UNIVERSITY OF MUMBAI

Revised Syllabus

For

Master of Computer Applications: MCA

Semester I and II

Under

FACULTY OF TECHNOLOGY

(As per Choice Based Credit and Grading System)

From,

Academic Year 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. 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, 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 is implemented for First Year of Master of Computer Applications (M.C.A.) from the academic year 20162017. Subsequently this system will be carried forward for Second Year and Third Year of M.C.A. in the academic years 2017 2018 and 20182019 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member Academic Council

University of Mumbai, Mumbai

Preamble:

It is a privilege to present the revised Choice Based Grading and Credit System(CBGCS) syllabus of Master of Computer Applications (M.C.A.) for Sem I and Sem II (effective from year 2016-17) with inclusion of outcome based approach and project based learning. The syllabus is designed keeping in view the requirements of Industry. The basic objective of the syllabus is to equip the students with the necessary knowledge, skills and foundation required for Application development.

Since the M.C.A. programme is inclined more towards Application Development and thus has more emphasis on latest programming languages and tools to develop better and faster applications using integrated approach. For this, the integrated lab concepts like mini-projects are introduced in Sem I and Sem II. The syllabus of Sem I and Sem II include the combination of various subject in the area of Business Management, Mathematics and Information Technology.

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 (MCA)
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
MCA101	Object Oriented Programming	04	--	--	04	--	--	04
MCA102	Software Engineering & Project Management	04	--	--	04	--	--	04
MCA103	Computer Organization and Architecture	04	--	--	04	--	--	04
MCA104	IT in Management	04	--	--	04	--	--	04
MCA105	Statistics and Probability	04	--	--	04	--	--	04
MCAL101	Lab I – SEPM and OOP Lab	--	06	--	--	03	--	03
MCAL102	Lab II – Web Technologies and Mini Project-Lab	--	06	--	--	03	--	03
Total		**20**	**12**	**--**	**20**	**06**	**--**	**26**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
MCA101	Object Oriented Programming	20	20	20	80	--	--	--	100
MCA102	Software Engineering & Project Management	20	20	20	80	--	--	--	100
MCA103	Computer Organization and Architecture	20	20	20	80	--	--	--	100
MCA104	IT in Management	20	20	20	80	--	--	--	100
MCA105	Statistics and Probability	20	20	20	80	--	--	--	100
MCAL101	Lab I – SEPM and OOP Lab	--	--	--	--	25	50	25	100
MCAL102	Lab II – Web Technologies and Mini Project Lab	--	--	--	--	25	50	25	100
Total		**100**	**100**	**100**	**400**	**50**	**100**	**50**	**700**

Program Structure for
Master of Computer Application (MCA)
Mumbai University
(With Effect from 2016-2017)
Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA201	Data Structures	04	--	--	04	--	--	04
MCA202	Operating System	04	--	--	04	--	--	04
MCA203	Computer Networks	04	--	--	04	--	--	04
MCA204	Financial accounting and Management	04	--	--	04	--	--	04
MCA205	Decision making and Mathematical Modelling	04	--	--	04	--	--	04
MCAL201	Lab I –OS and CN Lab	--	06	--	--	03	--	03
MCAL202	Lab II –DS and Web Application Development using Open source tools Lab	--	06	--	--	03	--	03
Total		**20**	**12**	**--**	**20**	**06**	**--**	**26**

Subject Code	Subject Name	Examination Scheme							
		Theory Course				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
MCA201	Data Structures	20	20	20	80	--	--	--	100
MCA202	Operating System	20	20	20	80	--	--	--	100
MCA203	Computer Networks	20	20	20	80	--	--	--	100
MCA204	Financial accounting and Management	20	20	20	80	--	--	--	100
MCA205	Decision making and Mathematical Modelling	20	20	20	80	--	--	--	100
MCAL201	Lab I – OS and CN Lab	--	--	--	--	25	50	25	100

MCAL202	Lab II –DS and Web Application Development using Open source tools Lab	--	--	--	--	25	50	25	100
Total		**100**	**100**	**100**	**400**	**50**	**100**	**50**	**700**

SEMESTER I
(2016-17)

Subject Code	Subject Name	Credits
MCA101	**Object Oriented Programming**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA101	**Object Oriented Programming**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA101	**Object Oriented Programming**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Basic Understanding of C Programming Language
Knowledge of Algorithms and Control Flow of a program

Course Educational Objectives (CEO):

CEO 1	To Explore and Study Object oriented programming and advanced C++ concepts.
CEO 2	To Improve problem solving skills by applying object oriented techniques to solve bigger computing problems.
CEO 3	To provide a Strong foundation for advanced programming.

Course Outcomes: At the end of the course, the students will be able to:

MCA101.1	Comprehend Object oriented programming concepts and their application
MCA101.2	To write applications using C++.
MCA101.3	Implement programming concepts to solve bigger problems.

Syllabus

Sr. No.	Module	Detailed Contents	Hours
1	**Programming Basics**	Introduction to Programming, Programming Paradigms, Programming Languages and Types. Introduction to C - Basic Program Structure, Execution flow of C Program, Directives, Basic Input /Output Introduction to Object Oriented Programming- OOP concepts, Advantages, Applications, Comparison of C and C++-Data Types, Control Structures, Operators and Expressions	**8**
2	**Introduction to C++**	Structure of a C++ program, Execution flow, Classes and Objects, Access modifiers, Data Members, Member Functions, Inline Functions, Passing parameters to a Function(pass by Value, Pass by Address, Pass by Reference), Function with default arguments, Function Overloading, Object as a Parameter, Returning Object Static data members and functions, Constant Data members and functions Constructors- Default, Parameterized, Copy, Constructor Overloading, Destructors Arrays, Array as a Class Member, Array of Objects, Strings-Cstyle strings and String Class	**10**
3	**Operator Overloading and Pointers**	Operator Functions-Member and Non Member Functions, Friend Functions Overloading Unary operators Overloading binary operators(Arithmetic, Relational, Arithmetic Assignment, equality), Overloading Subscript operator Type Conversion Operators- primitive to Object, Object to primitive, Object to Object Disadvantages of operator Overloading, Explicit and Mutable Pointers, Pointer and Address of Operator, Pointer to an Array and Array of Pointers, Pointer arithmetic, Pointer to a Constant and Constant Pointer, Pointer Initialization, Types of Pointers(void, null and dangling), Dynamic Memory Allocation, Advantages and Applications of pointers	**10**

4	**Inheritance and Polymorphism**	Inheritance Concept, Protected modifier, Derivation of Inheritance- Public, Private and Protected, Types of Inheritance-Simple, Multilevel, Hierarchical, Multiple, Hybrid, Constructors and Inheritance, Function Overriding and Member hiding Multiple Inheritance, Multipath inheritance – Ambiguities and solutions Polymorphism, Static and Dynamic Binding, Virtual Functions, Pure Virtual Functions, Virtual destructors, Abstract Classes, Interfaces	**8**
5	**Streams and Exceptions**	Files, Text and Binary Files, Stream Classes, File IO using Stream classes, File pointers, Error Streams, Random File Access, Manipulators, Overloading Insertion and extraction operators Error handling, Exceptions, Throwing and catching exceptions, Custom Exceptions, Built in exceptions	**8**
6	**Advanced C++**	Casting- Static casts, Const Casts, Dynamic Casts, and Reinterpret Casts. Creating Libraries and header files. Namespaces Generic Programming, Templates, Class Templates, Function Templates, Template arguments, STL Database Programming with MySQL	**8**

Reference Books:

1. The Complete Reference C, 4th EditionHerbert Sehlidt,Tata Mcgraw Hill
2. Object Oriented Programming in C++,4th Edition,Robert Lafore,SAMS Techmedia
3. The Complete Reference-C++,4th Edition. Herbert Schildt,Tata McGraw-Hill
4. The C++ Programming Language, 4th Edition,BjarneStroustrup,AddisonWesly
5. Starting Out with C++ Early Objects,8th Edition,Tony Gaddis et al,Addison-Wesley
6. C++ How to Program,8th Edition,Deitel and Deitel, Prentice Hall
7. Practical C++ Programming,2nd Edition,Steve Quoaline,O'reilly Publication
8. Absolute C++,4th Edition, Walter Savitch,Pearson Education

Web References:

1. https://dev.mysql.com
2. www.github.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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.

3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA102	**Software Engineering & Project Management**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA102	**Software Engineering & Project Management**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA 102	**Software Engineering & Project Management**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Knowledge of structure programming language and Application development.

Course Educational Objectives (CEO):

CEO 102.1	To understand the process of Software Engineering
CEO 102.2	To conceptualize the Software Development Life Cycle (SDLC) models.
CEO 102.3	To familiarize Project Management framework and Tools

Course Outcomes: At the end of the course, the students will be able to:

MCA102.1	Apply use of knowledge of Software Life Cycle to successfully implement the projects in the corporate world.
MCA102.2	Identify the Inputs, Tools and techniques to get the required Project deliverable and Product deliverable using 10 Knowledge areas of Project Management.
MCA102.3	Implement Project Management Processes to successfully complete project in IT industry.

Syllabus

Sr. No	Module	Detailed Contents	Hours
1	**Introduction to software engineering and project management**	Introduction to Software Engineering: Software, Evolving role of software, Three "R"-Reuse, Reengineering and Retooling, An Overview of IT Project Management: Define project, project management framework, The role of project Manager, Systems View of Project Management, Stakeholder management, Project phases and the project life cycle.	**6**
2	**Software Process Models**	Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model, Incremental Process model: Iterative approach, RAD, JAD model, Concurrent Development Model, Agile Development: Extreme programming, Scrum.	**6**
3	**Software Requirement Analysis and Specification**	Types of Requirement, Feasibility Study, Requirement Analysis and Design: DFD, Data Dictionary, HIPO Chart, Warnier Orr Diagram, Requirement Elicitation: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), Use Case Approach. SRS Case study, Software Estimation: Size Estimation: Function Point (Numericals). Cost Estimation: COCOMO (Numericals), COCOMO-II (Numericals). Earned Value Management.	**11**

4	**Software Project Planning**	Business Case, Project selection and Approval, Project charter, Project Scope management: Scope definition and Project Scope management, Creating the Work Breakdown Structures, Scope Verification, Scope Control.	**8**
5	**Project Scheduling and Procurement management**	Relationship between people and Effort: Staffing Level Estimation, Effect of schedule Change on Cost, Degree of Rigor & Task set selector, Project Schedule, Schedule Control, CPM (Numericals), Basic Planning Purchases and Acquisitions, Planning Contracting, Requesting Seller Responses, Selecting Sellers, Out Sourcing: The Beginning of the outsourcing phenomenon, Types of outsourcing relationship, The realities of outsourcing, Managing the outsourcing relationship.	**6**
6	**Software Quality**	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. Modern Quality Management, Juran and the importance of Top management, Commitment to Quality, Crosby and Striving for Zero defects, Ishikawa and the Fishbone Diagram.	**7 Hrs**
7	**Human Resource Management**	Human Resource Planning, Acquiring the Project Team: Resource Assignment, Loading, Leveling, Developing the Project Team: Team Structures, Managing the Project Team, Change management: Dealing with Conflict & Resistance Leadership & Ethics.	**4 Hrs**
8	**Software Risk Management and Reliability issues**	Risk Management: Identify IT Project Risk, Risk Analysis and Assessment, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation. Software Reliability: Reliability Metrics, Reliability Growth Modeling.	**4 Hrs**

Reference Books:

1. Software Engineering, 5th and 7th edititon, 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. Software Engineering Project Management by Richard H. Thayer Wiley India Publication.

6. Software Engineering for students: A Programming Approach by Douglas Bell, Pearson 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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA103	**Computer Organization and Architecture**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA103	**Computer Organization & Architecture**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA 103	**Computer Organization and Architecture**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:
Basic knowledge of Computer Fundamentals

Course Educational Objectives (CEO):

CEO1	To have a understanding of Digital systems and operation of a digital computer.
CEO2	To learn different architectures & organizations of memory systems, processor organization and control unit.
CEO3	To understand the working principles of multiprocessor and parallel organization's as advanced computer architectures

Course Outcomes: At the end of the course, the students will be able to:

MCA103.1	Design trade-offs Basic fundamentals in digital logic & structure of a digital computer
MCA103.2	Identify performance issues in processor and memory design of a digital computer.
MCA103.3	To Develop independent learning skills and be able to learn more about different computer architectures and hardware.
MCA103.4	To articulate design issues in the development of Multiprocessor organization & architecture.

Syllabus

Sr. No.	Module	Detailed Contents	Hrs
1	**Fundamentals of Digital Logic**	Boolean Algebra, Logic Gates, Simplification of Logic Circuits: Algebraic Simplification, Karnaugh Maps. Combinational Circuits : Adders, Mux, De-Mux, Sequential Circuits : Flip-Flops (SR, JK & D), Counters : synchronous and asynchronous Counter	**12**
2	**Computer System**	Comparison of Computer Organization &Architecture, Computer Components and Functions, Interconnection Structures. Bus Interconnections, Input / Output: I/O Module, Programmed I/O, Interrupt Driven I/O, Direct Memory Access	**06**
3	**Memory System Organization**	Classification and design parameters, Memory Hierarchy, Internal Memory: RAM, SRAM and DRAM, Interleaved and Associative Memory. Cache Memory: Design Principles, Memory mappings, Replacement Algorithms, Cache performance, Cache Coherence. Virtual Memory, External Memory : Magnetic Discs, Optical Memory, Flash Memories, RAID Levels	**08**
4	**Processor Organization**	Instruction Formats, Instruction Sets, Addressing Modes, Addressing Modes Examples with Assembly Language [8085/8086 CPU] , Processor Organization, Structure and Function. Register Organization, Instruction Cycle, Instruction Pipelining. Introduction to RISC and CISC Architecture, Instruction Level Parallelism and Superscalar Processors: Design Issues.	**12**
5	**Control Unit**	Micro-Operations, Functional Requirements, Processor Control, Hardwired Implementation, Micro-programmed Control	**04**

6	**Fundamentals of Advanced Computer Architecture**	Parallel Architecture: Classification of Parallel Systems, Flynn's Taxonomy, Array Processors, Clusters, and NUMA Computers. Multiprocessor Systems : Structure & Interconnection Networks, Multi-Core Computers: Introduction, Organization and Performance.	**08**
7	**Case Study**	Case study : Pentium 4 processor Organization and Architecture	**02**

Reference Books:

1. Modern Digital Electronics, R.P.Jain, 4e, Tata Mc Graw Hill.
2. Computer Organization & Architecture, William Stallings, 8e, Pearson Education.
3. Computer Architecture & Organization, John P. Hayes, 3e, Tata McGraw Hill.
4. Computer Organization, 5e, Carl Hamacher, Zconko Vranesic & Safwat Zaky, Tata McGraw Hill.
5. Digital Computer Fundamentals, Bartee C. Thomas , McGraw-Hill International Edition
6. Computer System Architecture, M. Morris Mano, Pearson Education.
7. Computer Architecture & Organization, Nicholas Carter, McGraw Hill.
8. Computer Architecture & Organization, 2e, Miles Murdocca & Vincent Heuring, Wiley India.

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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA104	**IT in Management**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA104	**IT in Management**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme						
MCA 104	**IT in Management**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Basic knowledge Information Technology

Course Educational Objectives (CEO):

CEO 1	Understand Information Technology and its practices in managing the business.
CEO 2	Conceptualize the process of Technology acquisition in an Industry.
CEO 3	Familiar with impact and issues of Information Technology for managing business operations with social concern.

Course Outcomes: At the end of the course, the students will be able :

MCA101.1	To use various IT tools used for managing the Industrial operation.
MCA101.2	To apply the decision for selecting the proper IT tools for Management operation.
MCA101.2	To design the strategic plan for using Information Technology in Management

Syllabus

Sr. No.	Module	Detailed Contents	Hours
1	**Information Technology Support and Application**	Introduction to Information Technology, Business Values Of IT, Role Of Computer in Modern Business, Current Trends, Business in Digital Economy.	**6**
2	**Information System and business applications**	Introduction to Information System: Information System, Classification and type of Information System, Information system Infrastructure and architecture, Role of Information systems in Business Today, Perspective on Information systems, Software and hardware platform to Improve Business Performance, Management opportunities challenges and Solutions, Business applications: Roles of IT in E-commerce, M-commerce.	**8**
3	**Acquisition of Information Technology**	Need to acquire technology, developing new technologies, Increasing strategic options, Gaining efficiency improvements, sources for acquiring technology, Responding to the competitive environment.	**8**
4	**Impact of Information Technology on organization and Strategic Issues of Information Technology**	Impact of Information Technology on organization : Modern Organizations ,Creating New Types of Organizations Strategic Issues of Information Technology: Information Technology and Corporate Strategy, Creating and Sustaining a Competitive Edge, Integrating Technology with the Business Environment, Managing Information Technology	**8**
5	**IT for managing International business and Governance**	International Business and IT technologies: International Business Strategies, Key Issues in International Environment, Managing IT Internationally. Governance concept: IT Governance, Internet governance, E-governance and internal IT processes.	**10**
6	**Information Technology Issues For Management**	Management in a Technological Environment, The Changing World of Information Action Plan	**6**
7	**Societal Implications And The Future With Technology**	Social Responsibilities, Ethics and Information Technology, The Future with Information Technology	**6**

Reference Books

Information Technology For Management – Transforming Organizations in Digital Economy by EFRAIM Turban, Dorothy Leidner (WILEY Student Edition)

Information Technology For Management by B. MuthuKumaran (OXFORD University Press)

Information Technology For Management 7th edAuthors Henry C Lucas,Mc Graw Hill Publications.
Information Technology For Management by Dr. CH. Seetha Ram.
Technology Acquisition ,A guided approach to technology acquisition and protection decision by Mortara and Ford.
Business Intelligence: Practices, Technologies, and Management- Rajiv Sabherwal, Irma Becerra-Fernandez
Manging and using Information Systems, K E Pearlson, C S Saunders, Wiley India

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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA105	**Statistics And Probability**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA105	**Statistics And Probability**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA 105	**Statistics And Probability**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Basic Mathematics, combinatorics and calculus Knowledge.

Course Educational Objectives (CEO):

CEO 1	To equip the students with a working knowledge of probability, statistics, and modeling in the presence of uncertainties.
CEO 2	To understand the concept of hypothesis and significance tests
CEO 3	To help the students to develop an intuition and an interest for random phenomena and to introduce both theoretical issues and applications that may be useful in real life.

Course Outcomes: At the end of the course, the students will be able to:

MCA105.1	Distinguish between quantitative and categorical data
MCA105.2	Apply different statistical measures on data
MCA105.3	Identify, formulate and solve problems
MCA105.4	Classify different types of Probability and their fundamental applications

Syllabus

Sr. No	Module	Detailed Contents	Hours
1	**Measures of Central Tendency &Measures of Dispersion**	Frequency Distribution, Histogram, Stem and leaf diagram, ogives, Frequency Polygon, Mean, Median, Mode, Range, Quartile Deviation, Mean Deviation, Box whisker plot, Standard Deviation, Coefficient of Variation	**8**
2	**Skewness, Correlation & Regression**	Karl Pearson's coefficient of Skewness, Bowley's coefficient of Skewness, Scatter Diagram, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient , Linear Regression and Estimation, Coefficients of regression	**8**
3	**Theory of Attributes**	Classes and Class Frequencies, Consistency of Data, Independence of Attributes, Association of Attributes	**4**
4	**Testing of Hypothesis**	Hypothesis, Type I and Type II errors. Tests of significance – Student's t-test:Single Mean, Difference of means, paired t-test, Chi-Square test:Test of Goodness of Fit, Independence Test	**10**
5	**Introduction to Probability**	Random experiment, Sample space, Events, Axiomatic Probability, Algebra of events	**4**
6	**Conditional Probability**	Conditional Probability, Multiplication theorem of Probability, Independent events, Baye's Theorem	**6**
7	**Random variables**	Discrete random variable, Continuous random variable, Two-dimensional random variable, Joint probability distribution, Stochastic independence	**7**
8	**Mathematical Expectation**	Expected value of a random variable, Expected value of a function of a random variable,Properties of Expectation and Variance, Covariance	**5**

Reference Books:

1. Fundamentals of Mathematical Statistics – 1st Edition S.C.Gupta, V.K.Kapoor , S Chand
2. Introduction to Probability & Statistics – 4th Edition J.Susan Milton, Jesse C. Arnold Tata McGraw Hill
3. Fundamentals of Statistics : 7th edition S C Gupta, Himalaya Publishing house
4. Probability and Statistics with Reliability, Queuing, And Computer Science Applications (English) 1st Edition: Kishore Trivedi, PHI
5. Schaum's Outlines Probability, Random Variables & Random Process 3rd Edition Tata McGraw Hill
6. Probability & Statistics for Engineers: Dr J Ravichandran, Wiley
7. Statistics for Business and Economics: Dr Seema Sharma, Wiley
8. Applied Business Statistics 7th Edition Ken Black, 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.

1. Question paper will comprise of total six questions.
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3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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	Teaching Scheme (Contact Hours per week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA L101	**Lab 1-SEPM and OOP Lab**	**--**	**06**	**--**	**--**	**03**	**--**	**03**

Examination Scheme					
End Sem. Exam. [Once in a semester]					
Laboratory Name		Term Work	Pract.	Oral	Total
MCA L101	**Lab 1-SEPM and OOP Lab**	**25**	**50**	**25**	**100**

Pre-requisites:

Basic Understanding of C Programming Language
Knowledge of Algorithms and Control Flow of a program

Course Educational Objectives (CEO):

CEO 1	To Understand Concepts of Object oriented programming and basics of Software Engineering
CEO 2	To learn how C++ supports Object Oriented Principles.
CEO 3	To Study Design of reliable and maintainable Object Oriented Applications using an Integrated Software Engineering Approach.

Course Outcomes: Students will be able to:

MCA L101.1	Design and Develop the solution to a problem using Object Oriented Programming Concepts
MCA L101.2	Demonstrate use of C++ Concepts
MCA L101.3	Develop real time applications.

Sr. No.	Module	Detailed Contents	Hours
1	**Programming Basics**	Basic Programs using C Programming Assignments using Control Structures Logic Building Programming Assignments	**8**
2	**Introduction to C++**	Programming Assignments Using Classes Programming Assignments using Static members and Methods Programming Assignments using Constant members and Methods Programming Assignments using Arrays and Strings	**8**
3	**Operator Overloading and Pointers**	Programming Assignments to Overload Operators Programming Assignments for Data Conversions Programming Assignments Using Pointers	**8**

4	**Inheritance and Polymorphism**	Programming Assignments based on Inheritance and Polymorphism	**8**
5	**Streams and Exceptions**	Programming Assignments based on Streams and Exceptions	**8**
6	**Advanced C++**	Programming Assignments based on Templates Case Study- Database Connectivity using MySQL	**8**
7	**SRS**	Business Case Software Requirement Specification (SRS to be attached for any sample project)	**4**
8	**Scheduling Tools and WBS**	Introduction to Project Scheduling tools (any open source softwares) Creating a Project Plan or WBS Establishing the Project Start or Finish Date Entering Tasks Attach Supporting Information Entering Task Durations Setting Task Constraints (Milestones) Gantt chart Pert/CPM chart	**8**
9	**Resource Management**	Resource Management (using open source tool) Managing Project Cost	**4**
10	**Cost Estimation and Quality Standards**	Solving examples using COCOMO and COCOMO II models, CPM numerical Case studies on Quality Standards	**4**
11	**A Mini – Project**	It is based on OOP and SE PM using an integrated approach (Maximum two students in a group)	**10**

Reference Books:

1. The Complete Reference C, 4th EditionHerbert Sehlidt,Tata Mcgraw Hill
2. Object Oriented Programming in C++,4th Edition,Robert Lafore,SAMS Techmedia
3. The Complete Reference-C++,4th Edition. Herbert Schildt,Tata McGraw-Hill
4. The C++ Programming Language, 4th Edition,BjarneStroustrup,AddisonWesly
5. Starting Out with C++ Early Objects,8th Edition,Tony Gaddis et al,Addison-Wesley
6. C++ How to Program,8th Edition,Deitel and Deitel, Prentice Hall
7. Practical C++ Programming,2nd Edition,Steve Quoaline,O'reilly Publication
8. Absolute C++,4th Edition, Walter Savitch,Pearson Education
9. Software Engineering, 5th and 7th edititon, by Roger S Pressman, McGraw Hill publication.
10. Managing Information Technology Project, 6edition, by Kathy Schwalbe, Cengage Learning publication.
11. Information Technology Project Management by Jack T Marchewka Wiley India publication.
12. Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
13. Software Engineering Project Management by Richard H. Thayer Wiley India Publication.

14. Software Engineering for students: A Programming Approach by Douglas Bell, Pearson publication.

Web References:

1. https://dev.mysql.com
2. www.github.com

Subject Code	Subject Name	Teaching Scheme (Contact Hours per Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MCA L102	**Lab-II: Web Technologies and Mini Project Lab**	**---**	**06**	**---**	**---**	**03**	**---**	**03**
Examination Scheme								
End Semester Exam [Once in a Semester]								
Laboratory Name					Term Work	Practical	Oral	Total
MCAL102: Lab-II: Web Technologies and Mini Project Lab					**25**	**50**	**25**	**100**

Pre-requisites: Basic understanding of programming fundamentals

Course Educational Objectives (CEO):

CEO 1	To study the concept and architecture of World Wide Web.
CEO 2	To learn web application development using open source technology.
CEO 3	To provide skills to design and develop dynamic web sites.

Course Outcomes: At the end of the course student will be able to

MCA L102.1	Acquire knowledge about functionality of world wide web
MCA L102.2	Develop web based applications using open source technology.
MCA L102.3	Design and develop dynamic web sites.

Syllabus

Sr. No.	**Module**	**Detailed Contents**	**Hours**
1.	**Introduction to the Web Technologies**	Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers.	**06**
2.	**HTML**	Basics of HTML, Structure of HTML code, formatting and fonts, color, hyperlink, lists, tables, images (Programming Assignments based on above topics)	**12**
3.	**Style Sheets**	Need for CSS, introduction to CSS, basic syntax and structure, Classes and Pseudo Classes, CSS tags for setting background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning etc. (Programming Assignments based on above topics)	**12**

4.	**Introduction to PHP**	Configuration and Installation of PHP, basic syntax of PHP, Expressions, Statements, Arrays, Functions, string, Regular Expressions, Date and Time Functions (Programming Assignments based on above topics)	**12**
5.	**PHP and MySQL**	File Handling- Creating a File, Reading from Files, Copying Files, Moving File, Deleting File, Updating File, Uploading Files, Form Designing using HTML 5, Validation's using PHP Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, Master-Detail relationships using Joins. Session Management- Using Cookies in PHP, HTTP Authentication, Using Sessions (Programming Assignments based on above topics)	**10**
6	**Mini Project**	A Mini – Project based on DS and WAD using an integrated approach.(Maximum Two students in a Group)	**26**

Reference Books:

1. Web Technologies, Black Book, dreamtech Press
2. HTML 5, Black Book, dreamtech Press
3. Learning PHP, MySQL, JavaScript, CSS and HTML 5, Robin Nixon, O'Reilly publication
4. Developing Web Applications in PHP and AJAX, Harwani, McGrawHill
5. Professional PHP Programming, Jesus Caspagnetto, Etal. Wrox Publication.
6. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel, Pearson
7. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India

SEMESTER II
(2016-17)

Subject Code	Subject Name	Credits
MCA201	**Data Structures**	**04**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA201	**Data Structures**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA 201	**Data Structures**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Understanding of Algorithms

Course Educational Objectives (CEO):

CEO 1	To teach efficient storage mechanisms of data for an easy access.
CEO 2	To design and implement various basic and advanced data structures.
CEO 3	To introduce various techniques for representation of the data in the real world.

Course Outcomes: At the end of the course, the students will be able to :

MCA201.1	Analyze and compute efficiency of various algorithms.
MCA201.2	Effectively choose the data structure that efficiently model the information in a problem
MCA201.3	Describe how Linear data structures are represented in memory and used by algorithms and their applications
MCA201.4	Identify the benefits of Non-linear Data Structures and their applications

Syllabus

Sr	Module	Detailed Contents	Hours
1	**Introduction to Data Structures & Algorithms**	Introduction of Data structures, Abstract Data Types, Performance Analysis: Space Complexity, Time Complexity, Asymptotic Notations (Big O, Omega, Theta), Performance measurement, Divide and Conquer, Back Tracking Method, Dynamic programming	**4**
2	**Sorting and searching algorithms**	Bubble sort, Insertion sort, Radix Sort, Quick sort, Merge sort, Heap sort, Selection sort, shell Sort, Linear Search, Sequential search, Binary search	**6**
3	**Hashing**	Different Hashing Techniques, Address calculation Techniques, Common hashing functions, Collision resolution techniques: Linear probe, Quadratic probe, Key offset. Rehashing, Double hashing, Link list addressing.	**8**
4	**Linear Data Structures**	Stack Definition, Operations, Implementation of Stacks (Array and Linked list) and applications-Evaluation of postfix expression, Balancing of parenthesis Queue: Definition, Operations, Implementation of simple queue (Array and Linked list) and applications of queue-BFS Types of queues: Circular, Double ended, Priority, Implementation using linked list Types of Linked List: Singly, Doubly and Circular Linked list Definition, Operations (Insert, delete, traverse, count, search) Applications of Linked List: Polynomial Addition and Subtraction	**14**
5	**Non-linear Data Structures**	Tree Definition and concepts, General Tree- Definition, Insertion and Deletion into general tree, Binary Tree- Definition, Insertion and Deletion into binary tree, Traversal of a binary tree, Reconstruction of a binary tree from traversal, Conversion of general tree into binary tree, Huffman tree, Expression tree, Binary threaded three Binary Search Tree- Definition, Operation, Implementation AVL tree- Definition, AVL tree rotation with examples, Heaps-Definition, Operations (insertion, delete, build) M way Tree- Introduction, B tree-definition and examples and B^*	**14**
6	**Graphs**	Definition, Types, Operations, Representation, Networks, Traversals of graph, Minimum spanning tree, Kruskal's Algorithm, Prim's Algorithm, Warshall's Algorithm,Shortest path algorithm-dijsktra's algorithm	**6**

Reference Books

1. Richard F Gilberg Behrouz A Forouzan , "Data Structure A Pseudocode Approach with C". Second edition

2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to ALGORITHMS", PHI, India Second Edition.
3. Shaum's Outlines Data Structure Seymour Lipschutz TMH
4. Michael T.Goodrich "Data Structures and Algorithms in C++-" Wiley Publications

Theory paper will be of **80** marks. **Internal** assessment will be of **20** marks, which will be the average of two tests (T1 and T2) of 20 marks each.

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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA202	**Operating System**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA 202	**Operating System**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme						
MCA 202	**Operating System**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites: Computer Organization and Architecture

Course Educational Objectives (CEO):

CEO 1	To teach Operating system design
CEO 2	To understand the process concurrency and synchronization, deadlocks and various memory management policies.
CEO 3	To teach the concepts of input/output, storage and file management
CEO 4	To teach various protection and security mechanisms and to study and compare different operating systems & their features.

Course Outcomes: At the end of the course, the students will be able to :

MCA202.1	Classify different styles of operating system designs
MCA202.2	Analyze process management, I/O management, memory management functions of Operating System

MCA202.3	Employ process scheduling and disk scheduling algorithms.
MCA202.4	Explore file management and protection and security concepts.

Syllabus:

Sr No	Module	Detailed Contents	Hours
1	**Introduction to System Software & operating System**	Introduction to System Software & operating System Overview of all system softwares: Compiler, Assembler, Linker, Loader, Operating system, OS services and Components, Types of OS-Batch, multiprocessing, multitasking, timesharing, Distributed OS ,Real time OS, virtual machines, System Calls ,types of System calls, Buffering, Spooling	5
2	**Process and Thread Management**	Process and Thread Management: - Concept of process and threads, Process states, Process management, Context switching, Interaction between processes and OS, Multithreading, CPU scheduling algorithms, multiprocessor scheduling algorithms, Real time scheduling algorithms	10
3	**Concurrency Control**	Concurrency Control: Concurrency and Race Conditions, Mutual exclusion requirements, Software and hardware solutions, Semaphores, Monitors, Classical IPC problems and solutions, Deadlock, Characterization, Detection, Recovery, Avoidance and Prevention	8
4	**Memory Management**	Memory Management: Memory partitioning, Swapping, Paging, Segmentation, Virtual memory, Overlays,Demand paging, Performance of Demand paging, Virtual memory concepts, Page replacement algorithms, Allocation algorithms	9
5	**Mass Storage Structure**	Mass Storage Structure: Secondary-Storage Structure, Disk structure, Disk scheduling, Disk management, Swap-space management, Disk reliability, Stable storage implementation, Introduction to clock, Clock hardware, Clock software	7
6	**File systems**	File systems: File concept, File support, Access methods, Allocation methods, Directory systems, File protection, Free space management	4
7	**Protection & Security**	Protection & Security: Protection- Goals of protection, Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights Security- The security problem, Authentication, One-Time passwords, Threats	4
8	**Case Study**	Case Study : Study of different Operating, Systems(Linux, Windows, Android OS, iOS)	5

Reference Books

1. Operating System Concepts (9th Ed) by Silberschatz and Galvin, Wiley, 2000.

2. Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall, 2000.
3. Modern Operating Systems by Andrew S Tanenbaum, Prentice Hall India, 1992.
4. Operating Systems (3rd edition) by Gary Nutt, NabenduChaki, SarmishthaNeogy, Pearson
5. Operating Systems Design & Implementation Andrew S. Tanenbaum, AlbertS. Woodhull Pearson
6. Operating Systems Achyut S. Godbole Tata McGraw Hill
7. Operating Systems D.M.Dhamrdhere Tata McGraw Hill

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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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 203	**Computer Networks**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA203	**Computer Networks**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA 203	**Computer Networks**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Digital Computer Fundamentals and computer architecture.

Course Educational Objectives (CEO):

CEO 1	To help learners get a grounding of basic network components and architecture.
CEO 2	To explore basic networking models.
CEO 3	To learn the way protocols are used in networks and their design issues.

Course Outcomes: At the end of the course, the students should be able to :

MCA203.1	Comprehend the basic concepts of computer networks and data communication systems.
MCA203.3	Analyze basic networking protocols and their use in network design
MCA203.3	Explore various advanced networking concepts.

Syllabus

Sr. No	Module / Unit	Detailed Contents	Hours

1	**Basics of Digital Communication**	Introduction to digital communication, Signal propagation, Signal types, Signal parameters , Switching & forwarding, Transmission impairments, Attenuation, Delay distortion, Noise, Effects of limited bandwidth, Data rate limits-Nyquist's theorem and Shannon's theorem.	**05**
2	**Network Organization and Models**	Basics of computer Network, topology & types of topologies, types of networks(LAN, MAN, WAN), Concept of Intranet & Extranet, Ad-Hoc Networks, types of communications (Asynchronous and synchronous) , modes of communications (simplex, half duplex, full duplex), Protocols, Networking models, ISO-OSI Reference Model, Design issues of the layer ,Internet Model (TCP/IP), Comparison of ISO-OSI & TCP/IP Model	**06**
3	**Networking Devices**	Connectivity Devices : Passive & Active Hubs, Repeaters, , Switches (2-Layer Switch, 3-Layer switch(Router), Bridges (Transparent Bridges, Spanning Tree, Bridges, Source Routing Bridges) , Brouters, Gateways.	**04**
4	**Application, Presentation & Session Layer**	Principles of Application Layer Protocols, The Web and HTTP, FTP, Telnet, Electronic Mail in the Internet (SMTP, MIME, POP3, IMAP), DNS, Introduction to SNMP.	**06**
5	**Transport layer**	Transport-Layer Services, port addressing, Multiplexing and Demultiplexing, Principles of Reliable Data Transfer, Congestion Control, TCP's Congestion Control. Quality of Service : Introduction, Queue Analysis, QoS Mechanisms, Queue management Algorithms, Feedback, Resource, Reservation.	**10**
6	**Network layer**	Network Service Model, Data gram & Virtual Circuit , Routing Principles, The Internet Protocol,(ipv4 & ipv6) , IP addressing and subnetting, Routing Algorithms., Hierarchical Routing, Routing in the Internet: Intra and inter domain routing; Unicast Routing Protocols RIP, OSPF, BGP, Multicast Routing Protocols : MOSPF, DVMRP. ATM Networks: Need for ATM, ATM Layers, ATM adaptation Layers, IP over ATM, Multi protocol Label switching (MPLS), Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes	**11**
7	**Data Link Layer**	Data Link Layer, Error Detection and Correction Techniques, Multiple Access Protocols, LAN Addresses and ARP & RARP , PPP: The Point-to-Point Protocol , Ethernet standards – IEEE 802.3, 802.5, FDDI, 802.6.	**08**
8	**Physical layer**	Physical Layer, Types of media wired and wireless media	**02**

Reference Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet , J. F. Kurose and K. W. Ross, Seventh Edition, Addison-Wesley.

2. Computer Networks: Principles, Technologies and Protocols for Network design, N. Olifer and V. Olifer, Wiley India
3. Data Communication and Networking, B. A. Forouzan, Fourth Edition, McGraw Hill.
4. Computer Networks, Andrew Tenenbaum, Fifith Edition, PHI .
5. TCP/IP Protocol Suite, B. A. Forouzan, Third Edition, Tata McGraw Hill edition.
6. Data and Computer Communications, William Stallings, Ninth Edition, 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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA204	**Financial Accounting and Management**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA204	**Financial Accounting and Management**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA204	**Financial Accounting and Management**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:

Some basic knowledge of accounting and good mathematical skills is recommended.

Course Educational Objectives (CEO):

CEO 1	Introduce the principles, concepts, and applications of financial accounting and management.
CEO 2	Explore, and use the accounting concepts emphasizing how financial statements communicate information about the business corporation's performance and position for users internal and external to management.
CEO 3	To introduce the underlying framework and concepts of Financial Accounting and Management and how these fit into the current global business scenario.

Course Outcomes: At the end of the course, the students should be able to:

MCA204.1	To use accounting functions as an information development and communication system that supports economic decision making and provides value to entities and
MCA204.2	Preparation of financial statements and related information and apply analytical tools in making both business and financial decisions.
MCA204.3	To analyze the impact of accounting system on several business functions and managers' decision making.
MCA204.4	To analyze and use financial statements; prepare budgets and investment options; assess risks and the rewards involved in firm's financial decisions.

Syllabus

Sr No.	Module	Detailed Contents	Hours
1	**Introduction to Accounting**	Introduction to Accounting:– Principles, Concepts, Double entry system of accounting, introduction to journal, voucher, ledger; preparation of trial balance, final accounts , trading and profit and loss account and balance sheet.(theory and numerical) Accounting Standards - AS1, AS2, AS3,AS9(only Theory), IFRS (International Financial Reporting Standards)	**12**
2	**BEA and Budgeting**	Break-even Analysis:-Concept of Break Even Point, Cost-Volume-Profit Analysis, Determination of Break Even Point, Margin of Safety and PV ratio, Impact of changes in Cost or selling price on BEP - Practical applications of Break-even Analysis. Budgeting: Budgeting–cash budget (theory and numerical),	**12**
3	**Financial Management Concepts**	Financial Management:–Meaning and scope, Objectives of time value of money, goals of FM, profit vs. value maximization. Leverages – operating, financial, composite.; cost of equity, preference and equity shares, bonds and debentures, weighted average cost of capital, capital gearing fundamentals.	**10**
4	**Tools and Techniques of FM**	Tools and Techniques for Financial Statement Analysis:- Ratio Analysis – Classification of Ratios – Short term solvency and long term solvency – Profitability ratios - Analysis and Interpretation of Financial Statements through ratios of Liquidity, Solvency and Profitability. Fund Flow Statement - Meaning, Importance, Statement of changes in working capital and statement of Sources and application of funds. Cash flow Analysis:- cash flow Statements: Preparation,	**10**

5	**Capital Budgeting Concepts**	Capital Budgeting:- Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital. Capital Budgeting: features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method; purpose of capital budgeting, capital budgeting process, and types of capital investment decisions. Accounting Rate of Return (ARR) and Net Present Value Method (simple numerical problems on these)	**8**

Reference Books:

1. Dr. Kapil Jain, Prof. Rashmi Somani, "Accounting for Managers", Dreamtech Press, 2015
2. S N Maheshwari, "Accounting for Management", Vikas Publishing, 3rd edition
3. Prasanna Chandra, "Financial Management Theory and Practices", TMH, 9th edition
4. Weygandt, Himmel, Kiesco, "Accounting Principles", 12th Edition,Wiley Publication.
5. Khan & Jain, "Financial Management", Mc Graw Hill
6. Siddiqui S.A. Siddiqui,"Managerial Economics & Financial Analysis", A.S. New Age.
7. V Sharan,"Fundamentals of Financial Management", 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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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
MCA205	**Decision Making and Mathematical Modeling**	**4**

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract	Tut	Theory	TW	Tut.	Total
MCA205	**Decision Making and Mathematical Modelling**	**04**	**--**	**--**	**04**	**--**	**--**	**04**

Subject Code	Subject Name	Examination Scheme							
MCA205	**Decision Making and Mathematical Modelling**	Theory Marks				TW	Pract	Oral	Total
		Internal Assessment			End Semester Exam				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		20	20	20	80	-	-	-	100

Pre-requisites:
Basic knowledge of mathematics

Course Educational Objectives (CEO):

CEO 1	To Understand the fundamental ideas of Discrete Mathematics
CEO 2	To Express the decision making concepts as a mathematical model
CEO 3	To Study and identify a real life business problem and computing requirements appropriate to its solution

Course Outcomes: At the end of the course, the students will be able to:

MCA205.1	Develop mathematical and logical thinking
MCA205.2	Model situations from variety of settings in generalised mathematical form
MCA205.3	Solve the real world business problem

Syllabus

Sr	Module	Detailed Contents	Hours
1	**Mathematical logic**	Propositions and logical operations, Conditional Statements , Methods of Proof , Mathematical Induction, Mathematical Statements , Logic and Problem Solving, Normal Forms	**8**
2	**Sets and Relations**	Set operations and functions, Product sets and partitions, Relations and digraphs, Paths in Relations and Digraphs, Properties of Relations , Equivalence Relations, Operations on Relations, Partially Orders Sets, Hasse diagram	**10**
3	**Graphs**	Graph, Representation of Graph, Adjacency matrix, Adjacency list, Euler paths and Circuits, Hamiltonian Paths and Circuits	**5**
4	**Mathematical Models**	Mathematical Models - Vehicular Stopping Distance Modeling using decision theory : Probability and Expected Value (e.g. Rolling the Dice, Life Insurance, Roulette etc) Decision Trees , Classification problems using Bay's theorem	**8**
5	**Modeling using difference equation**	Recurrence relation - Fibonacci series, Tower of Hanoi ,Lines in a plane Homogenous linear equations with constant coefficients, Particular Solution, Total Solution, Divide and Conquer Recurrence Relations (Fast Multiplication of Integers, Fast matrix Multiplication)	**10**
6	**Characteristics of Complex Business Problems**	Number of Possible Solutions, Time-Changing Environment, Problem-Specific Constraints, Multi-objective Problems, Modeling the Problem A Real-World Examples,	**4**
7	**MADM & MCDM**	Introduction to Multiple Attribute Decision-making (MADM) Multiple Attribute Decision-making Methods, Simple Additive Weighting (SAW) Method, Weighted Product Method (WPM), Analytic Hierarchy Process (AHP) Method, Entropy Method, Compromise Ranking Method (VIKOR), Weighted Average Method (WAM) Introduction to Multiple Criteria Decision Making (MCDM)	**7**

Reference Books

1. Discrete Mathematics and Its Applications 4th Edition , Kenneth H. Rosen ,McGraw Hill
2. A First Course in Mathematical Modeling 5th Edition, Frank R. Giordano, William P. Fox, Steven B. Horton
3. Adaptive Business Intelligence,F 1st Edition by Zbigniew Michalewicz, Martin Schmidt, Matthew Michalewicz, ConstantinChiriac, Springer Publication
4. Decision Making in the Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods,1st Edition by R. VenkataRao, Springer Publication
5. Discrete Mathematical structures 4th Edition, Kolman, Busby, Ross, PHI

6. Discrete Mathematics : SemyourLipschutz, VarshaPatilIINd Edition Schaum's Series TMH
7. Data Mining: Introductory and Advanced Topics ,3rd Edition, Dunham , Sridhar

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.

1. Question paper will comprise of total six questions.
2. Question Number One should be compulsory.
3. All question carry equal marks.
4. Students can attempt any three from the remaining.
5. 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	Teaching Scheme (Contact Hours per week)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA L201	**Operating System and Computer Networks Lab (OS and CN Lab)**	**--**	**06**	**--**	**--**	**03**	**--**	**03**
Examination Scheme								
End Sem. Exam. [Once in a semester]								
Laboratory Name					Term Work	Pract.	Oral	Total
MCA L201	**Operating System and Computer Networks Lab (OS and CN Lab)**				**25**	**50**	**25**	**100**

Pre-requisites: Basic overview of Computer and Computer Networking principles.

Course Educational Objectives (CEO):

CEO 1	To study the various user level and administrator level commands in operating system.
CEO 2	To learn shell script and AWK programming.
CEO 3	To make the learner aware of the practical issues and various networking devices with their interconnections and configurations.
CEO 4	To equip the learner with a hands-on experience of designing various networking applications.

Course Outcomes: At the end of the course, the students will be able to :

MCAL201.1	Apply various operating system commands.
MCAL201.2	To write a shell script and awk programming.
MCAL201.3	Design network for any business requirement.

Syllabus :

Sr.No.	Session	Contents	Hrs
1	**Operating System Basics**	Installation of Operating System with configuration, Disk fragmentation & partitioning, Linux introduction and file system - Basic Features, Advantages, Installation requirements, Basic Architecture of Unix/Linux system, Kernel, Shell, System administration Commands	**4**

2	**Basic OS Commands**	Basic commands, Commands for files and directories cd, ls, cp, md, rm, mkdir, rmdir, more, less, Creating and viewing files using 'cat', File comparisons, View files. Essential Linux commands. Understanding shells, Processes in Linux-process fundamentals, connecting processes with pipes, Redirecting input output, manual help, Background processing, managing multiple processes, changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep, Printing commands, find, wc, Cal, banner, touch, file, dd, Mathematical commands- bc, expr, factor, units. vi, vim editor	**8**
3	**Filter Commands**	Filter related commands-sort, grep, sed, head, tail, cut, paste, uniq Disk commands-disk related commands, checking disk free spaces	**8**
4	**Shell Programming**	Shell programming :- Shell programming, Basic of shell programming, Various types of shell, shell programming in bash, conditional and looping statements, case statements, parameter passing and arguments, Shell variables, shell keywords, Creating Shell programs for automate system tasks and report printing, use of grep in shell	**8**
5	**Advanced Shell Scripting**	Advanced Shell scripting-basic script functions, returning a value, using variables in functions, array and variable functions, function recursion, creating text menus	**6**
6	**Awk programming**	Study of gcc & basic Awk Programming-variables, expressions, built in variables , printf, storing in a file using -f option, comparison operator, BEGIN and END sections Awk Programming-arrays, functions, if statement, looping	**8**
7	**OS Security**	Securing Linux on a network-managing network services, controlling access to networks with nmap, implementing firewalls	**4**
8	**Introduction to packet tracer**	Study of Packet Tracer software interface, Basic Configuration of console, Router & Switches, Assigning IP v4 & IP v6 addresses to the interfaces of the routers, Subnetting /notation	**4**
9	**Routing Techniques**	Configure Static and default routing, RIPv2, EIGRP, OSPF	**4**
10	**Dynamic configuration**	Configuration of DCHP , Access List Configuration, Configuration of NAT, Static, Dynamic and PAT	**6**
11	**Authentication and VLAN**	Configuration of PPPoE (PAP, CHAP), Configure VLANs on the router, InterVLAN, Router on stick, multilayer VLAN, Spanning tree.	**4**
14	**Network Protocol**	Configure Telnet, DNS, HTTP, SMTP , FTP Servers, SNMP	**4**
15	**Mini Project**	A Mini – Project based on OS and CN using an integrated approach.(Maximum Two students in a Group)	**10**

Reference Books:-

1. Unix – Concepts & Applications, Sumitabha Das, Fourth Edition, McGraw Hill Education.
2. Unix Shell Programming – Yashwant Kanetkar, BPB Publications.
3.Linux Bible, Christopher Negus, Ninth Edition, Wiley Publications
4.Linux Command Line and Shell Scripting Bible, Third Edition, Richard Blum and Christine Bresnahan,Wiley Publications
5. Linux Programming A Beginner's Guide – Richard Petersen, Tata McGraw Hill Education
6.Cisco CCENT/CCNA ICND1 100-101 Official Cert Guide, Wendell Odom, CISCO Press

7. CCNA Routing and Switching ICND2 200-101 Official Cert Guide, Wendell Odom, CISCO Press.

Web Resources :

1) https://learningnetwork.cisco.com

Subject Code	Subject Name	Teaching Scheme (Contact Hours per Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MCAL202	Lab-II: Data Structure(DS) & Web Application Development using Open Source Tools Lab	---	06	---	---	03	---	03

Examination Scheme				
End Semester Exam [Once in a Semester]				
Laboratory Name	Term Work	Practical	Oral	Total
MCAL202: Lab-II: Data Structure (DS) & Web Application Development using Open Source Tools Lab	25	50	25	100

Pre-requisites: Basic understanding of fundamentals of any programming language and web technology

Course Educational Objectives (CEO):

CEO 1	To study various linear and non-linear data structures.
CEO 2	To provide knowledge for developing web applications using AJAX framework and open source tools.
CEO 3	To conceptualize effective storage mechanism for data and accessing it through web applications.

Course Outcomes: At the end of the course student will be able to

MCAL202.1	Effectively select the data structure model to be used for the real world problem.
MCAL202.2	Develop web based applications using AJAX framework and open source tools.
MCAL202.3	Build web application with effective storage mechanism for data.

Syllabus

Sr. No.	Session	Detailed Contents	Hours
1.	**Sorting**	Bubble Sort, Insertion Sort, Selection Sort, Shell Sort, Radix Sort	**04**
2.	**Searching**	Linear Search,Binary search	**02**
3.	**Stacks**	Array implementation, Linked List implementation, Evaluation of postfix expression	**04**

4.	**Queue**	Simple Queue, Linked List implementation of ordinary queue, Linked List implementation of circular queue, BFS, Linked List implementation of priority queue, Double ended queue	**08**
5.	**Linked lists**	Singly Linked Lists: Insert, Display, Delete, Search, Count, Reverse Circular Linked List: Insert, Display, Delete, Search, Count, Reverse Doubly Linked Lists : Insert, Display, Delete, Search, Count, Reverse	**08**
6.	**Binary search trees**	Insert, Recursive traversal: preorder, postorder, inorder, Search Largest Node, Smallest Node, Count number of nodes	**08**
7.	**Heap**	MinHeap: reheapUp, reheapDown, Delete, MaxHeap: reheapUp, reheapDown, Delete, HeapSort	**04**
8.	**Hashing**	Methods for Hashing: Direct, Subtraction. Modulo Division, Digit Extraction,Fold shift, Fold Boundary, Methods for Collision Resolution, Linear Probe	**04**
9.	**Graphs**	Represent a graph using the Adjacency Matrix, Find the shortest path in a graph using Warshall's Algorithm, Find the minimum spanning tree (using any method Kruskal's Algorithm or Prim's Algorithm)	**04**
10.	**AJAX Framework**	Making a Server Request, Loading HTML scriptlets from server, AJAX events, Making an AJAX Style File Upload.	**04**
11.	**JavaScript**	Client side scripting with JavaScript, variables, functions, conditions, Pop up boxes, Working with string, Numbers and arrays, Event handling in JavaScript, Working with forms elements, Validating form fields, Introduction to DOM	**06**
12.	**Web Application Development using Bootstrap**	Bootstrap - Introduction to Bootstrap, Bootstrap Grid System, Bootstrap Grid System - Advanced, Creating Layouts with Bootstrap, Bootstrap CSS - Understanding the CSS, CSS Customization / Skins, Responsive Web design with Bootstrap, Single Page Responsive site with Bootstrap, Bootstrap Plug-ins, Bootstrap Layout Components	**06**
13.	**Web Application Development using Joomla**	Joomla - Joomla fundamentals, Understanding the concept of Joomla Positions, Changing the layout structure by changing the module positio, Understanding Basic Joomla Template, Customizing Joomla Template, Building Custom Joomla Template, Linking CSS, Linking Javascript, Creating Custom Form, Changing the Form appearance using CSS	**06**
14.	**Mini Project**	A Mini – Project based on DS and WAD using an integrated approach.(Maximum Two students in a Group)	**10**

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to ALGORITHMS”, PHI, India Second Edition.
2. Richard F Gilberg Behrouz A Forouzan , “Data Structure A Pseudocode Approach with C“.
3. Shaum’s Outlines Data Structure Seymour Lipschutz TMH
4. HTML 5, Black Book, dreamtech Press
5. Learning PHP, MySQL, JavaScript, CSS and HTML 5, Robin Nixon, O’Reilly publication
6. Developing Web Applications in PHP and AJAX, Harwani, McGrawHill
7. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India
8. Extending Bootstrap Christoffer Niska, Packt Publishing
9. Bootstrap-Jake Spurlock O’Reilly publication
10. Joomla Bible, 2nd Edition, Ric Shreves, Wiley-India
11. The Official Joomla! Book, 2nd Edition, (Joomla! Press), by Jennifer Marriott, Elin Waring

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

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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 Majumdar
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

<table>
<tr><th>Course</th><th>Course Name</th><th colspan="3">Teaching Scheme</th><th colspan="3">Credits Assigned</th></tr>
<tr><td rowspan="6">MCA11</td><td rowspan="6">Mathematical Foundation for Computer Science 1</td><td colspan="3">Contact Hours</td><td colspan="3" rowspan="2"></td></tr>
<tr><td colspan="2">Theory</td><td>Tutorial</td></tr>
<tr><td colspan="2">3</td><td>1</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td colspan="6">Examination Scheme</td></tr>
<tr><td colspan="3">Theory</td><td rowspan="2">Term Work</td><td rowspan="2">End Sem Exam</td><td rowspan="2">Total</td></tr>
<tr><td>CA</td><td>Test</td><td>AVG</td></tr>
<tr><td>20</td><td>20</td><td>20</td><td>25</td><td>80</td><td>125</td></tr>
</table>

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

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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				
MCA 302	**Java Programming**	Test1 (T1)	Test2(T 2)	Average of T1 & T2					
		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				
MCA 303	**Information Security**	Test1 (T1)	Test2(T 2)	Average of T1 & T2					
		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					
MCA PR301	**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)

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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				
MCA 403	**Computer Graphics**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		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				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 4042	**Business Infrastructure and Management**	**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				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 4051	**Digital Forensics**	**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				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA 4054	**Artificial Intelligence and Soft Computing**	**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(T2)	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.

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

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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 Majumdar
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

Semester III

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

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCA31	Big Data Analytics and Visualization	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

Prerequisite: Some prior knowledge about SQL, Data Mining, DBMS would be beneficial.

Course Objectives:

Sr.No.	Course Objective
1	Provide an overview of exciting and growing field of big data analytics
2	Enchase the programming skills using big data technologies such as map reduce, NoSQL, Hive, Pig
3	Use Spark shell and Spark applications to explore, process, and analyze distributed data
4	Teach the component of visualization and understand why visualization is important for data analysis

Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate the key issues in big data management and its associated application for business decision	Understanding
CO2	Develop problem solving and critical thinking skills in fundamental enabling techniques like Map Reduce , NoSQL, Hadoop Ecosystem	Applying
CO3	Use of RDD and Data Frame to create Application in Spark.	Applying
CO4	Implement exploratory data analysis using visualization	Applying

Module	Detailed Contents	Hrs.
1	**Introduction to Big Data and Hadoop:** Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data ,Big Data Applications. Hadoop architecture: HDFS,YARN 2, YARN Daemons. Hadoop Ecosystem. **Self-Learning Topics:** Yet Another Resource Negotiator YARN 1.X	6
2	**HDFS and Map Reduce** **HDFS:** HDFS architecture, Features of HDFS,Rack Awareness,HDFS Federation	6

	Map Reduce:The Map Task, The Reduce Task, Grouping by Key,Partitioner and Combiners, Detail of Map Reduce Execution. **Algorithm Using Map Reduce:** Matrix and Vector Multiplication by Map Reduce Computing Selection and Projection by Map Reduce Computing Grouping and Aggregation by Map Reduce **Self-Learning Topics: Concept of Sorting and Natural Joins**	
3	**NoSQL:** Introduction to NoSQL, No SQL Business drivers NoSQL Data architecture patterns: key value stores, Column family Stores, Graph Stores, Document Stores. NoSQL to manage big data: Analyzing big data with shared nothing architecture, choosing distribution master slave vs. peer to peer. HBASE overview,HBASE data model, Read Write architecture. **Self-Learning Topics: Cassandra Case Study**	**5**
4	**Hadoop Ecosystem: HIVE and PIG** HIVE: background, architecture, warehouse directory and meta-store, HIVE query language, loading data into table, HIVE built-in functions, joins in HIVE, Partitioning. HiveQL: querying data, sorting and aggregation, 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. **Self-Learning Topics:Cloudera IMPALA**	**6**
5	**Apache Kafka:** Kafka Fundamentals, Kafka architecture, Case Study: Streaming real time data (Read Twitter Feeds and Extract the Hashtags) **Apache Spark:** Spark Basics, Working with RDDs in Spark, Spark Framework, aggregating Data with Pair RDDs, Writing and Deploying Spark Applications, Spark SQL and Data Frames. **Self-Learning Topics: KMeans and Page Rank in Apache Spark**	**9**
6	**Data Visualization:** Explanation of data visualization, Challenges of big data visualization, Approaches to big data visualization, D3 and big data, Getting started with D3, Another twist on bar chart visualizations, Tableau as a Visualization tool, Dashboards for Big Data - Tableau. **Self-Learning Topics: Splunk via web Interface.**	**8**

Reference Books:

Reference No	Reference Name
1	Tom White, "HADOOP: The definitive Guide" O Reilly 2012, Third Edition, ISBN: 978-1-449-31152-0
2	Chuck Lam, "Hadoop in Action", Dreamtech Press 2016, First Edition ,ISBN:13

	9788177228137
3	Shiva Achari," Hadoop Essential " PACKT Publications, ISBN 978-1-78439-668-8
4	RadhaShankarmani and M. Vijayalakshmi ,"Big Data Analytics "Wiley Textbook Series, Second Edition, ISBN 9788126565757
5	Jeffrey Aven,"Apache Spark in 24 Hours" Sam's Publication, First Edition, ISBN: **0672338513**
6	Bill Chambers and MateiZaharia,"Spark: The Definitive Guide: Big Data Processing Made Simple "O'Reilly Media; First edition, ISBN-10: 1491912219;
7	James D. Miller," Big Data Visualization" PACKT Publications.ISBN-10: 1785281941

Web References:

Reference No	Reference Name
1	https://hadoop.apache.org/docs/stable/
2	https://pig.apache.org/
3	https://hive.apache.org/
4	https://spark.apache.org/documentation.html
5	https://help.tableau.com/current/pro/desktop/en-us/default.htm

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		
MCA32	Distributed System and Cloud Computing	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, Operating Systems
Course Objectives: The course aim to

Sr.No.	Course Objective
1	Introduce concepts of Distributed Operating System, design issues IPC and RMI.
2	Understand the concepts of clock synchronization and shared memory.
3	Analyze various algorithms in Distributed System Management, File management and process management.
4	Analyze the principles and paradigm of Cloud Computing.
5	Understand the various design issues and challenges in cloud computing

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

	Outcome	Bloom Level
CO1	Illustrate principles and communication protocols of Distributed systems	Understanding
CO 2	Analyze clock synchronization and various algorithms	Analyzing
CO 3	Analyze Distributed shared memory and management concepts.	Analyzing
CO 4	Analyze Cloud computing and cloud models	Analyzing

Module	Detailed Contents	Hrs
1	**Module: Introduction to Distributed Computing Concepts:** Basic concepts of distributed systems, distributed computing models, issues in designing distributed systems **Inter Process Communication**	09

	Fundamental concepts related to inter process communication including message passing mechanism, Concepts of group communication **Remote Communication** Remote Procedural Call (RPC), Remote Method Invocation (RMI) **Self Learning Topics:** Case study on Java RMI	
2	**Module: Clock synchronization:** Introduction of clock synchronization, Global state, Mutual Exclusion Algorithms, Election algorithms. **Self Learning Topics:** Synchronization in Wireless Networks	**04**
3	**Module: Distributed Shared Memory:** Fundamental concepts of DSM, types of DSM, various hardware DSM systems, Consistency models, issues in designing and implementing DSM systems. **Self Learning Topics:** MemNet Architecture	**05**
4	**Module: Distributed System Management:** **Resource Management**Scheduling Algorithms, Task Assignment, Load balancing approach, Load sharing approach **Process Management** Process Migration Mechanism, Thread models **Distributed File System** Concepts of a Distributed File System (DFS), file models **Self Learning Topics:** Case Study of anyone distributed system	**06**
5	**Module: Introduction to Cloud Computing:** Cloud Computing history and evolution, benefits of cloud computing. **Cloud Computing Architecture** Cloud Architecture model, Types of Clouds: Public Private & Hybrid Clouds, Cloud based services: Platform as a service (PaaS), Software as a service (SaaS), Infrastructure as a service (IaaS) **Self Learning Topics:** Cluster computing, Grid computing, Fog computing	**06**
6	**Module: Classification of Cloud Implementations:** Amazon Web Services, Microsoft Azure & Google Cloud-- Compute Services, Storage Services, Network Services, Database services, Additional Services. Google AppEngine (GAE), Aneka, Comparativestudy of various Cloud Computing Platforms. **Cloud Issues and Challenges** Cloud computing issues and challenges like Security, Elasticity, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Identity and Access Management **Self Learning Topics:** Widows Azure Platform Appliance	**10**

Reference Books:

Reference No	Reference Name
1	Pradeep K. Sinha , Distributed Operating System: Concepts and Design, PHI Learning, ISBN No. 978-81-203-1380-4
2	Dr. SunitaMahajan , Seema Shah, Distributed Computing ,Oxford University Press,Second Edition, ISBN No. 978-01-980-9348-0
3	Andrew S. Tanenbaum , Distributed Operating Systems, Pearson Education , ISBN No. 978-81-317-0147-8
4	James Broberg and Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms Wiley, First edition, ISBN No. 978-04-708-8799-8
5	Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill, First Edition, ISBN No. 978-00-706-8351-8
6	RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing, Tata Mcgraw Hill, ISBN No. 978-12-590-2995-0

Web References:

Reference No	Reference Name
1	https://nptel.ac.in/courses/106/104/106104182/
2	https://webee.technion.ac.il/~idish/sigactNews/
3	https://curlie.org/Computers/Computer_Science/Distributed_Computing/
4	https://nptel.ac.in/courses/106102114/
5	https://nptel.ac.in/courses/106104024/

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		
MCAE331	Block Chain	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 knowledge of cryptography, networking, distributed systems and expertise in object oriented programming.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Provide the overview of the structure and mechanisms of Blockchain
2	Explain permissioned and decentralized Blockchain concepts
3	Understand cryptocurrency transactions and mining Blockchain.
4	Understand and write the smart contracts in Ethereum.
5	Understand the applications of Blockchain technology
6	Understand the hyperledger case studies in Blockchain.

Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Explain Blockchain technologies and their components.	Understanding
CO 2	Interpret the uses of cryptographic techniques in Blockchain	Understanding
CO 3	Demonstrate the use of hyperledger fabric and its components	Understanding
CO 4	Build the smart contracts in Ethereum	Applying
CO 5	Analyze the use of Blockchain technology in various domains	Analyzing

Module	Detailed Contents	Hrs
1	**Module: Introduction:** Basics of blockchain, History, Uses of Blockchain, Structure of a block, Transactions, Public Ledger, Distributed Consensus. Peer to peer systems, centralized and decentralized systems, Types of blockchain **Self-learning Topics:** Basics of cryptography (Symmetric and Asymmetric) RSA algorithm	04
2	**Module: Cryptographic Primitives:** Cryptographic hash functions – collision free, hiding, puzzle friendly (properties), Hash Chain, Hash tree- Merkle Tree, Public Key cryptography, Digital signatures. Use of hash functions and digital signatures in blockchain	06

	Self-learning Topics: Basics of data structure (Linked lists), Hash Functions	
3	**Module: Bitcoin:** Basics (Structure of block, creation of coins), Double Spending, Script (FORTH), Mining Process, Objectives of consensus mechanisms, Consensus in Bitcoin – Proof of Work, Sybil Attack, Proof of Elapsed Time, Proof of Stake, Proof of Burn **Self-learning Topics:** Other Cryptocurrencies.	08
4	**Module: Permissioned Blockchain:** Smart Contracts, Distributed Consensus, Faults in DC, Algorithms – Paxos, RAFT, Byzantine Fault Tolerance, Practical BFT **Self-learning Topics:** Distributed algorithms, Object oriented Programming Concepts	06
5	**Module: Ethereum:** History, Architecture, Accout Types , Gas, Transactions, Structure (Blocks, Transactions), Accounts, Ether, Gas, Ethereum Virtual Machine, Ethereum Mining process, Solidity. **Hyperledger Fabric**: Features of hyperledger, Architecture, ordering service, Transaction Flow, Membership and Identity Mangement, Gossip Protocol **Self-learning Topics:** BitcoinVsEthereum, EthereumVsHyperLedger	10
6	**Module: Case Study**: Blockchain in Government (Digital Identity, Tax Payments, Land Registration, Audit and Compliances), Supply Chain Management, Financial Services	06

Reference Books:

Reference No	Reference Name
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press
2	Don Tapscott,AlexTapscott, Blockchain Revolution, ISBN No. 9781101980132
3	Mark Gates, Blockchain ultimate Guide to understanding Blockchain, Bitcoin,Cryptocurrencies, Smart Contracts and Future of money, Wise Fox Publishing
4	VikramDhillon, David Metcalf, Max Hooper, Blockchain Enabled Applications, Apress, ISBN No.13:978-1-4842-3081-7
5	Melanie Swan,Blockchain Blueprint for a new economy, O'Reilly, First Edition, ISBN No.978-1-491-92049-7
6	MayukhMukhopadhyay, Ethereum Smart Contract Development, Packt publishing, First Edition, ISBN No.978-1-78847-304-0
7	Chris Dannen, Introducing Ethereum and Solidity, Apress, ISBN No.978-1-4842-2535-6
8	Martin Quest, Cryptocurrency Master Bundle
9	Nitin Gaur, Luc Desrosiers, Petr Novotny, Venkatraman Ramakrishna, Anthony O'Dowd, Salman A. Baset, Hands-On Blockchain with Hyperledger, Packt

Web References:

Reference No	Reference Name

1	https://blockexplorer.com/
2	https://en.wikipedia.org/wiki/Digital_signature
3	https://www.usenix.org/legacy/events/osdi99/full_papers/castro/castro_html/castro.html
4	https://www.hyperledger.org/projects/fabric
5	https://hyperledger-fabric.readthedocs.io/en/release-2.0/
6	https://eprint.iacr.org/2017/375.pdf
7	https://hbr.org/2017/01/the-truth-about-blockchain
8	https://bitcoin.org/bitcoin.pdf
9	https://blockgeeks.com/guides/what-is-blockchain-technology/
10	https://www.cs.hmc.edu/~geoff/classes/hmc.cs070.200101/homework10/hashfuncs.html
11	https://www.globalsign.com/en/ssl-information-center/what-is-public-key-cryptography
12	https://searchsecurity.techtarget.com/definition/asymmetric-cryptography
13	https://www.cryptocompare.com/coins/guides/what-is-a-block-header-in-bitcoin/
14	https://github.com/ethereum/wiki/wiki/White-Paper
15	http://ethdocs.org/en/latest/introduction/index.html
16	https://blockgeeks.com/guides/proof-of-work-vs-proof-of-stake/
17	https://www.coindesk.com/learn/ethereum-101/how-ethereum-works
18	https://www.coindesk.com/short-guide-blockchain-consensus-protocols

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		
		Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
MCAE332	Deep Learning	3	--	3	--	3
		Examination Scheme				
		Theory		Term Work	End Sem Exam	Total
		CA	Test	AVG		
		20	20	20	--	80	100

Prerequisite: Basic knowledge of mathematical and machine learning concepts.

Course Objectives

Sr.No.	Course Objective
1	To explain the concept of neural network and deep learning.
2	To understand appropriate learning rules for each of the architectures and learn several neural network paradigms.
3	To understand major deep learning algorithms and the problem settings for problem solving
4	To learn different regularization techniques used in deep learning.
5	To understand the optimization algorithms used for training of deep learning models.
6	To learn deep learning algorithms -CNN and RNN to solve real world problems.

`Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Demonstrate concepts, architectures and algorithms of Neural Networks to solve real world problems.	Understanding
CO 2	Identify deep feed-forward networks and different regularization techniques used in Deep Learning.	Applying
CO 3	Identify challenges in Neural Network optimization and different optimization algorithms used in Deep learning models	Applying
CO 4	Analyze deep learning algorithms which are more appropriate for various types of learning tasks in various domains	Analyzing

Module No.	Detailed Contents	Hrs
01	**ANN Algorithms** : Supervised Learning Network- McCulloch–Pitts Unit and Thresholding logic, Linear Separability, Multi-layer Perceptron Networks, Back-Propagation Network, factors	6

	affecting Backpropagation Training, Unsupervised Learning Networks- MaxNet. **Self learning Topic:** -Mexican Hat Net.	
02	**Deep Feed-forward Networks**: Introduction to Deep Learning, Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Other Architectural Considerations. **Self learning Topic:** - Applications of Deep neural networks.	**6**
03	**Regularization**: Regularization for Deep Learning - Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout. **Self learning Topic:-**Regularized Linear Regression.	**7**
04	**Optimization for Training Deep Models:** Need for Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, and Algorithms with Adaptive Learning Rates- AdaGrad, RMSProp, and Approximate Second-Order Methods-Newton's Method. **Self learning Topic:-**Conjugate Gradients Method.	**6**
05	**Convolutional Networks**: Motivation, Pooling, Convolutional layers, Additional layers, Residual Nets, Applications of deep learning. **Self learning Topic:-**Application of CNN.	**7**
06	**Recurrent and Recursive Nets:** Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder -Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. **Self learning Topic:-**Application of RNN.	**8**

Reference Books:

Reference No	Reference Name
1	Dr. S. N. Sivanandam and Dr. S. N. Deepa, Principles of Soft Computing, John Wiley
2	S. Rajasekaran & G.A. VijayalakshmiPai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice Hall of India.
3	Goodfellow I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016
4	Christopher M Bishop., Pattern Recognition and Machine Learning, McGraw-Hill, ISBN No0-07-115467-1.

5	Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6	Simon Haykin, Neural Networks and Learning Machines, 3rd Edition Prentice Hall of India, ISBN-10: 0-13-147139-2.
7	Anandita Das., Artificial Intelligence and Soft Computing for Beginners, ShroffPublication.ISBN 9789351106159.
8	Raul Rojas, Neural Networks: A Systematic Introduction, 1996 ISBN 978-3-540-60505
9	Deep Learning Tutorial Release 0.1, LISA lab, University of Montreal

Web References:

Reference No	Reference Name
1	https://olympus.greatlearning.in/courses/10905/pages/courseoutline?module_item_id=445065
2	https://www.youtube.com/watch?v=ve-Tj7kUemg&feature=youtu.be
3	https://www.coursera.org/specializations/deep-learning
4	https://www.tutorialspoint.com/python_deep_learning/index.htm

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 number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
MCAE333	Game Development	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 any Object Oriented Programming using C#

Course Objectives : Course aim to

Sr.No.	Course Objective
1	Learn basic Principles of Game Development
2	Understand components required to design a Game
3	Learn how to script gaming applications
4	Evaluate and use techniques of game development

Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate Principles of Game Development	Understanding
CO 2	Build applications using various components of Game development	Applying
CO 3	Develop multilayered and interactive games	Analyzing
CO 4	Solve Problems in 2D game development	Creating

Module	Detailed Contents	Hrs
1	**Module: Introduction to Game Development** Game Development, Genres of Game Development,Game development applications, Role of a Game Developer,A Playcentric Design Process,Designing Your Game,Managing game development projects,The Structure of Games,Frameworks and tools for Game Development **Self Learning Topics:**Game Design Strategies	6
2	**Module:Game Development Components** Game Objects,Models,Materials and Textures,Trrain,Environments,Lights and Cameras, Sound Effects	7

	Self Learning Topics: Game Art	
3	**Module:Scripting for Game development** Difference between unity and C# scripting, Scripting basics, Variables, Operators, Conditionals, Iterations, Methods, Input,Classes **Self LearningTopics:**Exception Handling	**7**
4	**Module: Managing State and Transitions** Identifying the Action Objects, Developing a State Machine, Lookup Table, Object Metadata, Processing the Auxiliary Objects, Handling Object Visibility, Handling Special Cases,Collisons **Self LearningTopics:**Gaming Ethics	**7**
5	**Module: Physics and Special Effects** Adding New Assets, Combining Physics and Keyframe Animation, Particle Systems, Other Special Effects,Collisions,Prefabs and animations, Unity Physics Joints,Unity 2D Effectors **Self LearningTopics:**Virtual World	**7**
6	**Module:Inventory Logic** Using Layers,Creating the Inventory Screen,Adding Inventory Icons,Organizing the Inventory Objects, InventoryLayout,Inventory overflow **Self LearningTopics:**Dialog Trees	**6**

Reference Books:

Reference No	Reference Name
1	Fullerton, Tracy. Game design workshop: a playcentric approach to creating innovative games. CRC press, 2014.ISBN: 1482217171
2	Schell, Jesse. The Art of Game Design: A book of lenses. CRC press, 2015. ISBN: 1498759564
3	Blackman, Sue. Beginning 3D Game Development with Unity 4: All-in-one, multi-platform game development. Apress, 2013. ISBN: 1430248998
4	Goldstone, Will. Unity game development essentials. Packt Publishing Ltd, 2009. ISBN: 184719818x
5	Murray, Jeff W. C# game programming cookbook for Unity 3D. CRC Press, 2014.
6	Paris Buttfield-addison , Jon Manning , Tim Nugent,Unity Game Development Cookbook: Essentials For Every Game, O'reilly Media, ISBN: 1491999152
7	Geig, Mike. Sams Teach Yourself Unity Game Development in 24 Hours. Pearson Education, 2014. ISBN-13: 978-0-672-33696-6
8	Norton, Terry. Learning C# by developing games with unity 3D. Packt Publishing Ltd, 2013. ISBN: 1849696586
9	Saunders, Kevin, and Jeannie Novak. Game development essentials: Game interface

	design. Cengage Learning, 2012. ISBN-13: 978-1-305-11054-0

Web References:

Reference No	Reference Name
1	www.unity.com
2	https://en.wikipedia.org/wiki/Video_game_development
3	https://www.gamedesigning.org/video-game-development/
4	https://github.com/Kavex/GameDev-Resources

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 each. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of each 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		
MCAE334	Ethical Hacking	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: Networking concepts, Structured Query Language, encryption algorithms

Course Objectives: course aim to

Sr.No.	Course Objective
1	Teach students to think like an ethical hacker and at the same time follow the code of professional ethics and the prescribed cyber laws.
2	Make oneself aware of the cybercrimes that are taking place in the real world.
3	Learn about the different hacking tools and techniques and practically use these tools to gain better understanding of the ethical hacking concepts.
4	Provide a deep understanding of security issues, threats and concerns in the cyber world and provide countermeasures to curb hacking.

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

Sr.No.	Outcome	Bloom Level
CO1	Recall the networking, sql, and encryption algorithm concepts to further study ethical hacking techniques, threats, tools and prevention against attacks.	Remembering
CO 2	Understand ethical hacking concepts, cases, ethics and cyberlaws.	Understanding
CO 3	Apply available hacking tools to find a solution to a given hacking issue.	Applying
CO 4	Analyze and classify the real-world hacking cases and situations.	Analyzing

Module	Detailed Contents	Hrs
1	**Module: Introduction to ethical Hacking:** What is ethical hacking? Types of hacking, advantages, disadvantages and purpose of hacking, Types of hackers, Code of ethics, Types of attacks and attack vector types, Prevention from hackers, The Indian IT Act 2000 and	04

	Amendments to the Indian IT Act(2008) ,Phases of hacking. **Self-Learning Topics:** ethical hacking tools	
2	**Module:Footprinting and Reconnaissance.** What is footprinting? Active and passive footprinting, purpose of footprinting , objectives of footprinting, footprinting threats, Types of footprinting, footprinting countermeasures. **Self-Learning Topics:** footprintingtools	**05**
3	**Module: Scanning networks, Enumeration and sniffing:** **Scanning networks:** Network scanning and its types, objectives of network scanning, scanning live systems, scanning techniques-TCP Connect / Full Open Scan, Types of Stealth scans, port scanning countermeasures, IDS evasion techniques, Banner grabbing and its tools, vulnerability scanning, proxy servers, anonymizers, IP spoofing and its countermeasures. **Enumeration and Sniffing:** What is Enumeration? Enumeration techniques, Enumeration types, Enumeration countermeasures, what is sniffing? Wiretrapping and its types, packet sniffing, sniffing threats, how sniffers work?, sniffing methods-ARP spoofing and MAC flooding, active and passive sniffing, types of sniffing attacks, sniffing countermeasures, sniffing detection techniques. **Self-Learning Topics:** Scanning, enumeration and sniffing tools.	**08**
4	**Module: Trojans and other Attacks:** Worms, viruses, Trojans, Types of worms, viruses and worms, Preventing malware attacks, types of attacks**:** (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs, Steganography - text, image and audio and video, types of Social Engineering: Physical social engineering**,** Remote social engineering and hybrid social engineering. **Self-Learning Topics: case studies, malware tools and steganographic tools.**	**08**
5	**Module: Hacking web servers, web applications and sql injection:** **Session hijacking:** What is session hijacking? , why session hijacking is successful? session hijacking techniques, session hijacking process, Types of session hijacking,	**08**

	session hijacking countermeasures: protecting and preventing, **Hacking web servers and web applications:** Causes of webservers being compromised, web server attacks, stages of web server attacks, defending against web server attacks, web application components, its working, architecture, web server attack vectors, web application threats and counter measures. **SQL Injection:** What is SQL injection, SQL injection threats, SQL injection attacks, SQL injection detection, Types of SQL injection, SQL injection methodology, SQL injection prevention and countermeasures. **Self-Learning Topics:** tools of session hijacking, web servers and applications and SQL injection.	
6	**Module: Wireless network hacking, cloud computing security, cryptography, Pen testing:** Types of wireless Architecture, wireless encryption techniques-WEP and WPA, breaking WEP/WPA and defending WPA encryption, wireless Sniffing, Characteristics, types of cloud computing services, models and benefits, threats and attacks, cryptography and its objectives, cryptography types, cryptography attacks, what is Pen Testing, need for pen testing, types and techniques of pen testing, phases of pen testing. **Self-Learning Topics:** Tools of WEP/WPA, cloud computing, cryptography, Pen testing.	**07**

Reference Books:

Reference No	Reference Name
1	Matt Walker, All-In-One-CEH-Certified-Ethical-Hacker-Exam-Guide.
2	Manthan Desai Basics of ethical hacking for beginners.
3	SunitBelapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.
4	Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson.
5	Sean-Philip Oriyano, Sybex, Certified Ethical Hacker Study Guide v9, Study Guide Edition,2016.
6	Emmett Duley and Chuck Easttom ,Comptia Security+ Study Guide.
7	Alana Maurushat, Ethical Hacking.
8	TutorialsPoint Professionals, Ethical Hacking by TutorialsPoint.

Web References:

Reference No	Reference Name
1	Code of ethics link https://cert.eccouncil.org/code-of-ethics.html
2	https://arc.bukancoder.co/Certified-Ethical-Hacker-Module-V8/

3	https://www.edureka.co/blog/steganography-tutorial
4	https://www.guru99.com/how-to-hack-using-social-enginering.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		
MCAE335	Quantum Computing	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 Physics and Mathematics

Course Objectives: Course aim to

Sr.No.	Course Objective
1	Impart the basic concepts of the emerging field of Quantum Computing
2	Learn and use various Quantum Computing algorithms
3	Demonstrate the working of basic quantum computing operations
4	Identify the basic requirements for implementing Quantum Computers

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

Sr.No.	Outcome	Bloom Level
CO 1	Understand basic principles and components of Quantum Computing	Understanding
CO 2	Analyze Quantum Computing algorithms	Analyzing
CO 3	Design programs to perform basic Quantum Computing operations	Creating
CO 4	Identify classes of problems that can be solved using Quantum Computing	Applying

Module	Detailed Contents	Hrs
1	**Module: Overview of Traditional Computing** Computers and the Strong Church-Turing thesis, Circuit Model of Computation, Linear Algebra Formulation of the Circuit Model, Reversible Computation, Dirac Notation, Operators, Functions of Operators **Self-Learning Topics:** Basic Linear Algebra	6

2	**Module: Qubits and General Quantum Operations** State of a Quantum System, Composite Systems, Measurement, Mixed States and General Quantum Operations: Mixed States, Partial Trace, General Quantum Operations **Self-Learning Topics**: Binary Operations	**8**
3	**Module: Quantum Model of Computation** The Quantum Circuit Model, Quantum Gates: 1 Qubit Gates, Universal Sets of Quantum Gates, Discrete Set of Universal Operations. **Self-Learning Topics**: Basic Gates	**8**
4	**Module: Programming for a QPU** One Qubit: Physical Qubit, Introducing the Circle Notation, QPU Instructions; Multiple Qubits: Circle Notation for Multi-Qubit Registers, Single Qubit Operations in Multi-Qubit Registers, QPU Instructions; Quantum Teleportation **Self-Learning Topics**: Additional QPU Instructions for Multiple Qubits	**8**
5	**Module: Quantum Arithmetic & Logic** Arithmetic on a QPU, Building Increment and Decrement Operators, Adding Two Quantum Integers, Negative Integers, Quantum Conditional Execution, Mapping Boolean Logic to QPU Operations, Basic Quantum Logic. **Self-Learning Topics**: Overview of Quantum Phase Estimation	**6**
6	**Module: QPU Applications** Real Data: Non-integer Data, QRAM, Matrix Encodings: How can a QPU Operations represent a Matrix; Quantum Supersampling (QSS): What can a QPU do for Computer Graphics, Conventional Supersampling, Computing Phase-Encoded Images. **Self-Learning Topics**: Shor's Factoring Algorithm	**4**

Reference Books:

Reference No	Reference Name
1	Kaye P, Laflamme R, Mosca M. An introduction to quantum computing. Oxford university press; 2007. ISBN No. 0198570007
2	Johnson, Eric R., NicHarrigan, and Mercedes Gimeno-Segovia. Programming Quantum Computers: Essential Algorithms and Code Samples. O'Reilly; 2019.

	ISBN No. 1492039683
3	Nielsen MA, Chuang I. Quantum computation and quantum information. Cambridge University Press; 2012. ISBN No. 9780511976667
4	Silva V. Practical Quantum Computing for Developers. Apress; 2018. ISBN No. 9781484242179
5	Rieffel EG, Polak WH. Quantum computing: A gentle introduction. MIT Press; 2011. ISBN No. 9780262526678
6	Aaronson S. Quantum computing since Democritus. Cambridge University Press; 2013. ISBN No. 9780521199568

Web References:

Reference No	Reference Name
1	https://cra.org/ccc/wp-content/uploads/sites/2/2018/11/Next-Steps-in-Quantum-Computing.pdf
2	https://www.ibm.com/quantum-computing/
3	https://eandt.theiet.org/content/articles/2019/04/quantum-for-dummies-the-basics-explained/
4	https://www.cl.cam.ac.uk/teaching/1718/QuantComp/
5	https://nptel.ac.in/courses/104104082/

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 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		
MCAE341	Intellectual Property Rights	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	Describe the concept of intellectual property, explain the classification of intellectual property rights, and elaborate on the justification and scope of IPRs.
02	Create awareness of the rights and infringements of rights and related protections of inventions, creations, and ideas using various IPRs under IP Laws of India as well as International Treaty procedures.
03	Describe registration process of various intellectual property in India as well as abroad.
04	Understand the circumstances under which a granted patent/copyright/design etc., could be revoked, opposed, taken away, or licensed.
05	Familiarize with the databases and tools for searching and filing of patents and other IPRs.
06	Discuss the National IPR Policy of India.

Course Outcomes: On successful completion of the course learner/student should be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Intellectual Property and IP Infringements.	Remembering
CO2	Understand and acquire knowledge of IPR policy followed in India.	Understanding
CO3	Demonstrate the know-how required to identify, assess, and apply for IP rights protection under various applicable laws and treaties in force.	Applying
CO4	Analyze the development, registration procedure, protection, compliance, and enforcement of various intellectual property rights.	Analyzing

Module	Detailed Contents	Hrs.
1	**Module: Introduction and Historical Background** **Introduction:** The Concept of Property: Its Definition, Its Features, and Classification – Intellectual Property as Creations of the Human Mind – Justifying Intellectual Property : Arguments for and Against It – Types of IPRs: Patent, Copyright, Trademark, Trade Secret, Industrial Design, Geographical Indication, Semiconductor Integrated Circuit Layout Design, Plant Variety & Farmer's Rights; Genetic Resources and Traditional Knowledge **Historical Background:** Evolution of IPRs through Various International Agreements, Treaties, & Conventions: From Paris Convention (1883) To WTO-TRIPS Agreement (1995) – Global IPR Organizations: WIPO (1967) and WTO (1995) **Self-Learning Topics:** Relevance of Intellectual Property in Today's Knowledge Economy	**05**
2	**Module: Patents** **Introduction to Patent:** What is a Patent? – Conditions for Grant of Patent – Patentable Inventions and Inventions Not Patentable – Process and Product Patents – Patent Specifications – The Process for Obtaining a Patent in India and Abroad – PCT Patent – Post-Grant Opposition, Revocation and Compulsory Licensing – Rights Granted to a Patentee – Patent Infringement & Its Remedies – Patent Search and Databases – e-filing of Patent Application **Emergence of Technology Patents:** Patenting the Inventions of Information Technology: Patenting Computer Programs and Software – Software Patents vs Software Copyrights: Lessons for India – Patenting of Biotechnology Inventions (or Patenting Life) **Self-Learning Topics:** Biotech Patents in India	**09**
3	**Module: Copyrights** **Introduction to Copyright:** Nature of Copyright – Copyright as a Property, Statutory Right, Idea versus Expression – Requirements for Copyrights – Idea-Expression Dichotomy: Merging of the Idea with Expression, Originality & Fixation – Various Works Protectable Under Copyrights – Authorship and Ownership – Registration of Copyrights – Term of the Copyright – Copyright Infringement, Its Remedies & Penalties. **Copyrights in the Digital Age** – Internet and Copyright – Copyrights in Computer Software – Copyrights for Electronic Database – Digital Copyright Protection in India **Self-Learning Topics:** Fair Use – Instances of Fair Use: Using Copyrighted Works in Education and Library	**09**
4	**Module: Trademarks and Trade Secrets** **Trademarks:** Introduction – The Rationale and Functions of a Trademark – Different Types of Trademarks – Categories of Trademark Distinctiveness – Recognizing a Good Trademark – What Cannot be Registered as a Trademark? – Registration & Renewal of a Trademark – Rights Granted by Trademark	**08**

	Registration – Different Classes of Trademark Infringement – Acts of Trademark Infringement & Remedies **Trade Secrets:** Trade Secret and its Characteristics - Kinds and Examples of Trade Secrets - Protection of Trade Secrets - Patents and Trade Secrets **Self-Learning Topics:** Origin of Trademarks System in India – Misappropriation of Trade Secrets	
5	**Module: Designs and Geographical Indications** **Design:** Defining a Design – Essentials of a Design – Registration & Term of Designs – Copyright in Registered Designs – Conditions for Registration of Industrial Designs – Procedure for Registration of Industrial Designs – Infringement of Industrial Designs and Remedies Against Infringement – The Hague Agreement **Geographical Indications:** Introduction - Concept of Geographical Indications - Kinds of Geographical Indications – Registration of GIs – Benefits of Registering GIs – Infringement of a Registered GI and Remedies Thereof **Self-Learning Topics:** IPRs forSemiconductor Integrated Circuit Layout Design	**07**
6	**Module: Harnessing Intellectual Property for National Development** India's New National IPR Policy, 2016: Vision Statement, Mission Statement and Objectives – IPR Administration System in India – Govt of India Initiatives & Schemes towards Promoting IPR **Self-Learning Topics:** Managing of Intellectual Property in Organizations	**02**

Reference Books:

Ref No	Reference Name
1	Nithyananda, K. V., Intellectual Property Rights: Protection and Management, Cengage Learning (2017), First Edition, ISBN: 9789386668578
2	NeerajPandey&KhusdeepDharni, Intellectual Property Rights, PHI Learning (2014), First Edition, ISBN: 812034989X, 9788120349896
3	Sreenivasulu N.S, Law Relating to Intellectual Property, Partridge Publishing (2013), First Edition, ISBN: 1482813939, 9781482813937
4	Ramakrishna B & Anil Kumar H.S, Fundamentals of Intellectual Property Rights – For Students, Industrialists, and Patent Lawyers, Notion Press (2017), First Edition, ISBN:1946556327, 9781946556325
5	Siva Vaidhyanathan, Intellectual Property: A Very Short Introduction, Oxford University Press (2017), Second Edition, ISBN: 9780195372779
6	Ahuja V. K., Law Relating to Intellectual Property Rights, Lexis Nexis (2017), Third Edition, ISBN: 9788131251652

Web References:

Reference No	Reference Name
1	National IPR Policy 2016 - http://cipam.gov.in/wp-content/uploads/2017/10/National-IPR-Policy-English-.pdf
2	**Intellectual Property – The Future, CIPAM, 2017** - http://cipam.gov.in/wp-

	content/uploads/2017/09/bookletIPR.pdf
3	WIPO Intellectual Property Handbook – (https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)
5	https://www.startupindia.gov.in/
6	https://dipp.gov.in/
7	http://ipindia.nic.in/

Intellectual Property Rights: Tutorials

Sr. No	Detailed Contents	Hrs.
01	Study of a real-world case on Patents	02
02	Study of a real-world case on Copyrights	02
03	Study of a real-world case on Trademarks	02
04	Study of a real-world case on Trade Secrets	02
05	Study of a real-world case on Industrial Design	02
06	Study of a real-world case on Geographical Indication	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		
MCAE342	Green Computing	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 computer peripherals
- Knowledge of data storage devices
- Some awareness towards Environment as a whole

Course Objectives: The course aim to

Sr. No.	Course Objective
01	Explain why Green IT is important to the enterprise over all
02	Create awareness among stakeholders and promote green initiatives in their environments leading to a green movement.
03	Adopt special skills such as knowledge about energy efficiency, ethical IT assets disposal, carbon footprint estimation.
04	Create eco-friendly environment.
05	Conduct basic equipment usage audits
06	Improve energy efficiency of their personal computing environment as well as the enterprise-wide computing environment

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

Sr. No.	Course Outcome	Bloom Level
CO1	Acquire expertise for improving the energy efficiency for laptops and personal computers by reducing the power consumption requirements	Remembering
CO2	Assess enterprise-wide and personal computing and computing energy consumption	Understanding
CO3	Recognize the necessity for long-term sustainability in IT	Understanding
CO4	Formulate plans for reducing IT heating and cooling requirements	Creating
CO5	Evaluate the regulatory and governance issues surrounding IT	Evaluating
CO6	Choose the best sustainable hardware for their applications	Analyzing

Module	Detailed Contents	Hrs.

1	**Trends and Reasons to Go Green:**
	• Overview andIssues
	• ConsumptionIssues
	  o Minimizing PowerUsage
	  o Cooling
	Self-Learning Topics: Current Initiatives andStandards
		05

2	**Introduction to Green IT:**
	• GreenIT
	• Holistic Approach to GreeningIT
	• Greening byIT **(can be used for case study also)**
	  o Using RFID for EnvironmentalSustainability
	  o SmartGrids
	  o Smart Buildings and Homes
	  o Green Supply Chain andLogistics
	  o Enterprise-Wide EnvironmentalSustainability
	Self-Learning Topics: Awareness toImplementation
		06

3	**Green Hardware** • Introduction, • Life Cycle of a Device or Hardware, • Reuse, Recycle and Dispose **Green Software** • Introduction • Energy-Saving SoftwareTechniques **Sustainable Software Development** **Self-Learning Topics:**Changing the way we work	**07**
4	**Green Data Centers** • Data Centre ITInfrastructure • Data Centre Facility Infrastructure: Implications for Energy Efficiency • IT InfrastructureManagement • Green Data Centre Metrics **Green Data Storage** • Introduction • Storage Media PowerCharacteristics • Energy Management Techniques for HardDisks • System-Level EnergyManagement **Green Networks and Communications** • Introduction • Objectives of Green NetworkProtocols • Green Network Protocols andStandards **Self-Learning Topics:**Refer some latest IEEE papers on the relevant topics	**08**
5	**Enterprise GreenIT Strategy:** • Introduction • Approaching Green IT Strategies • Business Drivers of Green IT Strategy • Organizational Considerations in a Green ITStrategy • Steps in Developing a Green ITStrategy • Metrics and Measurements in GreenStrategies	**06**

	Enterprise Green IT Readiness - Background: Readiness and Capability - Development of the G-Readiness Framework - Measuring an Organization's G-Readiness **Self-Learning Topics:**Sustainable IT Roadmap	
6	**Managing Green IT** - Introduction - Strategizing GreenInitiatives - Implementation of GreenIT - InformationAssurance - Communication and SocialMedia **Green Cloud Computing and Environmental Sustainability** - Cloud Computing and Energy Usage Model: - Features of Clouds Enabling Green Computing - Towards Energy Efficiency of Cloud Computing - Green Cloud Architecture **The Future of Green IT** - Green Computing and theFuture - Megatrends for GreenComputing - Tele-presence Instead ofTravel - Tele-commuting Instead ofCommuting - Deep GreenApproach **Self-Learning Topics:**Green IT Regulations and Standards	**08**

Reference Books:

Reference No.	Reference Name
1	Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line,Toby Velte, Anthony Velte, Robert Elsenpeter, 2008, McGraw Hill.
2	Harnessing Green IT,San Murugesan, G. R. Gangadharan, 2013, WILEY.
3	Green Computing-Tools and Techniques for saving energy, money and resources, Bud E. Smith, 2014, CRCPress.
4	GREEN IT FOR SUSTAINABLE BUSINESS PRACTICE, Mark G. O'Neill, An ISEB FoundationGuide.
5	Green Computing and Green IT BestPractices, Jason Harris
6	The Green of IT – How Companies Can Make a Difference for the Environment, John Lamb, IBM Press (2009).
7	Green Project Management, Richard Maltzman and David Shirley, CRC Press a Taylor and Francis Company (2010)
8	Foundations of Green IT, Marty Poniatowski, Prentice Hall, 2009

Web References: http://www.carbonfootprint.com

https://www.energystar.gov/

Tutorials

Sr. No.	Detailed Contents	Hrs.
1	Calculating the Energy Consumption or Carbon Footprint for a given location (eg: your College, Residence, or a specific building) and suggesting means of reducing Energy consumption or Carbon Footprint respectively	02
2	Use of Greening by IT Tools in a live location and submitting a report which indicates Before and After effects	02
3	Calculating the amount of E-waste generated from a given location (eg: your College, Residence, or a specific building) and monitoring the process of proper handling of E-waste.	02
4	Preparing a report on how Green Data Center can be feasibly applied to your Institute. Verifying the report from Industry Expert. Calculating the cost of implementing Green Data Center	02
5	Developing an Green IT Strategy for a given location (eg: your College, Residence, or a specific building) and submitting a report for the same	02
6	Studying which of the latest Green IT techniques (eg:- Remote Maintenance using Tools, E-Learning & E-Training, Web Conferencing & E-Webinar Meetings, E-Signatures, Virtual Filing & Cloud Computing) can be applied to your Institute and submitting report for the same.	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 20marks.
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		
MCAE343	Management 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: knowledge of computer peripheral, knowledge of information and security

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Understand the nature of management information systems and their applications in business.
2	Identify the major management challenges in building and using information systems.
3	Learn and explore IT security and Infrastructure. of management information systems.
4	Understand the ERP and its component.

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

Sr.No.	Outcome	Bloom Level
CO 1	Understand theoretical aspects of Management Information Systems.	Understanding
CO 2	Know the procedures and practices for handling information system effectively.	Understanding
CO 3	Acquire knowledge in various Decision Support Systems.	Remembering
CO 4	Recognize the necessity of IT security and Infrastructure in Management Information Systems.	Applying

Module	Detailed Contents	Hrs
1	**Management Information Systems (MIS):** 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 **Self Learning Topics:** Case Study on digital firm	6

2	**Information System and MIS:** **Organisations and Information Systems:**Modern Organisation, Information Systems in Organisations, Managing Information Systems in Organisations **Concepts of Management Information Systems:** Data and Information, Information as a Resource, Information in Organisational Functions, Types of Information Technology, Types of Information Systems, Decision Making with MIS, Communication in Organizations. **Self Learning Topics:** Case Study: Management Issues- Challenges for Managers	**7**
3	**Decision Support System, Knowledge Management and Management of Global Enterprise:** Decision Support System(DSS), DSS Models, Group Decision Support System(GDSS), Knowledge based Expert System(KBES), Enterprise Resource Planning(ERP) System, ERP Model and Modules, Benefits of ERP, Supply Chain Management(SCM), Information Management in SCM, Customer Relationship Management(CRM) **Self Learning Topics:** Study of EMS and MIS	**8**
4	**Business Intelligence for MIS:** Business Intelligence and MIS, what is Business Intelligence (BI), Tools and Techniques of BI, why is BI Developed? How is BI used? Process of generation of BI, MIS and BI. **Self Learning Topics:** Case illustration of BI	**6**
5	**Managing Information Systems and Information Technology Infrastructure:** **Managing Information System:** Challenges of Managing the IT Function, Vendor Management, IT Governance, **Information Technology Infrastructure and Choices:** What is the IT Infrastructure?, IT Infrastructure Decisions, Infrastructure Components, Networks **Self Learning Topics:** Case Study of Managing Information System	**6**
6	**Information Security:** Introduction, Threats and Vulnerability, Controlling Security Threat and Vulnerability, Managing Security Threat in E-Business, Measures of Information Security, Information Security Management. **Self Learning Topics:** Network Security, and Cyber Security for Information	**7**

Reference Books:

Reference No	**Reference Name**
1	Management Information Systems- A global digital Enterprise perspective, 5th edition - By W.S.Jawdekar, TMG Publications
2	MIS: Managing Information Systems in Business, Government and Society, 2ed by Rahul De, Wiley
3	Management Information System, James O'Brien, 7th edition, TMH
4	Management Information Systems, Loudon and Loudon, 11th edition, Pearson.

Web References:

Reference No	Reference Name
1	https://en.wikipedia.org/wiki/Management_information_system

MIS: Tutorial

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 applications of MIS in various Industries.	
2	Case studies can be chosen in the area like application of MIS in functional area and service sectors i.e. Banking, Insurance, Health Care, Aviation, Food Industry and Education etc.	12
3	Case studies based on various opensource technologies can also be included in discussion to understand the software supports in decision making of MIS.	

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		
MCAE344	Cyber Security and Digital Forensics	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: Course aim to

Sr.No.	Course Objective
1	Understand basics of cyber security
2	Acquire the knowledge of various tools and methods used in cyber crime
3	Learn the fundamentals of digital forensic
4	Apply appropriate skills and knowledge for solving digital forensic problems

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

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate understanding of basic concepts in cyber security	Understanding
CO 2	Make use of various tools and methods used in cybercrime	Applying
CO 3	Adapt fundamental knowledge of digital forensics	Creating
CO 4	Determine skills and knowledge for solving digital forensics Problems	Evaluating

Module	Detailed Contents	Hrs
1	**Module: Introduction to Cyber Security** Cybercrime and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA- 2000, A global Perspective on cybercrimes. **Self learningTopic:**Amendments to the Indian IT Act(2008).	4
2	**Module: Cyber offenses & Cybercrimes** How criminal plan the attacks, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, E-Mail Spoofing, Spamming,data diddling , salami attack, Cyber defamation, Internet Time Theft,SocialEngg, 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. **Self learning Topic:** Security Challenges Posed by Mobile Devices.	7
3	**Module:Tools and Methods Used in Cybercrime** Phishing, Password Cracking, Keyloggers and Spywares, Virus ,worms and trojans, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer	6

	OverFlow, Attacks on Wireless Networks,Identity Theft (ID Theft) **Self learning Topic:** Various types of viruses,Worms and Trojans	
4	**Module: Introduction to Digital Forensics** Introduction to Digital Forensics and its uses. Need of digital Forensics, Digital forensic life cycle, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing and Antiforensics. **Self learning Topic:** Various digital forensic models/ framework	**5**
5	**Module: Data Recovery and Evidence Collection** Data Recovery: Defined, data backup and recovery, role of backup in data recovery, Data recovery solutions, Hiding and recovering Hidden data Evidence Collection and Data Seizure: What is digital evidence, rules of evidence, Characteristics of evidence, Types of evidence, Volatile evidence, General procedure for collecting evidence, Methods of collection and collection steps, Collecting and archiving, Evidence handling procedures, Challenges in evidence handling Duplication and Preservation of Digital Evidence **Self learningTopic:**Symmetric and Asymmetric Encryption	**8**
6	**Module: Network Forensic and Steganography** Network Forensics : Network Fundamentals, Network Types, Network security tools and attacks, Intrusion Detection Systems (types and advantages and disadvantages) Email Investigations – E-Mail protocol, E-Mail as Evidence, Working of E-Mail, Steps in the E- Mail communication, IP Tracking, E-Mail Recovery, Android Forensic-Android forensic- The evolution of Android, The Android model, Android security, The Android file hierarchy, The Android file system, Android Data Extraction Techniques: Manual data extraction,Logical data extraction, Physical data extraction Cyber Forensics Tools: Tool Selection, hardware, Software, Tools (FKT, PKT) Steganography – categories of steganography in Forensics (Text, Image, Audio) **Self learning Topic:** Various forms of Internet Frauds	**10**

Reference Books:

Reference No	Reference Name
1	Nina Godbole, SunitBelapurCyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives –, Wiley India Publications Released: April 2011
2	John Sammons, “The Basics of Digital Forensics”, Elsevier 2012
3	Computer Forensics, Computer Crime Scene Investigation. By John R. Vacca, Charles River Media, INC. 2nd Edition

4	Jain, Dr. dhananjay R. Kalbande,Digital Forensic The Fascinating world of Digital forensic
5	Anthony Reyes,The Best Damn Cybercrime and Digital Forensic Book Period,, Jack Wiles
6	Practical Mobile Forensics: SatishBommisetty,RohitTamma and Heather Mahalik, Pack Publishing LTD 2014, ISBN-978-1-78328-831-1
7	Investigating Network Intrusions and Cybercrime EC-Council | Press
8	Computer Forensic investing Network Intrusions and cyber crime by Course Technology
9	Michael Gregg & David Kim,Inside Network Security Assessment: Guarding Your IT Infrastructure, Pearson Publication
10	Suresh T. Vishwanathan-The Indian Cyber Law ; Bharat Law House New Delhi

Web References:

Reference No	Reference Name
1	Computer Forensic Training Center Online http://www.cftco.com/ Computer Forensics World
2	http://www.computerforensicsworld.com/ Computer Forensic Services
3	http://www.computer-forensic.com/
4	Digital Forensic Magazine http://www.digitalforensicsmagazine.com/
5	The Journal of Digital Forensics, Security and Law http://www.jdfsl.org/
6	Journal of Digital Forensic Practice http://www.tandf.co.uk/15567281
7	https://www.researchgate.net/publication/220846511
8	https://www.researchgate.net/publication/306301164
9	https://www.researchgate.net/publication/308646775_An_introduction_to_steganography_methods

TUTORIAL :

Sr.No	Detailed content	Hrs .
1	Given a list of cases, identify whether the it falls under the category of virus, worms or trojans.	**1**
2	Two real life case study related to data diddling, salami attack and social engineering. Also , explaining what precautions needs to be taken from these attacks.	**1**

3	Any real life cases that were booked under the following sections: 1.Section 65 2. Sections 66A,66B,66C,66D,66E,66F	**1**
4	Various types of viruses, worms and trojans and explain how they work.	**1**
5	SQL injection technique. Make a presentation slide and demonstrate.	**1**
6	Take any 2 cyber crimes, explain in detail as a presentation. Also download its related video to demonstrate it in the class.	**1**
7	Understanding relevance of the OSI 7 Layer Model to Computer Forensics	**1**
8	Screen lock bypassing techniques and different of password cracking methods	**1**
9	Cyber Forensics Tools: Tool Selection, hardware, Software, Tools (FKT, PKT)	**1**
10	Investigate and browse recovered e-mails in 'R-Mail' tool.	**1**
11	Investigation of information of captured packets by using 'Wireshark' tool.	**1**
12	Recovering deleted data from an Android device by using the 'FKT' tool.	**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 each. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of each 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	Teaching Scheme			Credits Assigned		
MCAE345	Entrepreneurship 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: Nil

Course Objectives: The course aim to

Sr. No.	Course Objective
1	Instill a spirit of entrepreneurship among the student participants.
2	Provide an overview of the competences needed to become an entrepreneur.
3	Understand growth and managing strategies of venture and Social Responsibilities
4	Understand how to design effective and efficient Business Plan for intended users.
5	Understand role of Small-Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise
6	Recognize the importance of entrepreneurship and identify the profile of entrepreneurs and their role in economic growth.

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

Sr. No.	Outcome	Bloom Level
CO1	Understand the concepts and fundamentals of Entrepreneurship.	Understanding
CO 2	Understand the growth and development strategies for venture and Social Responsibilities	Understanding
CO 3	Identify the Role of Small-Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise.	Applying
CO 4	Analyse the process of Business Idea generation and converting the idea into a Business Model.	Analyzing
CO 5	Evaluate the effectiveness of different entrepreneurial strategies, policies and measures for promoting small industries.	Evaluating
CO 6	Create presentations and marketing strategies that articulate financial, operational, organizational, market, and sales knowledge for value creation.	Creating

Module No.	Detailed Contents	Hours
1	**Module: Overview of Entrepreneurship: The Entrepreneurial Perspective** Concept and Definitions: Manager, Entrepreneur, Entrepreneurship and Intrapreneurship, Importance and Significance of Growth of Entrepreneurial Activity, Traits, Characteristics, Skills and Qualities of Entrepreneurs, Classification and Types of Entrepreneurs, Emerging trends and issues in Entrepreneurship. **Self-learning topics:** Differences Between Entrepreneurs, Intrapreneurs&Ultrapreneurs	5
2	**Module: Creativity and New Venture Management** **Creative Business Ideas:** Identify and Recognizing Opportunities: Observing Trends and solving problems, Creativity: Concept, Components and types, Sources of New Venture Ideas: Concept, Pre-selection Process, Sources of Business Idea, Preliminary Research, Business Idea Evaluation, Other Analysis. **Writing a Business Plan:** Introduction of Business Plan, Guidelines for writing A Business Plan, Layout of Business Plan **(**Executive summary, Business Description, Industry Analysis, Market Analysis, Management Team and Company Structure, Operations Plan, Product Design and Development Plan, Financial Projections and Critical Risk Assessment, Harvest Strategy, Milestone Scheduling**)**, Presenting the Business Plan to Investors. Why some Business Plans Fail. **Self-learning topics:** Writing business plan for benefiting to an entrepreneur	8
3	**Module: Small Scale Industries Management** Introduction to Small Industry: Introduction, Concept of small industry, Position in India, Role of small industries in economic development. Definition of Small-scale Industries, Undertakings, SSI Policy Statement, Procedure for SSI Registration, The Strengths and Weakness of Small Business. Reasons for the significance of small sector, various forms of small-scale enterprises, Small Industries during various five-year Plans, Policies and measures for promoting small industries. **Self-learning topics:** Growth and Performance of Small-Scale Industries (SSI) in India, Problems for SSI.	7
4	**Module: Entrepreneurship Development and Government** **Role of Central Government and State Government in promoting Entrepreneurship** - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available **Role of following agencies in the Entrepreneurship Development** - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB) **Self-learning topics:** List out all the Central & State Government policies implemented for Entrepreneurship Development.	7

5	**Module: Marketing the Product or Service** Small Business Marketing: Strategy and Research: Concept, Marketing Strategies, Market Research. Product: Heart of Marketing Mix, Purchasing, Selecting Suppliers, Managing and controlling Inventor. Place: Location Types, Layout & Design. Price and Promotion: Economics of Pricing, Breakeven Analysis, Pricing-Setting Techniques, Credit Policies, Promotions. **Self-learning topics:** Role of Digital Marketing for an entrepreneur as promoting their product	**6**
6	**Module: Growth and Development of the Venture & Social Responsibility** Small Business Growth: Growing Firm, Transition to Professional Management, The Next Step: An Exit Strategy, Leadership in Action: Leadership Attributes, Negotiations, Delegation, Motivation Employees, HRM: Job Analysis, Recruitments, Selections, Trainings, Compensations, Introduction of Social Responsibility, Corporate Social Responsibility (CSR), Dimensions of CSR. **Self-learning topics:** Operation management responsibilities in managing Small Business.	**7**

Reference Books:

Reference No	Reference Name
1	Barringer, Ireland, "Entrepreneurship: Successfully Learning New Ventures", Pearson, Latest Edition
2	Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, Sixth Edition, The McGraw Hill Company.
3	Pocket Mentor "Creating A Business Plan", Harvard Business School Press, Boston, Massachusetts
4	David Butler "Enterprise Planning Development- Small Business Start-up Survival and Growth", Butterworth-Heinemann
5	Entrepreneurship and Small Business Management by Dr. C L Bansal, HarAnand Publications Pvt. Ltd. New Delhi, 2012
6	Entrepreneurship by Lall, Madhurima. Sahai, Shikha. Excel Books, New Delhi, 2008, 2nd Edition
7	Strategic Entrepreneurship "A Decision-making approach to new venture creation and management" Philip A. Wickham, Pearson Education Society
8	"Small Business Management" Entrepreneurship and Beyond, 5th Edition, Timoth S. Hatten
9	Vasant Desai, The Dynamics of Entrepreneurial Development and Management, 2015, Himalaya Publishing House.
10	PoornimaCharantimath, Entrepreneurship Development- Small Business Enterprise, Pearson.
11	Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
12	Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi

Web References:

Reference No	Reference Name
1	http://niesbud.nic.in/
2	http://msme.gov.in/
3	http://ssi.nic.in/
4	www.womenentrepreneursindia.com
5	www.msmetraining.gov.in
6	https://www.startupindia.gov.in
7	https://www.makeinindia.com
8	https://mygov.in
9	www.dcmesme.gov.in
10	www.nsic.co.in

EM: Tutorials

Sr. No.	Detailed Contents	Hrs.
1	Entrepreneurial Tasks.	01
2	Entrepreneurship Development in rural areas (Agriculture/Allied Business)	01
3	Women Entrepreneurship Development. (Case Study)	01
4	Team Building Activities (Board of Members/ Employees)	01
5	Entrepreneurship in Service Sector.	01
6	Preparing Business Plan	01
7	Scenarios for fundraising in Entrepreneurship	01
8	E-Business Brainstorming Activities	01
9	Impact of Globalization and Liberalization on SSI.	01
10	Risk Management in Entrepreneurship.	01
11	Social Development through Entrepreneurship.	01
12	CSR Case Study.	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 each. The Class Test is to be conducted when approx. 50 -60% of the syllabus is completed. Duration of each 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
MCAL31	Big Data Analytics and Visualization	02	01	25	30	20	75

Prerequisite: Basic Understanding of SQL, Java Programming and Python

Lab Course Objectives

Sr.No.	Course Objective
1	Understand Various Components of Hadoop for instance Hadoop2.x, HDFS, Map Reduce
2	Understand and gain knowledge of NoSQL DB and Data Modelling Concept
3	Teach Hadoop Ecosystem Projects Hive and Pig and its Programming Modules.
4	Learn Functional programming in spark and execute and create spark applications.
5	Teach Data Visualization and its importance using Tableau

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate HDFS Commands in Hadoop	Understanding
CO 2	Apply Map Reduce Programming Paradigm to solve the algorithmic problems	Applying
CO 3	Build No SQL Database and Query it Using Mongo DB	Applying
CO 4	Analyze the Data Using Hadoop Ecosystem Projects: Hive and Pig	Analyze
CO 5	Explain RDD and Data Frame Creation in Apache Spark	Evaluate
CO 6	Create various Visualizations using Tableau.	Creating

Description:

Module No	Detailed Contents	Hrs.
1	Set up and Configuration Hadoop Using Cloudera Creating a HDFS System with minimum 1 Name Node and 1 Data Nodes HDFS Commands **Self-Learning Topics**: Set up Hadoop in Linux Environment	2
2	Map Reduce Programming Examples Word Count. Union, Intersection and Difference. Matrix Multiplication. **Self-Learning Topics**: Natural Join Programming Example	4

3	Mongo DB: Installation and Creation of database and Collection CRUD Document: Insert, Query, Update and Delete Document. **Self-Learning Topics:** HBASE Commands	**4**
4	Hive: Introduction Creation of Database and Table, Hive Partition, Hive Built in Function and Operators, Hive View and Index. **Self-Learning Topics**: Configure Hive Metastore to MySQL	**4**
5	Pig: Pig Latin Basic Pig Shell, Pig Data Types, Creating a Pig Data Model, Reading and Storing Data, Pig Operations **Self-Learning Topics:**	**4**
6	Spark: RDD, Actions and Transformation on RDD , Ways to Create -file, data in memory, other RDD. Lazy Execution, Persisting RDD **Self-Learning Topics:** Machine Learning Algorithms like K-Means using Spark.	**2**
7	Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Tableau **Self-Learning Topics:** Tableau using web.	**6**

Reference Books:

Reference No	**Reference Name**
1	Tom White, "HADOOP: The definitive Guide" O Reilly 2012, Third Edition, ISBN: 978-1-449-31152-0
2	Chuck Lam, "Hadoop in Action", Dreamtech Press 2016, First Edition ,ISBN:13 9788177228137
3	Shiva Achari," Hadoop Essential " PACKT Publications, ISBN 978-1-78439-668-8
4	RadhaShankarmani and M. Vijayalakshmi ,"Big Data Analytics "Wiley Textbook Series, Second Edition, ISBN 9788126565757
5	Jeffrey Aven,"Apache Spark in 24 Hours" Sam's Publication, First Edition, ISBN: **0672338513**
6	Bill Chambers and Matei**Z**aharia,"Spark: The Definitive Guide: Big Data Processing Made Simple "O'Reilly Media; First edition, ISBN-10: 1491912219;
7	James D. Miller," Big Data Visualization" PACKT Publications. ISBN-10: 1785281941

Web References:

Reference No	**Reference Name**
1	https://hadoop.apache.org/docs/stable/
2	https://hive.apache.org/
3	https://pig.apache.org/
4	https://spark.apache.org/documentation.html
5	https://help.tableau.com/current/pro/desktop/en-us/default.htm

Suggested list of experiments

Practical No	Problem Statement
1	**HDFS:** List of Commands (mkdir, touchz, copy from local/put, copy to local/get, move from local, cp, rmr, du, dus, stat)
2	**Map Reduce:** **1.** Write a program in Map Reduce for WordCount operation. **2.** Write a program in Map Reduce for Union operation. **3.** Write a program in Map Reduce for Intersection operation. **4.** Write a program in Map Reduce for Grouping and Aggregation. **5.** Write a program in Map Reduce for Matrix Multiplication
3	**MongoDB :** 1. Installation 2. Sample Database Creation 3. Query the Sample Database using MongoDB querying commands a. Create Collection b. Insert Document c. Query Document d. Delete Document e. Indexing
4	**Hive:** 1. Hive Data Types 2. Create Database & Table in Hive 3. Hive Partitioning 4. Hive Built-In Operators 5. Hive Built-In Functions 6. Hive Views and Indexes **7.** HiveQL : Select Where, Select OrderBy, Select GroupBy, Select Joins
5	**Pig:** 1. Pig Latin Basic 2. Pig Data Types, 3. Download the data 4. Create your Script 5. Save and Execute the Script 6. Pig Operations : Diagnostic Operators, Grouping and Joining, Combining & Splitting, Filtering, Sorting
6	**Spark**: 1. Downloading Data Set and Processing it Spark 2. Word Count in Apache Spark.
7	**Visualization using Tableau:** Tableau: Tool Overview, Importing Data, Analyzing with Charts, Creating Dashboards, Working with maps, Telling Stories with tableau.

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
MCAL34	Distributed System and Cloud Computing Lab	02	01	25	30	20	75

Pre-requisite: Basic overview of Distributed systems and Cloud Computing.

Lab Course Objectives:

Sr.No.	Course Objective
1	Understand the concepts of Remote Process Communication, Remote Procedure Call and Remote Method Invocation.
2	Understand the concepts of Remote Object Communication.
3	Understand the mutual exculsion concept.
4	Understand the implementation of Cloud Computing Services.
5	Learn implementation of Identity Management using Cloud Computing concept.
6	Learn use of various tools and techniques to develop efficient, dynamic applications.

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Develop Remote Process Communication, Remote Procedure Call and Remote Method Invocation concepts.	Applying
CO 2	Develop Remote Object Communication programs.	Creating
CO 3	Develop mutual exclusion concept using Token ring algorithm.	Creating
CO 4	Implementation of Cloud Computing Services.	Applying
CO 5	Implementation of Identity Management using Cloud Computingconcept.	Applying
CO 6	Design Apps using Cloud Computing for windows Azure / Amazon AWS using Windows Azure Platform Training Kit and Visual Studio and Google App Engine by using Eclipse IDE.	Creating

Description:

Module	Detailed Contents	Hrs.

1	**Module: Remote Process Communication:** 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. **Self Learning Topics:** Other applications based on Remote process communication	**02**
2	**Module: Remote Procedure Call:** A remote procedure call is an inter process communication technique that is used for client-server-based applications. A client has a request message that the RPC translates and sends to the server. This request may be a procedure or a function call to a remote server. When the server receives the request, it sends the required response back to the client. The client is blocked while the server is processing the call and only resumed execution after the server is finished. **Self Learning Topics:** Other types of call semantics	**04**
3	**Module: Remote Method Invocation:** The Remote Method Invocation is an API that provides a mechanism to create distributed application in java. The client invokes methods via an interface. These methods are implemented on the server side. **Self Learning Topics:** Concept of client and server applications, remote interface, RMI registry tools	**04**
4	**Module: Remote Object Communication:** 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. **Self Learning Topics:** Concept of JDBC	**04**
5	**Module: Mutual Exclusion:** Token ring algorithm solves the mutual exclusion existing in the process communication. **Self Learning Topics:** Other algorithms of Mutual Exclusion	**02**
6	**Module: Implementation of Cloud Computing Services:** Cloud Computing provides different services such as SaaS, PaaS, IaaS, Storage as service and many more. Storage as a Service is a business model in which a large company rents space in their storage infrastructure to a smaller company or individual. **Self Learning Topics:** Other types of Cloud Services	**02**
7	**Module: Implementation of Identity Management using Cloud Computing concept:** The main goal of identity management is to ensure that only authenticated users are granted access to the specific applications, systems or IT environments for which they are authorized. **Self Learning Topics:** Other tools to implement the technique	**02**

8	**Module: App Development using Cloud Computing:** Make use of various tools and techniques to develop efficient, dynamic applications. **Self Learning Topics:** Other Technique of application Development and its Complexity	**06**

Reference Books:

Reference No	Reference Name
1	Pradeep K. Sinha, Distributed Operating Systems concepts and design, PHI, ISBN No. 978-81-203-1380-4
2	Herbert Schildt, The Complete Reference JAVA, Tata McGraw-Hill,7th Edition, ISBN No. 978-0-07-163177-8
3	Horstmann, Cornell, Core Java 2 Volume I Fundamentals, Sun Micro System, 7th Edition, ISBN No-13:978-0131482029
4	Horstmann, Cornell, Core Java 2 Volume II Advanced Features, Sun Micro System, 7th Edition, ISBN No-13:978-0131118263
5	Dr. Kumar Saurabh, Cloud Computing insights into new-era infrastructure, Willey ISBN No.10:8126528834
6	RajkumarBuyya, James Broberg, AndrzejGoscinski, Cloud Computing Principles and Paradigms, Willey Publication, ISBN No. 9780470887998
7	GautamShroff, Enterprise Cloud Computing Technology, Architecture, Applications, Cambridge University Press, ISBN No. 978-0-521-13735-5

Web References:

Reference No	Reference Name
1	https://onlinelibrary.wiley.com/
2	https://nptel.ac.in/courses/106106168/
3	https://nptel.ac.in/courses/106/105/106105167/
4	http://www.tutorialspoint.com
5	http://www.javapoint.com
6	https://aws.amazon.com/

Suggested list of experiments

Practical No	Problem Statement
1	To develop a program for multi-client chat server using Socket
2	To implement a Server calculator using RPC concept. (Make use of datagram)
3	To implement a Date Time Server using RPC concept. (Make use of datagram)
4	To retrieve day, time and date function from server to client. This program should display server day, time and date. (Use Concept of JDBC and RMI for accessing multiple data access objects)
5	The client should provide an equation to the server through an interface. The server will solve the expression given by the client.
6	Using MySQL create Library database. Create table Book (Book_id, Book_name, Book_author) and retrieve the Book information from Library database using Remote Object Communication concept.
7	Using MySQL create Elecrtic_Bill database. Create table Bill

	(consumer_name, bill_due_date, bill_amount) and retrieve the Bill information from the Elecrtic_Bill database using Remote Object Communication concept.
8	Implementation of mutual exclusion using Token ring algorithm.
9	Implementation of Storage as a Service using Google Docs
10	Implementation of Identity Management.
11	To develop Application for windows Azure / Amazon AWS using Windows Azure Platform Training Kit and Visual Studio.
12	To develop applications using Google App Engine by using Eclipse IDE

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 05 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
MCALE331	Block chain Lab	02	01	25	30	20	75

Pre-requisite: Basic programming skill in Python/ Java Script/Java.

Lab Course Objectives: The course aim to

Sr. No.	Course Objective
1	Impart a thorough understanding of cryptographic algorithm and hash functions
2	Understand the concepts of Bitcoin and Smart Contract
3	Understand the concepts of Solidity language
4	Understand the deployment of Dapp in Ethereum

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Implement encryption algorithms and hash functions	Applying
CO2	Construct a bitcoin blocks and validating	Applying
CO3	Construct a smart contract in Ethereum	Applying
CO4	Develop and deploy Dapp in Ethereum	Applying

Description:

Module	Detailed Contents	Hrs.
1	**Module: Cryptography:** Symmetric Encryption using Ceaser Cipher, Asymmetric Encryption using RSA, Hash Functions (SHA-256), Merkle Tree (Implementation in Python/Java Script/C++)	**06**
2	**Module:Cryptocurrency:** Concept of Bitcoin, block, blockchain, Immutable ledger**,** Public and Private Blockchain. (Implementation in Python/Java Script/C++)	**06**
3	**Module: Solidity Programming:** Introducing Solidity, Sample Code, Layout of Source File, Structure of a Contract, State Variables, Functions Types, Reference Types, Units, Special Variables and Functions, Expressions and Control Structures, Function Calls, Error Handling, Visibility for Functions and State Variable	**06**
4	**Module: Ethereum:** Ethereum Virtual Machine (EVM): Accounts, Transactions, Gas, Ether, Memory Dapp architecture: Developing a DApp, Compile and Deploy the Smart Contract, Publish the DApp, Connecting to DApp, Ganache Output for Transaction Migration	**06**
5	**Module: Case Study:** Use cases based on Hyper Ledger	**02**

Reference Books:

Reference No.	Reference Name
1	David H. Hoover, Kevin Solorio, and Randall Kanna, Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment, O'Reilly Publications, ISBN-13: 978-1492045267
2	Jimmy Song, Programming Bitcoin: Learn How to Program Bitcoin from Scratch, O'Reilly Publications, ISBN-13: 978-1492031499
3	RiteshModi, Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publications,
4	Chris Dannen, Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners, Apress

Web References:

Reference No	Reference Name
1	https://solidity.readthedocs.io/en/v0.6.7/
2	https://remix-ide.readthedocs.io/en/latest/#
3	https://www.sitepoint.com/solidity-for-beginners-a-guide-to-getting-started/
4	https://www.tutorialspoint.com/solidity/index.htm
5	https://bitcoin.org/en/getting-started
6	https://docs.python.org/3/library/hashlib.html

Suggested list of experiments:

Practical No.	Problem Statement
1	Implementation of Ceaser Cipher (Symmetric Encryption)
2	Implementation of RSA Algorithm (Asymmetric Encryption)
3	Implementation of SHA-256
4	Implementation of Binary Tree
5	Implement the creation of Bitcoin Block (Genesis Block)
6	Implement the creation of a Blockchain (Adding the blocks to the chain and validating)
7	Implement the creation of a public/private Blockchain
8	Implementation of an immutable Ledger
9	Simple Experiments using Solidity Program Constructs (if-then, while etc...)
10	Creation of smart contract in Ethereum
11	Creation of Dapp in Ethereum
12	Mini Project

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
MCALE332	Deep Learning Lab	02	01	25	30	20	75

Prerequisite: Basic understanding of machine learning concepts. **Lab Course Objectives**

Sr.No.	Course Objective
1	To understand dataset and pre-processing to build neural network models.
2	To apply appropriate learning rules for each of the architectures and build several neural network models.
3	To learn different regularization and optimization techniques used in deep learning
4	To identify the problems, choose relevant deep learning algorithms and analyze the results for respective applications.

`Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate Tensor flow/Keras deep-learning workstations.	Understanding
CO2	Choose appropriate data preprocessing techniques to build neural network models.	Applying
CO 3	Analyze different regularization and optimization techniques used in deep learning.	Analyzing
CO 4	Build neural network models using deep learning algorithms-CNN and RNN to solve real world problems.	Creating

Description:

Module No	Detailed Contents	Hrs
I	**Introduction to Tensor flow/Keras**-Installation, Importing Libraries and Modules. **Self Learning Topic:-**Setting up a deep-learning workstation.	2
II	**Working with Dataset**-Loading the dataset, Splitting dataset into training and testing data sets. **Self Learning Topic:-**Data representations for neural networks	2
III	**Data Preprocessing Techniques**- Numerical Data, Feature Scaling, Handling Missing Values, Categorical Data and String Data Types, Encoding, Data Splitting. **Self Learning Topic: -** Outliers detection.	2
IV	**Artificial Neural Networks-** McCulloch-Pitts neuron, single layer perceptron network, multi-layer perceptron network, Back propagation network. **Self Learning Topic:-** Adaline Network	6
V	**Regularization Techniques-** Dataset Augmentation, Early Stopping, Dropout. **Self Learning Topic:-** Optimization techniques(any one)	2

VI	**Deep Neural Network Algorithm: Convolutional Neural Network(CNN)-** Introduction to convnets, Adding a classifier, Training the convnet on given data set, The convolution operation, The max-pooling operation, Evaluating the model, analysing and visualizing results. **Self Learning Topic: -** Pre-trained Convnet.	**6**
VII	**Deep Neural Network Algorithm-Recurrent Neural Network (RNN) -** Training the model with RNN layers, Evaluating the model, analyzing and visualizing results. **Self Learning Topic: -** Pre-trained RNN.	**6**

Reference Books:

Reference No	Reference Name
1	François Chollet, Deep Learning with Python, 2018 by Manning Publications Co. ISBN 9781617294433.
2	Deep Learning Tutorial Release 0.1, LISA lab, University of Montreal
3	Sebastian Raschka, Vahid Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python,3rd Edititon, Packet Publishing.

Web References:

Reference No	**Reference Name**
1	https://www.kaggle.com/learn/deep-learning
2	https://github.com/topics/deep-learning-tutorial
3	https://towardsdatascience.com/building-our-first-neural-network-in-keras-bdc8abbc17f5
4	https://machinelearningmastery.com/tutorial-first-neural-network-python-keras/
5	https://subscription.packtpub.com/book/big_data_and_business_intelligence/9781786464453/3
6	https://data-flair.training/blogs/learning-rules-in-neural-network/

Suggested list of experiments

Practical No.	**Problem Statement**
1	Introduction to Tensor flow /Keras -Importing Libraries and Modules.
2	Loading the dataset, Splitting dataset into training and testing data sets.
3	Implementation of Data preprocessing techniques.
4	Implementation of Artificial Neural Networks -McCulloch-Pitts neuron with ANDNOT function, single layer perceptron network, multi-layer perceptron network for an AND function, Back propagation Network for XOR function with Binary Input and Output.
5	Implementation of Regularization Techniques.
6	Implementation and analysis of Deep Neural network algorithm: Convolutional neural network (CNN) - Object identification and classification, image recognition.
7	Implementation and analysis of Deep Neural network algorithm: Recurrent neural network (RNN) - Character recognition and web traffic Image classification.

Assessment:

Term Work: Will be based on Continuous Assessment

1. Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
   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
MCALE333	Game Development Lab	02	01	25	30	20	75

Pre-requisite: Understanding of Object Oriented Programming concepts and C#

Lab Course Objectives: Course aim to

Sr.No.	Course Objective
1	Learn Unity framework for Game Development
2	Implement object oriented programming concepts in Game Development
3	Demonstrate use of Game development components
4	Use gaming assets for designing 3D games

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Build Games using Object Oriented Programming Concepts	Applying
CO 2	Simplify Game Development Process using Unity Framework	Analyzing
CO 3	Develop state of art 2D games	Applying
CO 4	Plan creation of 3D games and Test them	Creating

Description:

Unit No	Detailed Contents	Hrs
1	**Module: Unity UI Basics** The Layout, Game Window, Toolbar, Selecting and Focusing, Snaps, 3d Objects **Self Learning Topics:** Exploring the Editor	04
2	**Module: Game Development Components** Game Objects,Models,Materials and Textures,Trrain,Environments,Lights and Cameras, Sound Effects	04

	Self Learning Topics: IDE components	
3	**Module: Unity C# Scripting** C# variables in Unity 3D ,C# numbers in Unity 3D,C# conditionals in Unity 3D,C# arrays & loops in Unity 3D ,C# functions & methods in Unity 3D, Object oriented programming & inheritance in C# for Unity **Self Learning Topics**: Software Development life cycle	**06**
4	**Module: Managing State and Transitions** Object Metadata, Processing the Auxiliary Objects, Handling Object Visibility, Handling Special Cases **Self Learning Topics**: State Machine	**04**
5	**Module: Physics and Special Effects** Games implementing the concepts of -Adding New Assets, Combining Physics and Keyframe Animation, Particle Systems, Other Special Effects,Collisions,Prefabs and animations, Unity Physics Joints, Unity 2D Effectors **Self Learning Topics:** Designing virtual world	**04**
6	**Module: Unity 3D Game** 3D Game Assets for your games in Unity, Unity 3D interface overview, Project creation & importing assets into Unity, Working with lighting & materials in Unity 3D,Altering shaders in Unity 3D,Switching build platforms in Unity 3D,Moving objects in Unity 3D,Coroutines & wait times in Unity 3D,Inheritance & reusability in Unity 3D ,Working with audio in Unity 3D **Self Learning Topics:** Extending your Unity 3D Game	**04**

Reference Books:

Reference No	Reference Name
1	Blackman, Sue. Beginning 3D Game Development with Unity 4: All-in-one, multi-platform game development. Apress, 2013. ISBN: 1430248998
2	Goldstone, Will. Unity game development essentials. Packt Publishing Ltd, 2009. ISBN: 184719818x
3	Murray, Jeff W. C# game programming cookbook for Unity 3D. CRC Press, 2014.
4	Paris Buttfield-addison , Jon Manning , Tim Nugent,Unity Game Development Cookbook: Essentials For Every Game, O'reilly Media, ISBN: 1491999152
5	Geig, Mike. Sams Teach Yourself Unity Game Development in 24 Hours. Pearson Education, 2014. ISBN-13: 978-0-672-33696-6
6	Norton, Terry. Learning C# by developing games with unity 3D. Packt Publishing Ltd, 2013. ISBN: 1849696586
7	Saunders, Kevin, and Jeannie Novak. Game development essentials: Game interface design. Cengage Learning, 2012. ISBN-13: 978-1-305-11054-0

Web References:

Reference No	Reference Name
1	www.unity.com
2	https://en.wikipedia.org/wiki/Video_game_development
3	https://www.gamedesigning.org/video-game-development/
4	https://github.com/Kavex/GameDev-Resources

Suggested list of experiments

Practical No	Problem Statement
1	Design of Amazing Racer Game
2	Design of Chaos Ball Game
3	Design of Captain Blaster Game
4	Design of zombie rush game
5	Design of Mini Golf
6	Design of PinBall Game
7	Design of DodgeBall Game
8	Design of Defender Game
9	Design of Gauntlet Runner game

***All experiments should be performed considering above list of games (any four)**

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
MCALE334	Ethical Hacking Lab	02	01	25	30	20	75

Pre-requisite: Basic understanding of fundamentals of any programming language

Lab Course Objectives: The Course aim to

Sr. No.	Course Objective
1	Study and understand how to gather and review information related using different foot printing techniques.
2	Study and understand network scanning, sniffing, and enumeration techniques, gather information using the different tools available and prevent hacking attacks.
3	Study different malware attacks, web servers, web applications and wireless network hacking, sql injection techniques, session hijacking and cryptography and use the tools to practically understand how the attacks take place.
4	Practically find and exploit vulnerabilities in a computer system using pen testing.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO1	Applying foot printing tools for information gathering issue.	Applying
CO 2	Applying tools for scanning networks, enumeration and sniffing.	Applying
CO 3	Applying tools for malware attacks, webserver and web applications, sql injection, session hijacking, wireless networking, cloud computing, cryptography.	Applying
CO 4	Developing malwares and attack tools	Creating
CO 5	Designing pen testing report.	Creating

Description:

Module No	Detailed Contents	Hrs
1	**Footprinting and Reconnaissance:** Performing footprinting using Google Hacking, website information, information about an archived website, to extract contents of a website, to trace any received email, to fetch DNS information.	02
2	**Scanning networks, Enumeration and sniffing:**	02

	Use port scanning. network scanning tools, IDS tool, sniffing tool and generate reports.	
3	**Malware Threats: Worms, viruses, Trojans**: Use Password cracking, Dictionary attack., Encrypt and decrypt passwords, DoS attack, ARP poisoning in windows, Ifconfig, ping, netstat, traceroute, Steganography tools. **Self-Learning Topics:** using additional hacking tools.	**06**
4	**Developing and implementing malwares :** Creating a simple keylogger in python, creating a virus, creating a trojan. **Self-Learning Topics:** Additional implementation of hacking tools.	**06**
5	**Hacking web servers, web applications:** Hacking a website by Remote File Inclusion, Disguise as Google Bot to view hidden content of a website, to use Kaspersky for Lifetime without Patch	**02**
6	**sql injection and Session hijacking** : SQL injection for website hacking, session hijacking. **Self Learning Topics:** using additional of hacking tools.	**02**
7	**Wireless network hacking, cloud computing security, cryptography :** Using Cryptool to encrypt and decrypt password, implement encryption and decryption using Ceaser Cipher. **Self-Learning Topics:** implementing additional encryption algorithms.	**04**
8	**Pen testing** : Penetration Testing using Metasploit and metasploitable,	**02**

Reference Books:

Reference No	Reference Name
1	Matt Walker, All-In-One-CEH-Certified-Ethical-Hacker-Exam-Guide.
2	Manthan Desai, Basics of ethical hacking for beginners
3	SunitBelapure& Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.
4	Alana Maurushat, Ethical hacking
5	TutorialsPoint professionals, Ethical Hacking.

Web References:

Reference No	**Reference Name**
1	https://www.tutorialspoint.com/ethical_hacking/ethical_hacking_arp_poisoning.htm
2	https://technicalustad.com/steganography-tools/
3	https://resources.infosecinstitute.com/dos-attacks-free-dos-attacking-tools/#gref
4	https://www.greycampus.com/opencampus/ethical-hacking/enumeration-and-its-types
5	https://www.youtube.com/watch?v=LUGkIvcQmGE
6	https://www.youtube.com/watch?v=zWg7U0OEAoE

Suggested list of experiments

Practical No	Problem Statement
1	Use software tools/commands to perform footprinting /information gathering and generate analysis report.
2	Use software tools/commands to perform network scanning and sniffing and generate analysis report.
3	Use software tools/commands to perform malware attacks and other cyber attacks and generate analysis report.
4	Implementation of keyloggers, viruses and trojans.
5	Use of software tools/commands for web servers and web applications hacking and generate analysis report.
6	Use of software tools/commands for performing sql injection and session hijacking and generate analysis report.
7	Use of software tools/commands to encrypt and decrypt password, implement encryption and decryption using Ceaser Cipher.
8	Using Metasploit and metasploitable for penetration testing.

Assessment:

Term Work: Will be based on Continuous Assessment

Laboratory work will be based on the syllabus with minimum 10 experiments.

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	Practical	Oral	Total
MCALE335	Quantum Computing Lab	2	1	25	30	20	75

Pre-requisite: Basic understanding of fundamentals of JavaScript

Lab Course Objectives : The Course aim to

Sr. No.	Course Objective
1	Learn the basics of Quantum Logic gates
2	Demonstrate the use of quantum arithmetic
3	Implement the model of quantum computation
4	Use QC-Engine to implement basic quantum algorithms.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome	Bloom Level
CO 1	Understand the various Quantum Logic gates	Understanding
CO 2	Design QC programs using quantum arithmetic	Applying
CO 3	Develop QC applications based on the quantum computing model	Applying
CO 4	Compare basic quantum computing algorithms	Evaluating

Description:

Module No	Detailed Contents	Hrs
1	**QC Engine** : Introduction to the QC Engine, Installation, Writing QC Engine Code *Self-Learning Topics: Practice QC Engine Code*	2 hrs
2	**One Qubit** : QPU Instructions: NOT, HAD, READ, WRITE, ROOT-of-NOT; Random bit, Combining QPU Operations *Self-Learning Topics: Quantum Spy Hunter*	6 hrs
3	**Multiple Qubits** : Reading a Qubit in a Multi-Qubit Register, Visualizing Larger Number of Qubits, QPU Instruction: CNOT, CPHASE, SWAP, CSWAP *Self-Learning Topics: Conditional Operation*	6 hrs
4	**Quantum Teleportation** : Create an entangled pair, Prepare the payload, Link payload and entangled pair, Put the payload into superposition, READ both Qubits, Receive and Transform, Verify the result *Self-Learning Topics: How is teleportation actually used?*	4 hrs
5	**Quantum Arithmetic & Logic** : QPU Arithmetic: How to build Increment & Decrement operators, Adding Two Quantum Integers; More Complicated Math: Quantum Conditional Execution. *Self-Learning Topics: Logical Operators*	6 hrs
6	**Quantum Application – Real Data** : Represent complicated data types in a QPU register, Encode non-integer numerical data in a QPU register, QRAM *Self-Learning Topics: Vector Encodings*	2 hrs

Reference Books:

Reference No	Reference Name
1	Kaye P, Laflamme R, Mosca M. An introduction to quantum computing. Oxford university press; 2007. ISBN No. 0198570007
2	Johnson, Eric R., NicHarrigan, and Mercedes Gimeno-Segovia. Programming Quantum Computers: Essential Algorithms and Code Samples. O'Reilly; 2019. ISBN No. 1492039683
3	Nielsen MA, Chuang I. Quantum computation and quantum information. Cambridge University Press; 2012. ISBN No. 9780511976667
4	Silva V. Practical Quantum Computing for Developers. Apress; 2018. ISBN No. 9781484242179
5	Rieffel EG, Polak WH. Quantum computing: A gentle introduction. MIT Press; 2011. ISBN No. 9780262526678
6	Aaronson S. Quantum computing since Democritus. Cambridge University Press; 2013. ISBN No. 9780521199568

Web References:

Reference No	Reference Name
1	https://cra.org/ccc/wp-content/uploads/sites/2/2018/11/Next-Steps-in-Quantum-Computing.pdf
2	https://www.ibm.com/quantum-computing/
3	https://eandt.theiet.org/content/articles/2019/04/quantum-for-dummies-the-basics-explained/
4	https://www.cl.cam.ac.uk/teaching/1718/QuantComp/
5	https://nptel.ac.in/courses/104104082/

Suggested list of experiments

Practical No	Problem Statement
1	Programming with One Qubit: Random bit, Random byte
2	Programming with One Qubit: Root-of-not, Quantum Spy Hunter
3	Programming with Multiple Qubits: Separable qubits, Entangled qubits
4	Programming with Multiple Qubits: Phase Kickback, Swap Test
5	Basic Teleportation
6	Quantum Arithmetic and Logic Programming: Increment & Decrement, Adding Two Quantum Integers
7	Quantum Arithmetic and Logic Programming: Add Squared, Quantum Conditional Execution.
8	Quantum Applications: Programs on QRAM

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
MCAL34	Mobile Computing Lab	04	02	50	30	20	100

Pre-requisite: Basic understanding on java programming and xml

Lab Course Objectives: Course aim to

Sr.No	Course Objective
1	Understand the Application development skills of Android and its Components.
2	Learn various Android application with different layouts and rich user interactive interfaces.
3	Develop Android application related to server-less database like SQLITE
4	Impart a thorough understanding of Dart and Flutter Programming

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate their understanding of the fundamental details of android and its components	Understanding
CO 2	Implement various android applications using different layouts & rich user interactive interfaces	Applying
CO 3	Demonstrate their skills of using SQLite database for android application database	Applying
CO 4	Demonstrate their ability to develop programs with dart programming and flutter	Applying

Description:

Module No.	Detailed Contents	Hours
1	**Module:** Introduction to Android and it's components Creating an android application Creating the activity, Design user interface with Views, Working with intents, fragments, services and different types of layouts components. Displaying picture and menus using views. **Self-Learning Topics:** The android platform, the layers of android, Four kinds of android components, understanding the androidManifest.xml file	06
2	**Module:** Basic Controls and UI Components Text view, Radio button, Checkbox, Image Button, Edit Text, Slider and other controls **Self-Learning Topics:** Methods of all control clas	04
3	**Module:** Data base Connectivity Persistence data using the file system (external, internal, SD card), working with shared preferences, Working with content providers, CRUD operation using SQLite	08

	database connection. **Self-Learning Topics:** Interface of Database	
4	**Module:** Graphics and animation, Multimedia Drawing graphics in android, creating animations with androids graphics API, Playing audio & video. **Self-Learning Topics:** Capturing media and photos, SMS and E-Mail messaging	**06**
5	**Module:** Location Based Services Display Maps, Getting location data, Monitoring a Location, Building location tracker. **Self-Learning Topics:** Difference between geocoding and reverse geocoding	**04**
6	**Module:** REST API integration Consuming Web services using HTTP (htttpurlconnection), Consuming using JSON services usingasynctask to perform network operations, Socket Programming, working with okhttp, Retrofit and Volley, publishing Android application on Google play store. **Self-Learning Topics:**Classes used for dealing with JSON messages and for performing background asynchronous tasks.	**08**
7	**Module:** Introduction to Dart and Flutter Introduction to structure of Dart Language, oops concept and classes & packages in Dart Programming, Introduction to Flutter, Flutter User Interface using widgets, Types of Widgets, Flutter List , Navigation, Effects, Building Layout. **Self-Learning Topics:** Deployment of android application on the play store	**08**
8	**Module:** Data Handling Understanding JSON Format, Using Database classes to write, read and serialize JSON, Flutter Form, Styling and Managing Widgets. **Self-Learning Topics:** Database connective details	**06**
9	**Module:** Case Study on IOS app Development Introduction swift programming concept, objective c. **Self-Learning Topics:** Some Idea of IOS	**02**

Reference Books:

Reference No	Reference Name
1	Wei-Meng Lee ,BEGINNING Android™ 4 Application Development , John Wiley & Sons Crosspoint Boulevard Indianapolis ,ISBN: 978-1-118-24067-0
2	Reto Meier, Professional Android™ Application Development ,Wiley Publishing, ISBN: 978-0-470-56552-0,www.wiley.com
3	ZigurdMednieks, Laird Dornin, G. Blake Meike, and Masumi Nakamura, Programming Android , Gravenstein Highway North, Sebastopol, CA 95472.ISBN=9781449316648
4	W. Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, Dreamtech Press Android in action, Third Edition, ISBN 9781617290503
5	Alessandro Biessek Flutter for Beginners: An Introductory Guide to Building Cross-platform Mobile Applications with Flutter and Dart 2 Packt Publishing Ltd. ISBN. 9781788990523

6	Marco L. Napoli Beginning Flutter: A Hands On Guide to App Development John Wiley &Sons,ISBN:- 1119550823, 9781119550822
7	Rap Payne Beginning App Development with Flutter: Create Cross-Platform Mobile Apps Apress, ISBN 978-1-4842-5181-2

Web References:

Reference No	Reference Name
1	https://android.google.com
2	https://codelabs.developers.google.com/codelabs/first-flutter-app-pt1/#0
3	https://flutter.dev/docs/reference/tutorials https://flutter.dev/docs/get-started/learn-more
4	https://opensourceforu.com/?s=Flutter
5	https://developer.apple.com/library/archive/referencelibrary/GettingStarted/DeveloiOSAppsSwift/
6	https://developer.apple.com/ios/
7	https://www.apple.com/in/ios/ios-13/

Suggested list of experiments

Practical No	Problem Statement
1	Android program using various UI components
2	Android program using different layouts and views
3	Android program based on Intents
4	Android program for notifications and alert box
5	Android program to perform CRUD operation using SQLite DB
6	Android program using Shared Preferences, Internal and External Storage
7	Android program to work with graphics and animation
8	Android program to work with google maps and locations
9	Android program to work with images and videos
10	Android program based on RestAPI
11	Flutter program using layout widgets and state management
12	Flutter program to work with SQLite Database
13	Flutter program based on RestAPI

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	Practical	Oral	Total
MCAL35	**Software Testing & Quality Assurance Lab**	**02**	**01**	**25**	**30**	**20**	**75**

Pre-requisite: Core Java, Web Technologies like HTML, CSS, XML, XPATH, DOM and JavaScript.

Lab Course Objectives: The Course aim to

Sr.No.	Course Objective
1	Understand the basic concepts in Software Testing.
2	Understand the essential characteristics, requirements and usage of Automation tool like Selenium Web Driver.
3	Understand Test Ng and automation framework basics.
4	Understand the basic concepts of software quality assurance.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome	Bloom Level
CO1	Apply manual software testing techniques to test a software application	Applying
CO 2	Implement Selenium tool to perform automation testing.	Applying
CO 3	Implement TestNg frameworks to test the application.	Applying
CO 4	Demonstrate validation checks and regression testing on the application.	Applying

Description:

Module	Detailed Contents	Hrs
1	**Testing Basics** : Study of Review, Construction of Control Flow Graph & Writing Test Cases with case studies. Unit Testing, Integration Testing & System Testing.	**4**

	Self Learning Topics: Requirement analysis and derive test scenarios Review of Project Document, Case Study.	
2	**Introduction to Selenium :** Introduction to automation Testing, Selenium latest version, Installation, Selenium WebDriver First Script. **Self Learning Topics:** Record and run a test case in Selenium IDE	**2**
3	**Selenium Web Driver Commands :** Implementing Web Drivers on Multiple Browser (chrome, Firefox),handling multiple frames Browser command, navigation Commands and find element command with Example. Locator (id, css selector, Xpath), synchronization in selenium, Handling Alerts using selenium web driver, types of alerts. Action Classes in selenium , Handling Drop Down, List Boxes, Command Button, radio buttons & text boxes. Waits command in selenium. **Self Learning Topics:** Implementation of web driver on safari	**8**
4	**TestNg Framework** : What is testNg? Installing Testng, TestNg Test, writing test cases using testNg, testNg annotation, Testing .xml **Self Learning Topics:** Parameters and dependencies from xml	**6**
5	**Automation Framework Basics** : Introduction to basic types, linear scripting, library architecture framework, data driven Framework. **Self Learning Topics:** Keyword Driven Framework	**4**
6	**Quality Assurance** : Introduction to software quality assurance, Validation checks and Regression Testing **Self Learning Topics:** Audits, ISO, QMSCase study	**2**

Reference Books:

Reference No	Reference Name
1	Software Testing Foundations, 4th Edition: A Study Guide for the Certified Tester Exam (Rocky Nook Computing) Fourth Edition,Andreas Spillner, Tilo Linz and Hans Schaefer.
2	Selenium WebDriver, Pearson, Rajeev Gupta, ISBN 9789332526297.
3	Selenium WebDriver Practical Guide - Automated Testing for Web Applications Kindle Edition ,SatyaAvasarala ,ISBN-13: 978-1782168850
4	Testng Beginner's Guide, Packt Publishing Ltd.VarunMenon, ISBN 1782166017, 9781782166016

Web References:

Reference No	Reference Name
1	https://www.toolsqa.com/selenium-tutorial/
2	https://www.guru99.com/selenium-tutorial.html
3	https://www.techlistic.com/p/selenium-tutorials.html

Suggested list of experiments

Practical No	Problem Statement
1	Take a review and write test cases for any known application.
2	Implement Web Drivers on Chrome & Firefox Browsers.
3	Demonstrate handling multiple frames in selenium
4	Implement Browser command and navigation Commands.
5	Implement the find element command
6	Demonstrate the Locator(id,css selector, path)
7	Demonstrate synchronization in selenium
8	Demonstrate different types of alerts
9	Demonstrate : Handling Drop Down, List Boxes
10	Demonstrate Command Button, Radio buttons & text boxes. Waits command in selenium
11	Demonstrate action classes in Selenium
12	Installation of TestNg , running testNg and TestNg annotations
13	Demonstrate data driven Framework.
14	Demonstrate Validation testing
15	Perform regression testing

Note: At least 12-14 programs

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	Pract.	Oral	Total
MCAP31	Mini Project – 2 A	02	01	50	-	--	50

Pre-requisite:

Lab Course Objectives: The course is aim to

Sr. No.	Course Objective
1	Acquaint with the process of identifying the needs and converting it into the problem.
2	Adapt to a rapidly changing environment by having learned and applied new skills, new technologies and provide solutions to the problems in various application domains.
3	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
4	Inculcate the process of innovation, self-learning and research.

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	Identify problems based on environmental, societal & research needs.	Applying
CO3	Apply Knowledge and skills to analyze and interpret data by applying appropriate research methods to solve societal problems in a group.	Applying
CO4	Design and evaluate solutions for complex problems.	Creating
CO5	Build small groups to work effectively in team on medium scale computing projects.	Creating
CO6	Create value addition for the betterment of the individual and society	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 IV

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:

- The Online Course- 1 (MOOC) has to be completed before the completion of the MCA course (it can be done in the Semester 1 to 4 but to be accounted in semester 4).
- Maximum one workload for faculty members for Research paper to be considered.
- Maximum two workload for faculty members for Internship projects to be considered.

Course Code	Course Name	Group	Contact Hours	Credits Assigned	
				Presentation	Total
			40	15	15

MCAI41	Internship	P	Examination Scheme			
			Internal Assessment		University Assessment	Total
			Presentation I	Presentation II	End Sem. Final Presentation	
			25	25	200	250

Pre-requisite: Software Project Management, Database Management, Software Development Technologies/Programming Languages, Software tools.

Course Objectives: The course aim to

Sr. No.	Course Objective
01	Prepare students to excel in computer applications to succeed in industry/ technical professions.
02	Train students with good computing breadth so as to comprehend, analyze, design and create computing solutions for the real life problems.
03	Learn professional skills and international relationships in a professional environment.
04	Design a system, component or process as per needs and specification of the clients.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate skills to use modern tools, software and equipment to analyze problems.	Understanding
CO2	Develop an exposure to real life organizational and environmental situations.	Analyzing
CO3	Apply SDLC phases in developing software projects and in writing the project document.	Applying
CO4	Create computing solutions for the real life problems as per the requirements of the domain.	Creating
CO5	Adapt professional and interpersonal ethics.	Creating

Assessment:

Internal Assessment Test: 50 marks

Internal Assessment consists of two presentations of 25 marks each.
The final marks should be the sum of the two presentations.

Rubrics have to be followed during project evaluation.

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td rowspan="2">Assessment (University/ Institute)</td><td>Teaching Scheme (Contact Hours)</td><td colspan="2">Credits Assigned</td></tr>
<tr><td>Presentation</td><td>Presentation</td><td>Total</td></tr>
<tr><td rowspan="4">MCAR42</td><td rowspan="4">Research Paper</td><td rowspan="4">Institute</td><td>01</td><td>01</td><td>01</td></tr>
<tr><td colspan="3">Examination Scheme</td></tr>
<tr><td colspan="2">Internal Assessment</td><td rowspan="2">Total</td></tr>
<tr><td>Mid term Presentation I</td><td>Mid term Presentation II</td></tr>
<tr><td></td><td></td><td></td><td>25</td><td>25</td><td>50</td></tr>
</table>

Pre-requisite: Nil

Course Objectives: The course is aimed to

Sr. No.	Course Objective
01	Understand analytic approach towards choosing a research paper and acquiring research skills.
02	Access relevant data and present new ideas related to area of research.
03	Adhere to ethical standard of research.
04	Understand what constitutes plagiarism and how to use proper citation styles.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Show data coherently, effectively and counter-hypothesis.	Understanding
CO2	Apply experience in preparation of research material for publication or presentation.	Applying
CO3	Identify relevant previous work that supports their research.	Applying
CO4	Analyze data and synthesize research findings.	Analyzing
CO5	Create research paper.	Creating

Following are the guidelines for Research Paper, MCA Sem.- IV:

- A Student shall do a in depth study in the specialized area by doing a survey of published technical literature and write a research paper in IEEE format (6-9 pages or 2000 to 3000 words) during second year (final year) of MCA program.

- The research topic must be approved from the Institute. The institute should set up a committee/Supervisor/Research Guide to scrutinize the topics and finalize the same
- The research paper may be written in a group of maximum 2 students under the guidance of Supervisor/Research Guide.
- The research paper must be published/presented in national/international conference or national/ international journal.

The paper structure should follow the IEEE format:
The following points are to be included in the Research Paper presentation:

1. Introduction
2. Literature Review
3. Problem Definition
4. Objective/Scope
5. Research Methodology
6. Analysis & Findings
7. Limitations & Future Scope
8. Conclusion

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.
3. Kothari C. R. (2004), "Research Methodology, Methods and techniques" (2^{nd} edition), New Delhi: New age International (p) Ltd.

Web References:

1. https://www.ieee.org/publications_standards/publications/authors/author_guide_interactive.pdf
2. http://www.fcsresearch.org/index.php?option=com_content&view=article&id=83&Itemid=166
3. https://www.ece.ucsb.edu/~parhami/rsrch_paper_gdlns.htm
4. http://nob.cs.ucdavis.edu/classes/ecs015-2007-02/paper/citations.html

Assessment:

Internal Assessment: 50 marks

Internal Assessment consists of two presentations of 25 marks each.

The marks distribution of two presentations is as given below:

Presentation I (Mid Term)	**Marks**	**Presentation II (Mid Term)**	**Marks**
Abstract, Introduction	05	Research Methodology	05
Literature Review	05	Analysis, Findings & Conclusion	10
Objectives/Scope	10	Publication	05
Presentation	05	Presentation	05
Total	**25**	**Total**	**25**

These two presentations should be taken at Institute level by Committee/Supervisor/Research Guide.

Rubrics have to be followed during research paper evaluation.

Course Code	Course Name	Teaching Scheme		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
MCAM43	Online Course- MOOC	4#	--	4	--	4!

Online Course- MOOC:

1. **Credits (4):**
    a. MOOC may be taken in any of semesters 1-4 but accounted for in semester 4 only.
2. **What may be credited as MOOC:**
    a. MOOC credits: Swayam, NPTEL, Smart Indian Hackathon, e-Yantra Competitions/MOOC
    b. Evaluation options:
        i. Grade (A-F) given by MOOC provider
        ii. Competition grade + college evaluation (if training FDP available)
    c. Evaluation basis:
        i. Smart India Hackathon - Only finalists get a grade based on evaluation by a college pane.
        ii. Swayam: as per Swayam evaluation guidelines
        Note: All Swayam courses are not 4 credits. For credits less than 4, e-Yantra mini competition can be combined with those courses to fulfill required credits.
        iii. e-Yantra: as per e-Yantra competition (optional/"opt-in") grade
    d. Other options may be added basis our experience with these options

For information:

e-Yantra offers MOOCs that can make a grade available upon request - this is an additional certificate over and above the usual "Merit," "Completion" and "Participation" certificates e-Yantra gives. Similarly the competition may be seen as a MOOC + project with a grade certificate as an extra.

- **Software Foundation Lab (MOOC 1 & 2)**
    - Equips students with skills to be a strong developer and researcher.
    - Includes Linux skills, Shell scripting, Latex, Python (extensive), AWK, Lex, SED (Stream editors), etc.
    - Mode: Hands-on assignments auto-evaluated by Gradefast - a system developed at IITB. Scalable and tested extensively and at scale in the e-Yantra competition.
    - MCQs for self-assessment after each module.
    - Optional mini-project at end.
    - e-Yantra can give grade for course
    - Basis merit and overall performance, student eligible for e-Yantra Internship Program.
- **Embedded Systems and Robotics Course**
    - Teaches principles of microcontrollers as an 8 week hands-on crash course.
    - Optional simulators give the same feel with skills directly translatable into real hardware.
- **Others:**
    - Image Processing and Computer Vision (IPCV), Internet of Things (IoT), Machine learning and Neural Network, 3D modeling & design using Blender, V-REP (simulator), Robotic Operating System (ROS), Control System design, etc.
    - These have successfully been deployed in training for e-Yantra Robotics Competition (eYRC) themes.

- Strong hands-on component in each case with the project.

Course Code	Course Name	Contact Hours	Credits Assigned
MCAS44	Institute Social Responsibility (ISR)	30 hours in the span of two years	02

Course Objective: The course is aimed to inculcate social awareness, values and environmentally responsible behavior among students.

Course Outcome: Learner/student will be able to create awareness among individuals towards institutional & individual social responsibility for societal development.

About Institute Social Responsibility (ISR) :

Institute Social Responsibility (ISR) refers to the continuous commitment by institutions to conduct them in an ethical manner and contribute towards the socioeconomic development of the society at large.

Social responsibility is an ethical theory, in which individuals are accountable for fulfilling their civic duty; the actions of an individual must benefit the whole of society. Social responsibility is a duty every individual has to perform so as to maintain a balance between economic growth and the welfare of society and the environment.

Social responsibility means sustaining the equilibrium between the two. It pertains not only to organizations but also to everyone whose action impacts the environment. This responsibility can be passive, by avoiding engaging in socially harmful acts, or active, by performing activities that directly advance social goals. 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.

Guidelines for ISR Activity:

- A teacher can be given responsibility as ISR coordinator, relaxation of 1 hour load can be given to the teacher.
- ISR coordinator is responsible to maintain the records of ISR activities and the students participating in the activity.
- Students shall participate in Social work activities individually or in association/collaboration with Institute/ Social organizations/NGOs/Clubs etc. with prior permission of ISR coordinator
- A Student shall complete at least 30 hours Social activities under the guidance of ISR Coordinator/HOD/Principal/Director between MCA Semester 1 to Semester 4 (preferably between semester 1 to semester 3).
- Certificate of Participation given by concern Institute/NGO/Social organization/Private or Government organization/Club etc shall be verified by ISR coordinator.
- 2 credits will be awarded on the completion of 30 hours ISR work which is certified by ISR coordinator.

Suggestive list of Activities for social concern among students but not limited to:

- Computer Literacy Programs for ZP School Students/ Villagers/ Farmers etc.
- Donation of used books.
- Visits and Help to Orphanage/Old homage.
- Public Awareness Programs for Health, Road Safety, Organ Donation, Global Warming, Plastic Eradication , Aids/Cancer/Corona Awareness
- River/Beach Cleanliness Drive.
- Voter Registration Drive.
- Blood Donation Camps.
- Disaster Management Program.
- Swachha Bharat Abhiyan.
- E Waste Collection and Disposal.
- Tree Plantation Drives.
- Anti Addiction Program.
- Yoga, Meditation, Self Defense Programs for Children.
- Programs for Physically Challenged People.

Program Structure for
Bridge Course - Master in Computer Applications
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

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

Course	Course Name	Teaching Scheme			Credits Assigned			
MCABR1	Programming with C++	Contact Hours						
		Theory	Pract	Tut	Theory	Practical	Tut.	Total
		03	--	--	--	--	--	--
		Examination Scheme						
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	Test	AVG					
		20	20	20	80	--	--	--	100

Pre-requisite: Nil

Course Outcomes:

Sr. No.	Course Outcome	Bloom Level
CO1	Comprehend Object oriented programming concepts and their application	Remembering
CO2	To write applications using C++.	Understanding
CO3	Implement programming concepts to solve bigger problems	Evaluating

Module	Detailed Contents	Hrs
01	Module: Programming Basics& Introduction to C++: • Introduction to Programming, Programming Paradigms, • Programming Languages and Types. • Introduction to Object Oriented Programming- OOP concepts,Advantages, Applications • Control Structures, Operators and Expressions • Structure of a C++ program, Execution flow, Classes and Objects, Access modifiers, Data Members, Member Functions, • Inline Functions, Passing parameters to a Function(pass by Value, Pass by Address, Pass by Reference), Function with default arguments, Function Overloading, Object as a Parameter, Returning Object • Static data members and functions, Constant Data members and functions • Constructors- Default, Parameterized, Copy, Constructor Overloading, Destructors • Arrays, Array as a Class Member, Array of Objects, Strings- Cstyle strings and String Class	08

02	Module: Operator Overloading and Pointers: • Operator Functions-Member and Non Member Functions, • Friend Functions Overloading Unary operators Overloading binary operators(Arithmetic, Relational, Arithmetic Assignment, equality), Overloading Subscript operator • Type Conversion Operators- primitive to Object, Object to primitive, Object to Object Pointer and Address of Operator, Pointer to an Array and Array of Pointers, Pointer arithmetic, Pointer to a Constant and Constant Pointer, Pointer Initialization, Types of Pointers(void, null and dangling), Dynamic Memory Allocation, Advantages and Applications of pointers	08
03	Module: Inheritance and Polymorphism • Inheritance Concept, Protected modifier, Derivation of Inheritance- Public, Private and Protected, Types of Inheritance-Simple, Multilevel, Hierarchical, Multiple, Hybrid • Constructors and Inheritance, Function Overriding and Member hiding • Multiple Inheritance, Multipath inheritance – Ambiguities and solutions • Polymorphism, Static and Dynamic Binding, Virtual Functions, Pure Virtual Functions, Virtual destructors, • Abstract Classes, Interfaces	08
04	Module: Streams and Exceptions • Files, Text and Binary Files, Stream Classes, File IO using Stream classes, File pointers, Error Streams, Random File • Access, Manipulators, Overloading Insertion and extraction operators • Error handling, Exceptions, Throwing and catchingexceptions, Custom Exceptions, Built in exceptions	08

Reference Books:

Reference No	Reference Name
1	The Complete Reference C, 4th EditionHerbertSehlidt,TataMcgraw Hill
2	Object Oriented Programming in C++,4th Edition,RobertLafore,SAMSTechmedia
3	The Complete Reference-C++,4th Edition. Herbert Schildt,Tata McGraw-Hill
4	The C++ Programming Language, 4th edition,BjarneStroustrup,AddisonWesly

Web References:

Reference No.	Reference Name
1	https://dev.mysql.com
2	www.github.com

Course	Course Name	Teaching Scheme			Credits Assigned			
MCABR2	**Data Structures**	Contact Hours						
		Theory	Pract	Tut	Theory	Practical	Tut.	Total
		03	--	--	--	--	--	--
		Examination Scheme						
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	Test	AVG					
		20	20	20	80	--	--	--	100

Pre-requisite: Nil

Course Outcomes:

Sr. No.	Course Outcome	Bloom Level
CO1	Effectively choose the data structure that efficiently model the information in a Problem	Remembering
CO2	Describe how Linear data structures are represented in memory and used by algorithms and their applications	Understanding
CO3	Identify the benefits of Non-linear Data Structures and their applications	Understanding

Module	Detailed Contents	Hrs
01	Introduction toData Structures& Algorithms: • Introduction of Data structures, Abstract Data Types, • Performance Analysis: Space Complexity, Time Complexity, • Asymptotic Notations (Big O, Omega, Theta), Performance • measurement, Divide and Conquer, Back Tracking Method, • Dynamic programming	05
02	Sorting andsearchingalgorithms: • Bubble sort, Insertion sort, Radix Sort, Selection sort, shell Sort, • Linear Search, Sequentialsearch, Binary search	05
03	Hashing • Different Hashing Techniques, Address calculationTechniques, • Common hashing functions, • Collision resolutiontechniques: Linear probe, Quadratic probe, Key offset. • Rehashing, Double hashing, Link list addressing.	05
04	Linear DataStructures: • Stack Definition, Operations, Implementation of Stacks(Array and Linked list) • Queue: Definition, Operations, Implementation of simplequeue (Array and Linked list) • Types of queues: Circular • Types of Linked List: Singly, Doubly and Circular Linked listDefinition, Operations (Insert, delete, traverse, count, search)	10

05	Non-linearData Structures: • Tree Definition and concepts, • General Tree • Binary Tree • Traversal of a binary tree, • Conversion of general tree into binary tree, • Huffman tree, Expression tree • Binary Search Tree- Definition, Operation, Implementation	10

Reference Books:

Reference No	Reference Name
1	Richard F Gilberg Behrouz A Forouzan , "Data Structure A Pseudocode Approach withC". Second edition
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introductionto ALGORITHMS", PHI, India Second Edition.
3	Shaum"s Outlines Data Structure Seymour Lipschutz TMH

Course	Course Name	Teaching Scheme			Credits Assigned			
MCABR3	**Operating System**	Contact Hours						
		Theory	Pract	Tut	Theory	Practical	Tut.	Total
		03	--	--	--	--	--	--
		Examination Scheme						
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	Test	AVG					
		20	20	20	80	--	--	--	100

Pre-requisite: Nil

Course Outcomes:

Sr. No.	Course Outcome	Bloom Level
CO1	Classify different styles of operating system designs	Remembering
CO2	Analyze process management, I/O management, memory management functions of Operating System	Understanding
CO3	Employ process scheduling and disk scheduling algorithms	Understanding

Module	Detailed Contents	Hrs

01	Introduction Operating System & Process and Thread Management: • Introduction to System Software & operating System • Overview of all system softwares: Compiler, Assembler, Linker, Loader, Operating system, OS services and Components, Types of OS-Batch, multiprocessing, multitasking, timesharing, Distributed OS ,Real time OS, virtual machines, • System Calls ,types of System calls, Buffering, Spooling • Process and Thread Management: - Concept of process and threads, Process states, Process management, Context switching, Interaction between processes and OS, • Multithreading, CPU scheduling algorithms, multiprocessor scheduling algorithms, • Real timescheduling algorithms	10
02	Concurrency Control: • Concurrency and Race Conditions, • Mutual exclusion requirements, Software and hardware solutions, • Semaphores, Monitors, Classical IPC problems and solutions, Deadlock, Characterization, Detection,Recovery, Avoidance and Prevention	10
03	Memory Management: • Memory Management: Memory partitioning, Swapping, • Paging, Segmentation, Virtual memory, Overlays, Demandpaging, Performance of Demand paging, • Virtual memory concepts, • Page replacement algorithms, Allocationalgorithms	04
04	Mass Storage Structure & File systems: • Mass Storage Structure: Secondary-Storage Structure, Disk structure, Disk scheduling, Disk management, • Swap-space management, Disk reliability, Stable storage implementation, • Introduction to clock, Clock hardware, Clock software • File concept, File support, Access methods, • Allocation methods, Directory systems, File protection, • Free space management	10
05	Protection & Security: • Protection- Goals of protection, • Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights • Security- The security problem, Authentication, One-Timepasswords, Threats	06

Reference Books:

Reference No	Reference Name
1	Operating System Concepts (9th Ed) by Silberschatz and Galvin, Wiley, 2000.

2	Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall, 2000.
3	Modern Operating Systems by Andrew S Tanenbaum, Prentice Hall India, 1992.
4	Operating Systems (3rd edition) by Gary Nutt, NabenduChaki, SarmishthaNeogy, Pearson

Course	Course Name	Teaching Scheme			Credits Assigned			
MCABR4	**Computer Networks**	Contact Hours						
		Theory	Pract	Tut	Theory	Practical	Tut.	Total
		03	--	--	03	--	--	--
		Examination Scheme						
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	Test	AVG					
		20	20	20	80	20	--	--	100

Pre-requisite: Nil

Course Outcomes:

Sr. No.	Course Outcome	Bloom Level
CO1	Comprehend the basic concepts of computer networks and data communication	Remembering
CO2	Analyze basic networking protocols and their use in network design	Understanding
CO3	Explore various advanced networking concepts.	Understanding
CO4	To explore basic networking models.	Understanding

Module	Detailed Contents	Hrs

01	Basics of Digital Communication: • Introduction to digital communication, • Signal propagation, Signal types, Signal parameters , Switching & forwarding, Transmission impairments, Attenuation, • Delay distortion, Noise, Effects of limited bandwidth, • Data rate limits-Nyquist‟s theorem and Shannon‟stheorem Network Organization and Models: • Basics of computer Network, topology & types of topologies, types of networks(LAN, MAN, WAN), • Concept of Intranet & Extranet, Ad-Hoc Networks, types of communications (Asynchronous and synchronous) , modes of communications (simplex, half duplex, full duplex), Protocols, • Networking models, ISO-OSI Reference Model, Design issues of the layer ,Internet Model (TCP/IP), • Comparison of ISO-OSI & TCP/IPModel	6
02	Networking Devices: Connectivity Devices : Passive & Active Hubs, Repeaters, Switches (2-Layer Switch, 3-Layer switch(Router), • Bridges (Transparent Bridges, Spanning Tree, Bridges, • Source Routing Bridges) , Brouters, Gateways Application, Presentation & Session Layer: • Principles of Application Layer Protocols, The Web and HTTP, FTP, Telnet, Electronic Mail in the Internet • (SMTP, MIME, POP3, IMAP), DNS, Introduction toSNMP.	06
03	Transport layer: • Transport-Layer Services, port addressing, • Multiplexing and Demultiplexing, • Principles of Reliable Data Transfer, • Congestion Control, TCP‟s Congestion Control. • Quality of Service : Introduction, Queue Analysis, QoS Mechanisms, Queue management Algorithms, Feedback, • Resource, Reservation.	06
04	Network layer: • Network Service Model, Data gram & Virtual Circuit , • Routing Principles, The Internet Protocol,(ipv4 & ipv6) , • IP addressing and subnetting, Routing Algorithms., • Hierarchical Routing, Routing in the Internet: Intra andinter domain routing; Unicast Routing Protocols RIP, • OSPF, BGP, Multicast Routing Protocols : MOSPF,DVMRP. • ATM Networks: Need for ATM, ATM Layers, ATM adaptation Layers, IP over ATM, Multi protocol Labelswitching (MPLS), Drawbacks of traditional routingmethods, Idea of TE, TE and Different Traffic classes	10

05	Data LinkLayer: • Data Link Layer, Error Detection and CorrectionTechniques, • Multiple Access Protocols, LAN Addressesand ARP & RARP , PPP: The Point-to-Point Protocol , • Ethernet standards – IEEE 802.3, 802.5, FDDI, 802.6. Physical layer: • Physical Layer, • Types of media wired and wireless media	10

Reference Books:

Reference No	Reference Name
1	Computer Networking: A Top-Down Approach Featuring the Internet , J. F. Kurose andK. W. Ross, Seventh Edition, Addison-Wesley.
2	Computer Networks: Principles, Technologies and Protocols for Network design, N.Olifer and V. Olifer, Wiley India
3	Data Communication and Networking, B. A. Forouzan, Fourth Edition, McGraw Hill.
4	Computer Networks, Andrew Tenenbaum, Fifith Edition, PHI .

Course	Course Name	Teaching Scheme			Credits Assigned			
MCABR5	**Discrete Mathematics**	Contact Hours						
		Theory	Pract	Tut	Theory	Practical	Tut.	Total
		03	--	01	--	--	--	--
		Examination Scheme						
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	Test	AVG					
		20	20	20	80	--	--	--	100

Pre-requisite: Nil

Course Outcomes:

Sr. No.	Course Outcome	Bloom Level
CO1	To Understand the fundamental ideas of Discrete Mathematics	Remembering
CO2	Develop mathematical and logical thinking	Understanding

Module	Detailed Contents	Hrs
01	Mathematicallogic: • Propositions and logical operations, Conditional Statements , • Methods of Proof , Mathematical Induction, • MathematicalStatements , • Logic and Problem Solving, Normal Forms Sets andRelations: • Set operations and functions, Product sets and partitions, • Relations and digraphs,	20

	• Paths in Relations and Digraphs, • Properties of Relations , Equivalence Relations, Operationson Relations, Partially Orders Sets, Hasse diagram	
02	Graphs: • Graph, Representation of Graph, Adjacency matrix, • Adjacency list, Euler paths and Circuits, Hamiltonian Pathsand Circuits	10
03	Modeling usingdifferenceequation: • Recurrence relation - Fibonacci series, Tower of Hanoi • Lines in a plane Homogenous linear equations with constantcoefficients, • Particular Solution, Total Solution, Divide andConquer Recurrence Relations	10

Reference Books:

Reference No	Reference Name
1	Discrete Mathematics and Its Applications 4th Edition , Kenneth H. Rosen, McGraw Hill
2	Discrete Mathematical structures 4th Edition, Kolman, Busby, Ross, PHI

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				
MCA 501	**Wireless and Mobile Technology**	Test1(T1)	Test2(T2)	Average of T1 & T2					
		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				
MCA 502	**Advance Distributed Computing**	Test1 (T1)	Test2 (T2)	Average of T1 & T2					
		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				
		Test1 (T1)	Test2(T2)	Average of T1 & T2					
MCADLE5042	**Machine Learning**	**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				
		Test1 (T1)	Test2(T2)	Average of T1 & T2					
MCADLE5043	**Internet of Things**	**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				
		Test1 (T1)	Test2 (T2)	Average of T1 & T2					
MCA ILE5053	**Management Information System**	**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					
MCAL502	**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(T2)	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				
MCAP R601	**Internship-Project**	Theory Course				Total
		Internal Assessment			End Semester Exam	
		Presentation 1	Presentation 2	Total		
		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.