internet

Course Educational Objectives (CEO): At the end of the course, the students will be able to:

CEO ILE5052.1	To understand Research and Research Process
CEO ILE5052.2	To acquaint students with identifying problems for research and develop research strategies
CEO ILE5052.3	To familiarize students with the techniques of data collection, analysis of data and interpretation

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAILE5052.1	Prepare a preliminary research design for projects in their subject matter areas
MCAILE5052.2	Accurately collect, analyze and report data
MCAILE5052.3	Present complex data or situations clearly
MCAILE5052.4	Review and analyze research findings Get the knowledge of objectives and types of research

Syllabus

Sr. No	Module	Detailed Contents	Hrs
1	**Introduction and Basic Research Concepts**	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research , Issues and Problems in Research , Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**10**
2	**Types of Research**	Basic Research , Applied Research , Descriptive Research,Analytical Research , Empirical Research ,Qualitative and Quantitative Approaches	**08**
3	**Research Design and Sample Design**	Research Design – Meaning, Types and Significance , Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**10**
4	**Research Methodology**	Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research Problem , Formulation of Research Problem , Review of Literature , Formulation of Hypothesis , Formulation of research Design , Sample Design , Data Collection , Data Analysis , Hypothesis testing and Interpretation of Data , Preparation of Research Report	**08**
5	**Formulating Research Problem**	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**08**
6	**Outcome of Research**	Preparation of the report on conclusion reached , Validity Testing & Ethical Issues , Suggestions and Recommendation	**08**

References:

- Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
- Kothari, C.R.1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
- Kumar Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.

- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any four from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAILE5053	**Management Information System**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAILE 5053	**Management Information System**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
MCA ILE5053	**Management Information System**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	**--**	**--**	**100**

Pre-requisites:

Information Technology in Management

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOILE5053.1	Understand the nature of management information systems and their applications in business
CEOILE5053.2	Learn the core activities in the systems development process.
CEOILE5053.3	Identify the major management challenges in building and using information systems.

Course Outcomes (CO): At the end of the course, the students will be able to

MCAILE5053.1	Understand theoretical aspects of Management Information Systems
MCAILE5053.2	Know the procedures and practices for performing information system planning and design.
MCAILE5053.3	Gain knowledge in various Decision Support Systems
MCAILE5053.4	Understand the implications of Management Information Systems on business

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Management Information Systems**	Perspectives on Information Systems, Nature and scope of MIS, Characteristics of MIS, Need and Role of MIS, Impact of MIS, functions and future of MIS, MIS: A support to the management, MIS: organization effectiveness, MIS for a digital firm, Case Study	**09**
2	**Strategic Design and Development of MIS**	Strategic Management of the Business, Strategic design of MIS,Business Strategy Implementation, Development of Long Range Plans of MIS, Ascertaining the class of Information, Determining the Information Requirement, Development and Implementation of MIS, MIS: Development Process Model, case study.	**10**
3	**Decision Making**	Decision making concepts, Decision Analysis by analytical modelling, Behavioral concepts in decision making, Organizational decision making, MIS and Decision Making, Case Study	**09**
4	**Information, knowledge, Business Intelligence**	Information Concepts, Information :A Quality Product, Classification of the information, Methods of data and information collection, Value of information, General model of a human as a information processor, Summary of information concepts and their implications, Knowledge and knowledge management systems, Business Intelligence, MIS , and the Information and Knowledge, Case Study	**10**
5	**E-Commerce: Applications and Issues**	Introduction to E-Commerce**,** Scope of E-commerce, E-Commerce Applications and Issues, case study	**07**
6	**Securing Information Systems**	System Vulnerability and Abuse, Business value of security and control, Technology and Tools for protecting Information, Resources,case study	**07**

References:

- Management Information Systems- A digital form perspective, 4th edition - By W.S.Jawdekar, TMG Publications
- Management Information Systems- A global digital Enterprise perspective, 5th edition - By W.S.Jawdekar, TMG Publications
- Management Information System, James O'Brien, 7th edition, TMH
- Management Information Systems, Loudon and Loudon, 11th edition, Pearson.

Assessment:

Internal:

Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAILE5054	**Green Computing**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut	Total
MCAILE 5054	**Green Computing**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
MCA ILE5054	**Green Computing**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	**20**	**20**	**80**	**--**	--	--	**100**

Pre-requisites:

Basic knowledge of Hardware, software and networking

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOILE5054.1	Understand what Green IT is and how we can meet standards set for Green Computing
CEOILE5054.2	Comprehend Green IT from the perspective of hardware, software, storage, and networkingat the enterprise level.
CEOILE5054.3	Strategize Green Initiatives and look at the future of Green IT

Course Outcomes (CO): At the end of the course, the students will be able to

MCAILE5054.1	Create awareness among stakeholders and promote green initiatives in their environments leading to a green movement.
MCAILE5054.2	Adopt special skills such as knowledge about energy efficiency, ethical IT assets disposal, carbon footprint estimation.
MCAILE5054.3	Create eco-friendly environment.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs

1	**Trends and Reasons to Go Green**	• Overview and Issues
		• Current Initiatives and Standards
		• Consumption Issues
		  ○ Minimizing Power Usage
		  ○ Cooling
			08

2	**Introduction to Green IT**	• Green IT
		• Holistic Approach to Greening IT
		• Awareness to Implementation
		  ○ Green IT Trends
		  ○ Green Engineering
		• Greening by IT
		  ○ Using RFID for Environmental Sustainability
		  ○ Smart Grids
		  ○ Smart Buildings and Homes
		  ○ Green Supply Chain and Logistics
		  ○ Enterprise-Wide Environmental Sustainability
			08

3	**Green Hardware and Software**	**Green Hardware** • Introduction , • Life Cycle of a Device or Hardware , • Reuse, Recycle and Dispose **Green Software** • Introduction • Energy-Saving Software Techniques **Changing the way we work** • Going Paperless	**08**
4	**Green Data Centers and Storage**	**Green Data Centers** • Data Centre IT Infrastructure • Data Centre Facility Infrastructure: Implications for Energy Efficiency • IT Infrastructure Management • Green Data Centre Metrics **Green Data Storage** • Introduction • Storage Media Power Characteristics • Energy Management Techniques for Hard Disks • System-Level Energy Management **Green Networks and Communications** • Introduction • Objectives of Green Network Protocols • Green Network Protocols and Standards	**08**
5	**Enterprise Green IT Strategy**	• Introduction • Approaching Green IT Strategies	**08**

		• Business Drivers of Green IT Strategy • Business Dimensions for Green IT Transformation • Organizational Considerations in a Green IT Strategy • Steps in Developing a Green IT Strategy • Metrics and Measurements in Green Strategies • Organizational and Enterprise Greening • Greening the Enterprise: IT Usage and Hardware	
6	**Managing and Regulating Green IT**	**Managing Green IT** • Introduction • Strategizing Green Initiatives • Implementation of Green IT • Information Assurance • Communication and Social Media **Regulating Green IT** • Introduction • The Regulatory Environment and IT Manufacturers • Non-regulatory Government Initiatives • Industry Associations and Standards Bodies • Green Building Standards • Green Data Centres • Social Movements and Greenpeace **The Future of Green IT** • Green Computing and the Future • Megatrends for Green Computing • Tele-presence Instead of Travel • Tele-commuting Instead of Commuting • Deep Green Approach	**12**

References:

- Toby Velte, Anthony Velte, Robert Elsenpeter, 2008, Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line, McGraw Hill.
- San Murugesan, G. R. Gangadharan, 2013, Harnessing Green IT, WILEY.
- Bud E. Smith, 2014, Green Computing-Tools and Techniques for saving energy, money and resources, CRC Press.
- Mark G. O'Neill, GREEN IT FOR SUSTAINABLE BUSINESS PRACTICE, An ISEB Foundation Guide.
- Jason Harris, Green Computing and Green IT Best Practices.

Web References:

- http://www.carbonfootprint.com
- https://www.energystar.gov/

Assessment:

Internal:

Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAL501	**Mobile Application and User Experience Design Lab**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut.	Total
MCAL501	**Mobile Application and User Experience Design Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCAL501	**Mobile Application and User Experience Design Lab**	**--**	**--**	**--**	**--**	**25**	**50**	**25**	**100**

Pre-requisites:

Basic understanding on Java programming and XML

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOL501.1	Understand the entire Android Apps Development Cycle
CEOL501.2	Apply the advanced android development techniques
CEOL501.3	Conceptualize the design of user applications using User Experience Design.

Course Outcomes (CO): At the end of the course, the students will be able to

MCAL501.1	Demonstrate Android activities life cycle
MCAL501.2	Apply proficiency in coding on a mobile programming platform.
MCAL501.3	Design and develop innovative android applications
MCAL501.4	Create real life application with end-to-end understanding of User experience practices.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Introduction to Android**	The android platform, the layers of android, Four kinds of android components, understanding the androidManifest.xml file, creating an android application Introduction to android SDK, Exploring the development environment	**04**
2	**User interfaces**	Creating the activity, working with views, using resources Working with intents and services, Different types of layouts, components.	**06**
3	**Storing and Retrieving data**	Using the file system, working with shared preferences, persisting data to a database, Working with content providers	**10**
4	**Graphics and animation, Multimedia**	Drawing graphics in android, creating animations with androids graphics API,Playing audio & video, Capturing media	**06**
5	**Location, Sensors**	Using Location Manager and Location Provider, working with maps, Working with GPS, Bluetooth and WiFi, Integrating google maps, services for push notificationGoogleads.	**04**
6	**REST API integration**	UsingAsyncTask to perform network operations, introduction to HtttpUrlConnection and JSON, performing network operations asynchronously, working with OkHttp, Retrofit and Volley	**08**
7	**Database connectivity and distributing androidapplication**	SQLite Programming, Android database connectivity using SQLite , distribution options, packaging and testing the application, distributing applications on google play store	**08**
8	**Open source UX tools**	Study of open source UX tools	**02**
9	**Creating new prototype**	selecting device, defining prototype settings	**02**
10	**Identify and describe the objectives for UED experiment**	a. Perform user research b. User requirement collection c. User Requirement Analysis d. Create User personas, user scenarios , customer journey maps	**08**
11	**UX Design – for Web and Mobile application**	a. Conceptual Design- Site Maps b. Create Wireframe c. Create Screens, Widgets, Outlines d. Setting properties e. Ordering Screens, Screen Transition f. Adding Actions & Triggers, Header & footer	**08**
12	**UX Evaluation**	a. Set UX Goals b. Perform UX Evaluation and Reporting c. Usability Test	**02**
13	**Mini project**	Developing mobile applications based on UED principles.	**10**

References

- Android in action, Third Edition, W. Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz, Dreamtech Press.
- Beginning Android 4 Application Development, Wei-Meng Lee, Wrox Publications
- Helllo, Android Introducing Google's Mobile Development Platform, Fourth Edition, Ed Burnette, SPD Publications.
- The UX Book by Rex Hartson and PardhaPyla, MK Publication
- Smashing UX Design by Jesmond Allen and James Chudley, John Wiley & Sons
- A Project Guide to UX Design by Russ Unger and Carolyn Chandler, O'reillyRies, Series Editor
- Agile Experience Design by Lindsay Ratcliffe and Marc McNeill , Pearson
- Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler, Rosenfeild Media
- Human Computer Interaction by Alan Dix, New riders
- Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden, Morgan Kaufmann
- Don't Make Me Think, Revisited by Steve Krug, New riders
- The User Experience Team of One by Leah Buley, Rosenfeild Media
- The Elements of User Experience by Jesse James Garrett, New riders
- Sketching User Experiences: The Workbook by Saul Greenberg, SheelaghCarpendale, Nicolai Marquardt and Bill Buxton, Morgan Kaufmann, workbook edition

Assessment:
Term work consists of any two case studies or mini project covering the above syllabus.

Internal:
Assessment consists of two tests (T1 and T2) .The final marks should be the average of the two tests.

End Semester Theory Examination: Guidelines for setting up the question paper.

- Question paper will comprise of total six questions.
- Question Number One should be compulsory.
- All question carry equal marks.
- Students can attempt any three from the remaining.
- Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Subject Code	Subject Name	Credits
MCAL502	**Open Source System for ADC Lab**	**03**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut.	Total
MCAL502	**Open Source System for ADC Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1(T1)	Test2(T2)	Average of T1 & T2					
MCA L502	**Open Source System for ADC Lab**	**--**	**--**	**--**	**--**	**25**	**50**	**25**	**100**

Pre-requisites:

Basic overview of Advanced Distributed Computing and Cloud Computing.

Course Educational Objectives (CEO): At the end of the course student will be able to

CEOL502.1	To Understand Concepts of distributed and cloud computing
CEOL502.2	To learn open source technology.
CEOL502.3	To teach various protection and security mechanisms for data using cloud concepts

Course Outcomes (CO): At the end of the course student will be able to

MCAL502.1	Design and Develop the solution to a problem using java concepts
MCAL502.2	Demonstrate use of java Concepts
MCAL502.3	Explore various advanced distributed concepts.

Syllabus

Sr. No.	Session	Detailed Contents	Hrs
1	**Remote Process Communication**	**Develop a program for multi-client chat server.** **Concept:** Develop a multi-client chat server application where multiple clients chat with each other concurrently. The messages sent by different clients are first communicated to the server and then the server, on behalf of the source client, communicates the messages to the appropriate destination client.	**08**
2	**Remote Procedure call**	**Implementation of Remote Procedure Call** **Concept:** This application will demonstrate the remote procedure communication. a) Implement a Server calculator containing ADD(),MUL(),SUB() etc. b) Implement a Date Time Server containing date() and time()	**08**
3	**Remote Method Invocation**	**Remote Method Invocation supporting the distributed computing in java.** **Concept:** Create a client and server application where the client invokes methods via an interface. These methods are implemented on the server side. Create the necessary STUBS and SKELETONS. a) Design a Graphical User Interface (GUI) based calculator (scientific or standard). Operations should be performed using both mouse and keyboard. b) Retrieve time and date function from server to client. This program should display server date and time. c) Equation solver. The client should provide an equation to the server through an interface. The server will solve the expression given by the client. (a-b)2 = a2 –2ab + b2; If a = 5 and b = 2 then return value = 52 – 2.5.2 + 22 = 9.	**14**
4	**Memory Management**	**Implementation of Shared Memory** a) Write a program to increment counter in Shared memory	**04**
5	**Remote Object Communication**	**Remote objects for database access.** **Concept:**Pass remote objects from the server to the client. The client will receive the stub object (through remote interfaces) and saves it in an object variable with the same type as the remote interface. Then the client can access the actual object on the server through the variable. Make use of JDBC and RMI for accessing multiple data access objects. a) Retrieve the students information from the college database. b) Retrieve the list of books available in the library. c) Retrieve the MTNL billing information from the MTNL database	**10**
6	**Enterprise Java Beans**	1) Sample program for basic arithmetic operations implemented in session bean. 2) Sample program on message bean demonstration.	**10**

		3)Sample program to Book Information using Entity bean 4) Demonstrate a program on Statefull and Stateless Bean.	
7	**Mutual Exclusion**	**Implementation of mutual exclusion using any of the technique.** **Concept**: This technique solves the mutual exclusion existing in the process communication. a) Centralized b) Distributed c) Token Ring **Note:** Use any one technique	**08**
8	**Cloud Computing**	**Study of cloud technologies :** Virtualization Technologies, Virtual Machine Technology, Cloud data center	**08**
9	**Grid Services**	**Study of Grid services using various tools.(any two)**	**02**
10	**Case studies**	Google, Microsoft, AWS.	**06**

Based on the recommended syllabus student should provide one Presentation/Case study.

Reference Books:-

1. Core Java2 Volume I & II – Horstmann, Cornell.
2. Complete Reference – Herbert Schildt.
3. Distributed computing system and concepts – Andrew Tanenbaum
4. Distributed OS - Pradeep K. Sinha , PHI
5. Cloud Computing unleashing next gen infrastructure to application – Dr.KumarSaurabh,willey
6. Cloud Computing insights into new-era infrastructure –Dr.Kumarsaurabh, willey

Subject Code	Subject Name	Credits
MCAPR501	**Mini Project**	**02**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract.	Tut.	Total
MCAPR501	**Mini Project****	**--**	**--**	**--**	**--**	**--**	**--**	**02**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCA PR501	**Mini Project**	--	--	--	--	**25**	--	**25**	**50**

Pre-requisites:

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOPR501.1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
CEOPR501.2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
CEOPR501.3	Study designing small projects in a multidisciplinary environment.

Course Outcomes (CO): At the end of the course, the students will be able to:

MCAPR501.1	Design, implement and evaluate a project.
MCAPR501.2	Gain project management skills.
MCAPR501.3	Work effectively and ethically in a team towards project development
MCAPR501.4	Demonstrate the ability to produce a technical document.

Sample Guidelines for Preparing and Documenting the Project Report

Sr. No.	Module	Detailed Contents
1	Introduction	• Introduction of the project • Problem definition • Objective of Project • scope of Project
2	Literature Survey	• Existing System • Proposed System • Knowledge Integration • Use Cases
3	Analysis	• Exploring Possibilities • Feasibility Analysis • Cost Benefit Analysis • Flowchart/ DFD/ER/UML diagram(any other project diagram
4	Methodology	• Criteria & constraints (Process models) • Tools used • Procedure
5	Design And Developing A Prototype	• Module design and organization • Data Design • user interface design • Model or Prototype
6	Project Execution Plan	Plan using Project Management Tools
7	Testing & Validation	Test cases and Report (based on manual & automation testing)
8	User Manual	• Explanation of Key functions • Method of Implementation • Forms • Output Screens
9	Conclusion	Project Conclusion & Future enhancement

- Rubrics guidelines to be followed during project evaluation.
- **REFERENCES should be written as**
  1. Author Name, Title of Paper/ Book, Publisher's Name, Year of publication
  2. Full URL Address

Parameters for Evaluation:

- The mini project is evaluated for 50 marks.
- Term work should be based on 2 presentations of ten marks each and five marks for documentation.
- Oral (25 marks) should be based on final demonstration and presentation.

** Mini Project will be performed by students during summer vacation of Even Semester of second year (SEM IV). Mini project will be evaluated in SEM V. Evaluation of the mini project will be internal 25 marks as TW and 25 marks as oral examination conducted by External Examiner.

Program Structure for

Master of Computer Application (CBCGS)
Mumbai University
(With Effect from 2017-2018)
Semester VI

Subject Code	**Subject Name**	**Teaching Scheme (Contact Hours)**	**Credits Assigned**	
		Presentation	**Project**	**Total**
MCAPR601	Internship – Project	30	15	15
MCA 602	Seminar – Research Paper	05	01	01
Total		**35**	**16**	**16**

Subject Code	Subject Nam	Examination Scheme				
		Theory Course				Total
		Internal Assessment			End Sem. Exam.	
		Presentation 1	Presentation 2	Total		
MCA PR601	Internship – Project	25	25	50	100	150
MCA 602	Seminar – Research Paper	--	--	--	50	50
Total		**25**	**25**	**50**	**150**	**200**

SEMESTER VI

Subject Code	Subject Name	Credits
MCAPR 601	**Internship- Project**	**15**

Subject Code	Subject Name	Teaching Scheme	Credits Assigned	
		Presentation	Project	Total
MCA PR601	**Internship- Project**	**30**	**15**	**15**

Subject Code	Subject Name	Examination Scheme				
		Theory Course				Total
		Internal Assessment			End Semester Exam	
		Presentation 1	Presentation 2	Total		
MCAP R601	**Internship-Project**	**25**	**25**	**50**	**100**	**150**

Pre-requisites: --

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEOPR601.1	Achieve hands on experience in an organization
CEOPR601.2	Relate classroom and textbook learning to the real world.
CEOPR601.3	Learn the professional skills and interpersonal relationship in professional environment

Course Outcomes (CO): At the end of the course, the students will be able to

MCAPR601.1	Attain an exposure to real life organizational and environmental situations
MCAPR601.2	Attain technical skills as per the requirements of the domain
MCAPR601.3	Adapt professional and interpersonal ethics.
MCAPR601.4	Articulate SDLC phases in developing software project and in writing the project document.

The guidelines regarding preparation of Internship-Project report for MCA SEM-VI

- To take hands-on experience of the real world, every candidate is required to undertake a project of 6 months duration in an organization of repute and must submit their project documentation.
- Each student should submit different documentation in a specified format illustrating his/her role/contribution in the project and write the documentation from his/her perspective.
- One copy should be submitted for University records which will be retained by the college and another one is student copy.
- Each student must submit one CD having the documentation part in PDF file format only.
- Hard copy of the project report must be submitted before a week of finalpresentation.
- Students have to present their project individually.

- Feedback form from the Industry should be submitted separately in sealed envelope to the internal guide.
- Students must ensure the originality of the work with ethics.

Assessment:

Internal:
Assessment consists of two presentations of 25 marks each.The final marks should be the sum of the two presentations.

Rubrics has to be followed during project evaluation.

Subject Code	Subject Name	Credits
MCA602	**Research Paper**	**01**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Presentation	Pract	Tut	Presentation	Pract	Tut	Total
MCA602	**Research Paper**	**05**	**--**	**--**	**01**	**--**	**--**	**01**

Subject Code	**Subject Name**	Examination Scheme							
		Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2(T 2)	Average of T1 & T2					
MCA602	**Research Paper**	--	--	--	**50**	--	--	--	**50**

Course Educational Objectives (CEO): At the end of the course, the students will be able to

CEO602.1	Understand analytic approach towards choosing a research project and acquiring research skills
CEO602.2	Access relevant data and present new ideas related to area of research.
CEO602.3	Adhere to ethical standard of research.

Course Outcomes(CO): At the end of the course, the students will be able to

MCA602.1	Write a research paper.
MCA602.2	Present data coherently and effectively, outcome and counter-hypothesis
MCA603.3	Attain experience in preparation of research materials for publication or presentation.

Seminar (50 Marks)-

1. Students must have in depth study in a specialized area by doing a survey of published technical literature and write a research paper in IEEE format (6-9 pages).
2. The research topic must be approved from the Institute. The institute should set up a committee to scrutinize the topics and finalize the same
3. The research paper may be written in a group of maximum 2 students.
4. The research paper must be published in national/ international conference or national/ international journal of repute.
5. The bifurcation of marks for the seminar will be as follows:
   a. Original Contribution – 10 marks
   b. Paper Quality – Published (5 marks)
      Contents (5 marks)
   c. Documentation (Language format) – 10 Marks
   d. Oral Presentation – 10 Marks
   e. Conclusion (Future Scope/ Recommendations/ Suggestions/ Findings)-10 marks

Reference:

1. James D. Lester , Writing Research Papers: A Complete Guide (10th Edition)
2. How to Write a Great Research Paper, Book Builders, Beverly Chin, July 2004, Jossey-Bass

Web References:

- https://www.ieee.org/publications_standards/publications/authors/author_guide_interactive.pdf
- http://www.fcsresearch.org/index.php?option=com_content&view=article&id=83&Itemid=166
- https://www.ece.ucsb.edu/~parhami/rsrch_paper_gdlns.htm
- http://nob.cs.ucdavis.edu/classes/ecs015-2007-02/paper/citations.html

Assessment:

Marking Scheme

Sr	Topics	Marks
1	Original Contribution	10
2	Published	5
	Contents	5
3	Documentation	10
4	Oral Presentation	10
5	Future Scope/ Recommendations/ Suggestions/ Findings	10

Rubrics have to be followed during research paper evaluation.