VIVEKANAND EDUCATION SOCIETY'S INSTITUDE OF TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)

Master of Computer Applications

MCA

FACULTY OF SCIENCE & TECHNOLOGY

Effect from the academic year 2023–2024

Program Structure for First Year Master of Computer Applications
Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA11	Statistics for Data Science	3	--	1	3	--	1	4
MCA12	Java for Full Stack Development	3	--	--	3		--	3
MCA13	Data Warehousing and Mining.	3	--	--	3	--	--	3
MCA14	UX Design and Development	3	--	1	3	--	1	4
MCAL11	Python Programming LAB	--	4	--	--	2	--	2
MCAL12	Java for Full Stack Development LAB	--	2	--	--	1	--	1
MCAL13	Data Analytics with R LAB	--	2	--	--	1	--	1
MCAL14	Web Application Technologies LAB	--	4	--	--	2	--	2
MCAP11	Project Seminar (Real Life Problems based on Societal Issues)	--	2	--	--	1	--	1
Value Added Course/Social Empowerment Course (Universal Human Values(UHV)/ Indian Knowledge System (IKS))					01 Credit will be Consider in ISR			
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	MT	Tot					
MCA11	Statistics for Data Science	20	20	40	60	2	25	--	125
MCA12	Java for Full Stack Development	20	20	40	60	2	--	--	100
MCA13	Data Warehousing and Mining.	20	20	40	60	2	--	--	100
MCA14	UX Design and Development	20	20	40	60	2	25	--	125
MCAL11	Python Programming LAB	--	--	--	--	--	50	50	100
MCAL12	Java for Full Stack Development LAB	--	--	--	--	--	25	50	75
MCAL13	Data Analytics with R LAB	--	--	--	--	--	25	50	75
MCAL14	Web Application Technologies LAB	--	--	--	--	--	50	50	100
MCAP11	Project Seminar (Real Life Problems based on Societal Issues)	--	--	--	--	--	50	--	50
Total		--	--	160	240	--	250	200	850

Program Structure for First Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA21	Combinatorial Algorithms for Problem Solving	3	--	1	3	--	1	4
MCA22	Artificial Intelligence and Machine Learning	3	--	--	3	--	--	3
MCA23	Cyber Security And Digital Forensics	3	--	1	3	--	1	4
MCA24	IOT and IIOT	3	--	--	3	--	--	3
MCAE25	Elective - 1	3	--	1	3	--	1	4
MCAL21	Artificial Intelligence and Machine Learning Lab	--	2	--	--	1	--	1
MCAL22	Soft Skill Development Lab	--	2	--	--	1	--	1
MCAL23	IOT and IIOT Lab	--	2	--	--	1	--	1
MCAL24	Skill based Lab Course. DevOps Lab	--	4	--	--	2	--	2
MCAL25	Skill based Lab Course User Interface Lab	--	2	--	--	1	--	1
MCAL26	Skill based Lab Course AI Development Tools Lab	--	2	--	--	1	--	1
MCAP21	Project Stage- 1	--	2	--	--	1	--	1
Total		**15**	**16**	**3**	**15**	**8**	**3**	**26**

Program Structure for First Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester II

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		CA	MT	Tot.					
MCA21	Combinatorial Algorithms for Problem Solving	20	20	40	60	2	25	--	125
MCA22	Artificial Intelligence and Machine Learning	20	20	40	60	2	--	--	100
MCA23	Cyber Security And Digital Forensics	20	20	40	60	2	25	--	125
MCA24	IOT and IIOT	20	20	40	60	2	--	--	100
MCAE25	Elective – 1	20	20	40	60	2	25	--	125
MCAL21	Artificial Intelligence and Machine Learning Lab	--	--	--	--	--	25	50	75
MCAL22	Soft Skill Development Lab	--	--	--	--	--	50	--	50
MCAL23	IOT and IIOT Lab	--	--	--	--	--	25	50	75
MCAL24	Skill based Lab Course. DevOps Lab	--	--	--	--	--	50	50	100
MCAL25	Skill based Lab Course User Interface Lab	--	--	--	--	--	25	50	75
MCAL26	Skill based Lab Course AI Development Tools Lab	--	--	--	--	--	25	50	75
MCAP21	Project Stage- 1	--	--	--	--	--	50	--	50
Total		--	--	**200**	**300**	--	**325**	**250**	**1075**

Elective 1

Sr. No.	Course Code	Course Name
1	MCAE251	Digital Marketing and Business Analytics
2	MCAE252	Agile Project Management
3	MCAE253	Entrepreneurship Management

Program Structure for Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester III

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 - 2	3	--	--	3	--	--	3
MCAE34	Elective - 3	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 2 Lab	--	2	--	--	1	--	1
MCAL34	Skill based Lab Mobile Computing Lab	--	4	--	--	2	--	2
MCAL35	Software Testing and Quality Assurance Lab	--	2	--	--	1	--	1
MCAP31	Project Stage -2	--	2	--	--	1	--	1
Total		**12**	**14**	1	**12**	**07**	**1**	**20**

Program Structure for Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester III

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		CA	MT	Tot					
MCA31	Big Data Analytics and Visualization	20	20	40	60	2	--	--	100
MCA32	Distributed System and Cloud Computing	20	20	40	60	2	--	--	100
MCAE33	Elective – 2	20	20	40	60	2	--	--	100
MCAE34	Elective - 3	20	20	40	60	2	25	--	125
MCAL31	Big Data Analytics and Visualization Lab	--	--	--	--	--	25	50	75
MCAL32	Distributed System and Cloud Computing Lab	--	--	--	--	--	25	50	75
MCALE33	Elective 2 Lab	--	--	--	--	--	25	50	75
MCAL34	Skill based Lab Mobile Computing Lab	--	--	--	--	--	50	50	100
MCAL35	Software Testing Quality Assurance Lab	--	--	--	--	--	25	50	75
MCAP31	Project Stage-2	--	--	--	--	--	50	-	50
Total		**--**	**--**	**160**	**240**	--	**225**	**250**	**875**

Elective 2

Sr. No.	Course Code	Course Name	Lab Course Code
1	MCAE331	Block chain	MCALE331
2	MCAE332	Deep Learning	MCALE332
3	MCAE333	Ethical Hacking	MCALE333

Elective 3

Sr. No.	Course Code	Course Name
1	MCAE341	Sustainable Computing
2	MCAE342	Natural Language Processing
3	MCAE343	Computational Intelligence

Program Structure for Second Year Master of Computer Applications
Scheme for Autonomous Program
(With Effect from 2023-2024)
Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
MCAI41	Industry Internship/ Research Internship at Research Institute/Incubation Center	--	40	--	15	15
MCAR42	Research Paper	1@	--	1	--	1
MCAM43	Online Course- (MOOC)	4#	--	4	--	4!
MCAS44	Institute Social Responsibility*	--	--	--	--	1+1*
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	Industry Internship/ Research Internship at Research Institute/Incubation Center	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
* For ISR, One Credit will be assigned for UHV/IKS Course.Swayam/AICTE Student FDP Course and for another one credit student should complete at least 2 activities of ISR .

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

- @ Research Paper has to be Published before the Completion of the MCA(It will accounted in SEM IV)
- For Bridge Course Students, Subject MCABR3 and MCABR4 will be accounted for MOOC (04 Credits)which should be completed in SEM I and SEM II.

Program Structure for First/Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Bridge Course

For the graduates, not having graduation in Computer Science/Information Technology / Computer Application, need to complete the bridge course along with the MCA regular course

Course Code	Course Name	Group	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut	Total
MCABR1	Object Oriented Programming Methodology with Java	ICT	NPTEL/ Udemy Course#	2		--	--	--	---
MCABR2	Data Structures	ICT	NPTEL/ Udemy Course#	2		--	--	--	--
MCABR3	Operating System	ICT	04 Week NPTEL Certificate Course			--	--	--	--
MCABR4	Computer Network	ICT	04 Week NPTEL Certificate Course						
	Total			04	--	--	--	--	--

Course Code	Course Name	Group	Examination Scheme							
			Theory					Pract		
			Internal Assessment			End Sem.	Exam. Duration	Pract	Oral	Total
			CA	MT	Tot.		In Hrs			
MCABR1	Object Oriented Programming Methodology with Java	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–	100
MCABR2	Data Structures	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–	100
MCABR3	Operating System	ICT	Assessment will be according to the NPTEL Certificate Course and Credit							100
MCABR4	Computer Network	ICT	Assessment will be according to the NPTEL Certificate Course and Credit							100
	Total									400

#Course will be Suggested By the Subject Teachers

Master of Computer Applications

Academic Year 2023-24

SEM:-I

Program Structure for First Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA11	Statistics for Data Science	3	--	1	3	--	1	4
MCA12	Java for Full Stack Development	3	--	--	3		--	3
MCA13	Data Warehousing and Mining.	3	--	--	3	--	--	3
MCA14	UX Design and Development	3	--	1	3	--	1	4
MCAL11	Python Programming Lab	--	4	--	--	2	--	2
MCAL12	Java for Full Stack Development Lab	--	2	--	--	1	--	1
MCAL13	Data Analytics with R Lab	--	2	--	--	1	--	1
MCAL14	Web Application Technologies Lab	--	4	--	--	2	--	2
MCAP11	Project Seminar (Real-Life Problems based on Societal Issues)	--	2	--	--	1	--	1
Value Added Course/Social Empowerment Course (Universal Human Values (UHV)/ Indian Knowledge System (IKS))					01 Credit will be Consider in ISR			
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	MT	Tot					
MCA11	Statistics for Data Science	20	20	40	60	2	25	--	125
MCA12	Java for Full Stack Development	20	20	40	60	2	--	--	100
MCA13	Data Warehousing and Mining.	20	20	40	60	2	--	--	100
MCA14	UX Design and Development	20	20	40	60	2	25	--	125
MCAL11	Python Programming Lab	--	--	--	--	--	50	50	100
MCAL12	Java for Full Stack Development Lab	--	--	--	--	--	25	50	75
MCAL13	Data Analytics with R Lab	--	--	--	--	--	25	50	75
MCAL14	Web Application Technologies Lab	--	--	--	--	--	50	50	100
MCAP11	Project Seminar (Real-Life Problems based on Societal Issues)	--	--	--	--	--	50	--	50
Total		--	--	160	240	--	250	200	850

Semester I

Course Code	Course Name	Teaching Scheme			Credits Assigned		
		Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
MCA11	Statistics for Data Science	Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: Student must know

1. Set theory
2. Basic principles of counting

Course Objectives: Course is aim to

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
6	Understand different ways to calculate probability.

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

Sr.No.	Outcome	Bloom Level
CO1	Apply different statistical measures to various types of data	Applying
CO2	Evaluate using regression analysis	Evaluating
CO3	Analyze different types of probability and their fundamental Applications.	Analyzing
CO4	Apply probability distribution to real world problems	Applying
CO5	Formulate and test the hypothesis for business problem using various methods	Creating
CO6	Evaluate probability distribution using random variables.	Evaluating

Module	Detailed Contents	Hrs
1	**Measures of Central Tendency & Measures of Dispersion:** Frequency Distribution, Histogram, Stem and leaf diagram, ogives, Box whisker plot, Frequency Polygon, Mean, Median, Mode, Range, Quartile Deviation, Standard Deviation, and Coefficient of Variation. **Self-Learning Topics:** Basics of variance, Basic principles of counting.	**5**
2	**Skewness, Regression, and correlation:** Skewness: Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness. Correlation: Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient. Regression: Linear and Non-linear regression (quadratic), Estimation using linear regression. **Self-Learning Topics:** Apply correlation and regression on real world data and its graphical representation.	**8**
3	**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.	**8**
4	**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.	**8**
5	**Theoretical probability distributions:** Binomial, Poisson, Normal. **Self-Learning Topics: S**tudy of properties of standard normal variate.	**5**
6	**Sampling & Testing of hypothesis:** Sampling: Probability Sampling, Non- Probability Sampling Hypothesis testing, Type I and Type II errors. Tests of significance – single sample, Student's t-test, large sample test (z-test). **Self-Learning Topics:** Study of elementary sampling methods.	**5**

Reference Books:

Reference No	Reference Name
1	S.C.Gupta, V.K.Kapoor, S Chand, Fundamentals of Mathematical Statistics, Sultan and Chand sons publication, First Edition
2	Hwei P. Hsu, Schaum's Outlines Probability, Random Variables & Random Process, Tata McGraw Hill, Third Edition
3	J.Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics, Tata McGraw Hill, Fourth Edition
4	Dr J Ravichandran, Probability & Statistics for Engineers, Wiley
5	Dr Seema Sharma, Statistics for Business and Economics, Wiley
6	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 Statistics 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:

Sr No	Topic	Hours
1	Find Bowley's & Karl Pearson's coefficient of skewness	1
2	Calculate Karl Pearson's and Spearman's coefficient of correlation	1
3	To fit linear regression and estimate	1
4	Examples on addition and multiplication theorem of probability	1
5	Examples based on Bayes' theorem	1
6	Examples based on independence of discrete random variables.	1
7	Examples based on independence of continuous random variables.	1
8	Example on Poisson distribution	1

9	Example on normal distribution	1
10	Example on t-test	1

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks
The term work will be based on Tutorial Performance.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA12	Java for Full Stack Development	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	--	60	100

Prerequisite:

1. Basic understanding of any Object-Oriented Programming Language
2. Successfully completed Programming Concepts of Core Java course

Course Objectives: Course is aim to

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
6	Understanding Spring Boot RESTful Web Services.

Course Outcomes: On successful completion of the 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
CO2	Create JSP using standard actions, custom tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags.	Creating
CO3	Understand and develop applications using Spring Framework, Lightweight Container and Dependency Injection with Spring.	Creating
CO4	Develop applications using Aspect Oriented Programming with Spring.	Creating
CO5	Apply JDBC Data Access with Spring and demonstrate Data access operations with JDBC Template and Spring.	Creating

CO6	Create Spring Boot Web Application and Spring Boot RESTful WebServices.	Creating

Module	Detailed Contents	Hrs
01	**Introduction Java EE Programming** JSP Architecture, JSP building blocks, Scripting Tags, implicit object, Introduction to Bean, standard actions, 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**
02	**Spring Frameworks:** Introduction to Spring Framework,POJO Programming Model, Lightweight Containers (Spring IOC container, Configuration Meta Data, Configuring and using the Container) Dependency Injection with Spring- Setter Injection, Constructor Injection, Circular Dependency, Overriding Bean, Auto Wiring Bean Lookup, Spring Manage Beans). **Self-learning topics** Bean Definition Profiles.	**6**
03	**Spring and AOP** Aspect Oriented Programming with Spring, Types of advice, Defining PointCut Designator, Annotations. **Self-learning topics** AspectJ.	**5**
04	**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**
05	**Getting Started with Spring Boot** Introduction, Spring Boot and Database, Introduction to exception handling in spring boot. **Self-learning topics** Spring Boot Web Application Development, Understanding Transaction Management in Spring.	**5**
06	**ReactJS** Introduction to reactjs, understanding JSX, React components, component lifecycle, react class, introduction to react State and Props, react event, react conditionals, react list and forms, hook. **Self-learning topics** Model-ViewController framework, Flux,	**9**

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, Dreamtech Press. 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

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:-NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Course	Course Name	Teaching Scheme			Credits Assigned		
MCA13	Data Warehousing and Mining	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	--	60	100

Prerequisite: Database Management System

Course Objectives： Course is aim to

Sr. No.	Course Objective
1	Understand the architecture of the data warehouse, ETL process, and OLAP functions.
2	Understand the concept of data analytics and apply it to real world data.
3	Demonstrate the various data pre-processing techniques.
4	Analyze the data and generate the association rules for real world problems.
5	Demonstrate the classification algorithms and apply them to real world problems.
6	Demonstrate the various clustering algorithms and apply them to real world problems.

Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO 1	Model the data warehouse with the ETL process and perform dimensional modeling and data analysis using OLAP operations.	Understanding
CO2	Apply various types of analytics to get data insights.	Applying
CO 3	Apply various Data preprocessing and Data reduction techniques.	Applying
CO 4	Discover associations among items using association rule mining.	Analyzing
CO5	Classify data using various Classification Algorithms to support decision making.	Evaluating
CO6	Apply various Clustering Algorithms to make informed decisions.	Evaluating

Module	Detailed Contents	Hrs
01	**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 Schemas, major features and functions of OLAP, OLAP models- ROLAP and MOLAP, and the difference between OLAP and OLTP. **Self-Learning Topics**: Study any one DW implementation.	**08**
02	**Data Analytics:** Data Analytics Overview, Importance of Data Analytics, Types of Data Analytics, Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Benefits of Data Analytics, and Data Visualization Techniques. **Self-Learning Topics**: Case Studies of Data analytics.	**06**
03	**Module: Data Pre-processing:** 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**: Data normalization.	**07**
04	**Data Mining Algorithm- Association Rules:** Association rule mining: support and confidence, frequent item sets, Market Basket Analysis, the Apriori algorithm, associative classification, and classification- Rule mining. **Self-Learning Topics**: Evaluation Metrics.	**06**
05	**Data Mining Algorithm-Classification:** Classification methods: Statistical-based algorithms- Regression, Naïve Bayesian classification, Distance-based algorithm- K-Nearest Neighbor, and Tree-based algorithms -ID3, C4.5, and CART. **Self-Learning Topics**: Confusion Metrics.	**07**

06	**Module: Data Mining Algorithm-Clustering:** Clustering Methods: Partitioning methods - K-Means, Hierarchical-Agglomerative and Divisive Methods. **Self-Learning Topics**: Expectation Maximization Clustering Algorithm.	**05**

Reference Books:

Reference No	Reference Name
1	Han, Jiawei, Jian Pei, and Micheline Kamber, Data mining: concepts and Techniques, Second Edition, Elsevier, Morgan Kaufmann, 2011.
2	Ponniah Paulraj, Data warehousing fundamentals: a comprehensive guide for IT professionals, John Wiley & Sons, 2004.
3	Dunham, Margaret H, Data mining: Introductory and advanced topics, Pearson Education India, 2006.
4	Gupta, Gopal K, Introduction to data mining with case studies, PHI Learning Pvt. Ltd., 2014.
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.
8.	Data Analytics Made Accessible by Dr. Anil Maheshwari

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/

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more: -NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCA14	UX Design and Development	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	Tot			
		20	20	40	25	60	125

Prerequisite: Knowledge of Software Engineering and its Concepts

Course Objectives: course aim to

Sr.No.	Course Objective
01	Understand the concepts of Software Engineering and process Model
02	Understand the Agile Development process
03	Gain an understanding of interaction design and cognitive aspects of the users
04	Understand and familiarize the Process of Interaction Design and Paradigm
05	To learn Evaluation and Usability Testing Techniques and Models
06	Develop interest in User Experience Design Process

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

Sr.No.	Course Outcome	Bloom Level
CO1	Demonstrate Software development Process Model in the designing	Understanding
CO2	Be able to Understand the Agility methods and concepts.	Understanding
CO3	Assess the range of possibilities for interaction design.	Evaluating
CO4	Be able to design applications and services that are user-centered.	Applying
CO5	Learn tools and techniques for Evaluating User Experiences	Understanding
CO6	Demonstrate the ability to evaluate the Interface Design	Evaluating

Module	Detailed Contents	Hrs
01	**Software Engineering and Software Development Process Model-** Software, types of software engineering, evolving role of software, challenges in software development. **Software Development Process Model** Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model. **Self-Learning Topics: -**Incremental Process model: Iterative approach, RAD model,UML.	**05**
02	**Agile Development-** What is Agility? 12 Agile principles, Agility and the cost of change, what is an agile process? Extreme programming, Scrum, Scrum Life cycle and Agile Scrum Framework. **Self-Learning Topics: -**Kanban, Kaizen.	**05**
03	**Agile Process Models** Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Crystal, Feature Driven Development (FDD), Lean Software Development (LSD), Agile Modeling (AM), Agile Unified Process (AUP). **Self-Learning Topics: - Agile Tools.**	**06**
04	**Interaction Design and Cognitive Aspects:** Good and Poor Design, What Is Interaction Design? The User Experience, Understanding Users, Accessibility and Inclusiveness, Usability and User Experience Goals. Cognition, cognitive framework, cognition in interaction design, Mental Models, classic theories of cognition, recent theories of cognition. **Self-Learning Topics:** Data Analysis, Interpretation and Presentation.	**08**
05	**The Process of Interaction Design** Understanding & Conceptualizing Interaction Design, Conceptualizing Interaction, Conceptual Models, Interface Metaphor, Interaction Type, Paradigms, Visions, Theories, Models, and Frameworks, Design, Prototyping, And Construction. **Self-Learning Topics:** Social Interaction, Emotional Interaction.	**08**
06	**Evaluation and Usability Testing** Introducing Evaluation, Evaluation Studies: From Controlled To Natural Settings, **Evaluation**: 1) Inspections: Heuristic Evaluation and Walk-Throughs 2) Analytics and A/B Testing And Models, Usability testing and Field Studies. **Self-Learning Topics:** Predictive Models.	**07**

Reference Books:

Reference No.	Reference Name
1	Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
2	Interaction Design Beyond Human-Computer Interaction , Sharp Rogers , 2nd edition , Wiley
3	Software Engineering, 7th Edition, "Roger S pressmen", TMH
4	The Unified Modelling Language Reference manual, Second Edition, James Rambaugh,Iver Jacobson, Grady Booch, Addition- Wesley.
5	Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI(2005).

Web References:

Reference No.	Reference Name
1	https://www.tutorialspoint.com
2	https://technologyadvice.com
3	https://archive.nptel.ac.in/courses/107/103/107103083/

Tutorials

Suggested Tutorials List, but not limited to the following Lists:-

Sr. No.	Detailed Contents	Hrs.
01	Study of Agile Jira Tool	01
02	Design Persona and Mental model for the Case study	02
03	Design Storyboard for the case study	02
04	UML Diagrams: Use Case Diagram.	01
05	UML Diagrams: Activity Diagram.	01
06	UML Diagrams: Class Diagram.	01
07	UML Diagrams: Sequence Diagram	01
08	UML Diagrams: State Chart Diagram.	01
09	UML Diagrams:Component Diagram.	01
10	UML Diagrams:Deployment Diagram.	01

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on the Tutorial Performance

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Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL11	Python Programming Lab	04	02	50	30	20	100

Prerequisite: Knowledge of some programming language like C, Java

Course Objectives

Sr.No.	Course Objective
1	Decision Making, control statements and functions in Python programming.
2	Object Oriented Programming using Python
3	Data structure in Python
4	Database Programming using Python
5	Concepts of Threads, process and Synchronization.
6	Text processing with python

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	To understand basic concepts, control statements, and functions in python.	Understanding
CO2	To explore Object Oriented Programming using Python	Applying
CO3	To explore data structures Linked list, stack and Queues with Python.	Applying
CO4	To evaluate database operations in python.	Evaluating
CO5	To evaluate threading modules and synchronizing threads in Python.	Evaluating
CO6	To explore text processing with python	Analyzing

Module	Detailed Content	Hours
1	**Python basics**	**5**
	Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python,	
2	**Modularization and Classes**	**4**
	Functions, List and Tuples, Dictionaries, Exception in Handling, Introduction to OOP, Classes, Objects, Interfaces, Inheritance	
3	**Data Structure in Python**	**3**
	Link List, Stack, Queues, Dequeues	
4	**Python Integration Primer**	**4**
	Graphical User interface, Python database connectivity	
5	**Threads in Python**	**4**
	Thread and Process, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue	
6	**NumPy and Pandas**	**6**
	Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing. Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames	

Reference Books:

Reference No	Reference Name
1	Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series
2	Laura Cassell, Alan Gauld, “Python Projects”, Wrox Publication
Digital material:	
1	The Python Tutorial",http://docs.python.org/release/3.0.1/tutorial/
2	Beginning Perl,https://www.perl.org/books/beginning-perl/
3	http://spoken-tutorial.org
4	https://starcertification.org/Certifications/Certificate/python

Text References:

Reference No	Reference Name
1	Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press
2	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication

3	Anurag Gupta, G. P. Biswas, “Python Programming”, McGraw-Hill
4	E. Balagurusamy, “Introduction to computing and problem-solving using python”,McGraw Hill Education
5	Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press
	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication

Suggested experiments using Python:	
Sr.No.	**Title of Experiments**
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python.
3	Demonstrate inheritance and polymorphism.
4	Menu driven program for data structure using built in function for link list, stack and queue.
5	Write a Python program to understand different types of Exceptions
6	Creating GUI with Python containing widgets such as labels, textboxes, radio, checkboxes, and custom dialog boxes.
7	Program to demonstrate CRUD (create, read, update and delete) operations on databases (SQLite/ MySQL) using Python.
8	Programs on Threading using Python.
9	Exploring basics of NumPy Methods.
10	Program to demonstrate the use of NumPy: Array objects.
11	Program to demonstrate Data Series and Data Frames using Pandas.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 25 Marks (Journal: 10-marks, Attendance: 05-marks, and project: 10-marks)

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Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL12	Java for Full Stack Development Lab	02	01	25	30	20	75

Prerequisite: 1. Basic understanding of Core Java Programming.
2. Basics of web technology.

Lab Course Objectives: Course is aim 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
6	Develop 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
CO2	Build JSP web applications using standard actions, custom tags and JSTL Tags.	Creating
CO3	Develop applications using Spring Framework, Lightweight Containers and Dependency Injection with Spring.	Applying
CO4	Develop applications using Aspect Oriented Programming with Spring.	Applying
CO5	Build JDBC application with Spring using JdbcTemplate.	Creating
CO6	Develop Spring Boot Web Application and Spring Boot RESTful web services.	Creating

Description:

Module	Detailed Contents	Hrs
01	**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
02	**Spring Framework:** Programs based on using Spring Framework, dependency injection. **Self-Learning Topics:** Bean Definition Profiles.	4
03	**Aspect Oriented Programming:** Programs based on Spring AOP – Before, After, Around, After Returning and After Throwing advice, PointCuts. **Self-Learning Topics:** AspectJ	4
04	**JDBC Data Access with Spring using Oracle/ MySQL database:** Programs based on Spring JDBC, JdbcTemplate, PreparedStatementCallback, ResultSetExtractor and RowMapper interface. **Self-Learning Topics:** Basic JDBC Program using DML operation.	4
05	**Getting Started with Spring Boot:** Programs based on Spring Boot. **Self-Learning Topics:** Understanding Transaction Management in Spring, RESTful Web Services with Spring Boot.	6
06	**Getting Started with ReactJs:** Introduction to ReactJs, understanding JSX, React components, react class, State and Props, event, conditionals, list and forms. **Self-Learning Topics: Model-View** Controller framework, Flux.	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:

Sr.No.	Topics of Coverage
1	Assignment based on collections in java
2	Assignment based on Lambda and wildcard
3.	Assignment based on web application development using JSP
4.	Assignment based on Session Management
5	Assignment based on Spring Framework
6	Assignment based on Aspect Oriented Programming
7	Assignment based on Spring JDBC
8	Assignment based on ResultSetExtractor and RowMapper interface
9	Assignment based on Spring BOOT
10	Assignment based on ReactJS

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments:

	05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL12

Term Work: 25 marks
The term work will be based on the Continuous Assessment and Laboratory work

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Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL13	**Data Analytics with R Lab**	**02**	**01**	**25**	**30**	**20**	**75**

Prerequisite: Database Management System, SQL.

Lab Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Understand methods and techniques to acquire different types of data.
2	Demonstrate various techniques to preprocess the data.
3	Demonstrate various data reduction and manipulation techniques.
4	Demonstrate various data visualization methods.
5	Demonstrate the processes and techniques used in diagnostic and prescriptive analytics.
6	Demonstrate various methods for predictive analytics.

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

Sr.No.	Outcome	Bloom Level
CO1	Understand and apply various methods and techniques to acquire different types of data.	Understanding
CO2	Demonstrate data Preprocessing techniques.	Applying
CO3	Demonstrate data reduction and manipulation techniques.	Analyzing
CO4	Apply various data visualization methods.	Applying
CO5	Identify the processes and techniques used in diagnostic and prescriptive analytics.	Applying
CO6	Demonstrate and evaluate different data mining techniques like classification and clustering	Evaluating

Description:

Module No	Detailed Contents	Hrs
1	**Basics of R and Data Acquisition:** Introduction to R, Data Types and Objects, Reading and writing data, reading data from the console, Operators, Conditional Statements, Using CSV files, XML files, Web Data, JSON files, Databases, and Excel files. Packages, attaching, and detaching data. **Self-Learning Topics**: Loops, Functions, Loading data from Relational Databases, XML.	4
2	**Data Preprocessing:** Data preprocessing techniques in R - Naming and Renaming variables, adding a new variable, Dealing with missing data, and Dealing with categorical data. **Self-Learning Topics**: Sorting, Date Conversion.	4
3	**Data Management:** Data reduction using subsetting, Introduction to Dplyr and Tidyverse, select, transmute, arrange, filter, groupby. **Self-Learning Topics:** R Markdown to create webpages and pdfs.	4
4	**Descriptive Analytics:** Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts, Visualization With Ggplot2. **Self-Learning Topics:** Handling Outliers.	4
5	**Diagnostic and Prescriptive Analytics:** Correlation Plots, EDA, Market Basket Analysis, Normal and Binomial distributions, Univariate and Bivariate Analysis. **Self-Learning Topics:** Themes and Transformation in Graphs, Multiple graphs in single figure.	4
6	**Predictive Analytics with R:** Supervised Learning - Linear Regression, Logistic Regression, Classification Models like Random Forest and Decision Tree, Unsupervised Learning - Clustering algorithms like K-Means and hierarchical Clustering. **Self-Learning Topics**: GUI Development Using Rattle.	6

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
3	Beginning Data Science in R_ Data Analysis, Visualization, and Modelling for the Data Scientist Thomas Mailund

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	Write commands for following Data acquisition, Install packages, Loading packages Data types, checking type of variable, printing variable and objects (Vector, Matrix, List, Factor, Data frame, Table)
2	Write commands for following 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).
3	Write commands for 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
4	Write commands for Implementation of Data reduction using subsetting, implementation and usage Dplyr & Tidyverse, select, transmute, arrange, filter, groupby on any dataset.
5	Write commands for Working with different types of R Charts and Graphs like Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts,
6	Implement data Visualization with Ggplot2,
7	Implement commands for drawing various Correlation Plots and learn the process of EDA
8	Implementation of Normal and Binomial distributions, Univariate and Bivariate Analysis,

9	Implementation and analysis of Apriori Algorithm using Market Basket Analysis
10	Implementation and analysis of Linear regression and logistic regression through graphical methods.
11	Implementation and analysis of Classification algorithms like Naive Bayesian, K-Nearest Neighbor, ID3, C4.5
12	Implementation and analysis of clustering algorithms like K-Means and hierarchical clustering.

Assessment:

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL13

Term Work: 25 marks

The term work will be based on Continuous Assessment and Laboratory work.

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Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL14	Web Application Technologies LAB	04	02	50	30	20	100

Prerequisite: Basic understanding of fundamentals of Web Technologies and JavaScript

Lab Course Objectives Course is aim to

Sr.No.	Course Objective
1	Understand concepts of REPL and Node.js Console.
2	Create simple websites based on Node.js features
3	Demonstrate database connectivity and operations
4	Make applications using Typescript concepts.
5	Construct Angular Forms using fundamentals of angular.
6	Create Single page applications using Angular.

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

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate the working of REPL and Node.js console.	Applying
CO2	Build simple websites making use of various Node.js features	Applying
CO3	Design a dynamic web application enabled with database connectivity	Creating
CO4	Use the fundamentals of Typescript to build web applications.	Applying
CO5	Build applications using Angular components.	Applying
CO6	Develop Forms with 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 **Node.js Modules, Events & Functions:** Standard Callback Pattern, Event Emitter Pattern, Event Types, Event Emitter API, Creating an Event Emitter. **Self-Learning Topics**: W3C Architecture, Additional Events.	8
2	**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
3	**Databases:** Connect and Communicate with a MySQL Database, adding data to the database, Reading data. **Self-Learning Topics:** Working with any other database.	10
4	**Typescript:** Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules. **Self-Learning Topics:** Typescript Generics.	8
5	**Introduction to Angular:** Introduction to Angular,Setup for local development environment,Angular Architecture,Angular Components and directives,Data Binding. **Self-Learning Topics:**Styles Binding In Components.	6
6	**Angular Forms and Modules:** Template Driven Forms,Reactive Forms,Working with Pipes,Services in Angular,Angular Routing,Angular Modules,Single Page Applications. **Self-Learning Topics:** Custom Directives.	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 Reference

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.tutorialspoint.com/master-typescript-learn-typescript-from-scratch/index.asp
6	https://angular.io/docs
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 components of typescript.
8	Create an application to demonstrate directives and pipes
9	Demonstrate features of Angular forms with a program

10	Create an application to demonstrate SPA.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments: 30-marks, Attendance Theory & Practical: 10-marks, Assignments: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL14

Term Work: 50 marks
The term work will be based on the Continuous Assessment and Laboratory work

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Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP11	**Project Seminar (Real Life Problems based on Societal Issues)**	**02**	**01**	**50**	**-**	**--**	**50**

Prerequisite: NIL

Lab Course Objectives: The course is aims to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on teamwork, effective communication, critical thinking and problem-solving skills.
2	Acquaint students with effective communication and problem-solving skills.
3	Adapt to rapidly changing critical thinking and problem-solving skills.
4	Adapt to a rapidly changing environment by having learned and applied new skills.
5	Adapt to applied new technologies effectively
6	Acquaint students with the process of applying basic computer applications and providing 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 a team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating
CO5	Communicate and report effectively project related activities and findings.	Understanding
CO6	Students will be able to practice acquired knowledge within the chosen area of technology for project development	Applying

Guidelines for Project:

1. Students shall form groups of 2 to 3 students.
2. Students should 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 timetable 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 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. Faculty may give inputs during project activity; however, focus shall be on self- learning.
5. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with Guide/ Supervisor.
6. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Project:

I) Term work (25 Marks):

- The progress of the 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) 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 the project and demonstrate their understanding of need/problem.
- Project shall be evaluated through a presentation and demonstration of the working model by the student project group to a panel of examiners at Institute level.
- 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.
- Effective use of skill sets.
- Contribution of an individual as a member or leader.
- Clarity in written and oral communication.

***

Semester II

Program Structure for First Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MCA21	Combinatorial Algorithms for Problem Solving	3	--	1	3	--	1	4
MCA22	Artificial Intelligence and Machine Learning	3	--	--	3	--	--	3
MCA23	Cyber Security And Digital Forensics	3	--	1	3	--	1	4
MCA24	IOT and IIOT	3	--	--	3	--	--	3
MCAE25	Elective - 1	3	--	1	3	--	1	4
MCAL21	Artificial Intelligence and Machine Learning Lab	--	2	--	--	1	--	1
MCAL22	Soft Skill Development Lab	--	2	--	--	1	--	1
MCAL23	IOT and IIOT Lab	--	2	--	--	1	--	1
MCAL24	Skill based Lab Course. DevOps Lab	--	4	--	--	2	--	2
MCAL25	Skill based Lab Course User Interface Lab	--	2	--	--	1	--	1
MCAL26	Skill based Lab Course AI Development Tools Lab	--	2	--	--	1	--	1
MCAP21	Project Stage 1	--	2	--	--	1	--	1
Total		**15**	**16**	**3**	**15**	**8**	**3**	**26**

Program Structure for First Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester II

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		CA	MT	Tot.					
MCA21	Combinatorial Algorithms for Problem Solving	20	20	40	60	2	25	--	125
MCA22	Artificial Intelligence and Machine Learning	20	20	40	60	2	--	--	100
MCA23	Cyber Security And Digital Forensics	20	20	40	60	2	25	--	125
MCA24	IOT and IIOT	20	20	40	60	2	--	--	100
MCAE25	Elective – 1	20	20	40	60	2	25	--	125
MCAL21	Artificial Intelligence and Machine Learning Lab	--	--	--	--	--	25	50	75
MCAL22	Soft Skill Development Lab	--	--	--	--	--	50	--	50
MCALE23	IOT and IIOT Lab	--	--	--	--	--	25	50	75
MCAL24	Skill based Lab Course. DevOps Lab	--	--	--	--	--	50	50	100
MCAL25	Skill based Lab Course User Interface Lab	--	--	--	--	--	25	50	75
MCAL26	Skill based Lab Course AI Development Tools Lab	--	--	--	--	--	25	50	75
MCAP21	Project Stage 1	--	--	--	--	--	50	--	50
Total		**--**	**--**	**200**	**300**	--	**325**	**250**	**1075**

Elective 1

Sr. No.	Course Code	Course Name
1	MCAE251	Digital Marketing and Business Analytics
2	MCAE252	Agile Project Management
3	MCAE253	Entrepreneurship Management

SEM II

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCA21	Combinatorial Algorithms for Problem Solving	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: Basic knowledge of Mathematics and Statistics

Course Objectives: Course is 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 and obtain their optimal solution
3	Solve the assignment problems and obtain their optimal solution
4	Develop the abilities in project evaluation techniques.
5	Understand job sequencing and solve real world problems.
6	Understand 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 models for a broad range of problems in business and industry.	Creating
CO2	Apply mathematics and mathematical modelling to forecast implications of various choices in real world problems	Applying
CO3	Think strategically and decide the optimum alternative from various available options	Evaluating
CO4	Apply PERT/CPM in project evaluation.	Applying
CO5	To Minimize the cost or time of completion of a sequencing problem.	Evaluating
CO6	Evaluate performance parameters of a real system using simulation 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), Traveling Salesman Problem : Hungarian method. **Self Learning Topics:** Simple applications in daily life	**6**
04	**PERT and CPM** 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. **Self Learning Topics:** Project crashing.	**7**
05	**Sequencing Problem** Two machines n jobs , three machines n jobs, n machines m jobs **Self Learning Topics:** Use of sequencing in real world problems	**4**
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. Able Baker call center problem.Simulation of inventory system (Newspaper seller problem) **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	Hrs
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	Traveling salesman Problem using Hungarian method	1
8	Critical Path method and PERT	1
9	2 job sequencing and 3 job sequencing	1
10	Single server queue simulation	1

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Total 25 Marks
(Experiments/Tutorials: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Term Work: 25 marks
The term work will be based on the Tutorial Performance

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	MT	Total			
		20	20	40	--	60	100

Prerequisite: Basics of data mining and Mathematical foundations of computer science-MCA11

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Understand different Artificial Intelligence 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, and clustering methods.
6	Become familiar with ensemble methods to improve the learning process.

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

Sr.No.	Outcome	Bloom Level
CO1	Understand Artificial Intelligence concepts and applications.	Understanding
CO2	Apply Artificial intelligence techniques for problem solving.	Applying
CO3	Analyze the fundamentals of machine learning algorithms, and the paradigms.	Analyzing
CO4	Analyze the fundamentals of learning algorithms for Forecasting.	Applying
CO5	Analyze the fundamentals of kernel machines and ensemble methods.	Applying
CO6	Identify methods to improve machine learning results for better predictive performance.	Applying

Module	Detailed Contents	Hrs	
1	**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. **Search Strategies:** Solving problems by searching, Search- Issues in the Design of Search Programs, Uninformed Search- BFS and DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, AO*Algorithms. **Self-Learning topics**: Tabu search	10	
2	**Module: Artificial Neural Networks:** Introduction, Activation Function, Optimization algorithm- Gradient descent, Networks- Perceptrons, Adaline, Multilayer Perceptrons and Backpropagation Algorithms Training Procedures, Tuning the Network Size **Self-Learning topics:** Maxnet algorithm	6	
3	**Introduction to ML**: Machine Learning Basics, Applications of ML,Data Mining vs. Machine Learning vs. Big Data Analytics, Types of Learning. Supervised Learning- Naive Bayes 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. **Self-Learning topics:** Density clustering, K-medoid	4	
4	**Forecasting and Learning Theory:** Non-linear regression, Logistic regression, Random Forest, Bayesian 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	

5	**Kernel Machines and 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: Bagging, Stacking, Boosting,, Implementing the AdaBoost algorithm, Classifying with AdaBoost , Bootstrapping and cross Validation Self-**Learning topics:** SMO Algorithm	10
6	**Dimensionality Reduction**: Introduction, Subset Selection, Principal Component Analysis, Multidimensional Scaling, and Linear Discriminant Analysis. **Self-Learning topics;** Feature selection, feature ranking and subset selection	3

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, and 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, 2013, ISBN 1259006166, 9781259006166
7	EthemAlpaydn, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6.
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

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCA23	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	MT	Total			
		20	20	40	25	60	125

Prerequisite: NIL

Course Objectives: Course is 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
5	Acquire depth knowledge of relationship between IT and Forensics Investigation
6	Understand different aspects of digital evidences and Digital Forensic

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

Sr.No.	Outcome
CO1	Demonstrate understanding of basic concepts in cyber security
CO 2	Make use of various tools and methods used in cybercrime
CO 3	Adapt fundamental knowledge of digital forensics
CO 4	Determine skills and knowledge for solving digital forensics Problems
CO5	Have in depth knowledge of relationship between IT and Forensics Investigation
CO6	Study different aspects of digital evidences and Digital Forensic Tools

Module	Detailed Contents	Hrs
1	**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).	**5**
2	**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	**Tools and Methods Used in Cybercrime** Phishing, Password Cracking, Keyloggers and Spywares, Virus ,worms and trojans, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer OverFlow, Attacks on Wireless Networks,Identity Theft (ID Theft) **Self learning Topic:** Various types of viruses,Worms and Trojans	**6**
4	**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 Anti Forensics. **Self learning Topic:** Various digital forensic models/ framework	**7**
5	**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,	**7**

	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	
6	**Network Forensic** 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, EMail 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) **Self learning Topic:** Various forms of Internet Frauds.	**7**

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

TUTORIAL :

Sr.No	Detailed content	Hrs .
1	Given a list of cases, identify whether it falls under the category of virus, worms or trojans.	**1**
2	Two real life case studies related to data diddling, salami attack and social engineering. Also , explaining what precautions need 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 emails in 'R-Mail' tool.	**1**
11	Investigation of information of captured packets by using 'Wireshark' tool.	**1**
12	Case Study on 'FKT' tool.	**1**

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks
The term work will be based on the Tutorial Performance

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCA24	IOT and IIOT	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	--	60	100

Prerequisite: 1. Knowledge of Computer Networks.
2. Basics of Cloud.

Course Objectives: Course is 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 aspects and generic design methodology.
4	Explain the IoT security aspects and generic design methodology.
5	Discuss IoT applicability in various domains along with the concept of Web of Thing (WoT).
6	Discuss IoT applicability in various domains along with the concept of 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
CO2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT	Understanding

CO3	Analyze various protocols for IoT security aspects and generic design methodology	Analyzing
CO4	Analyze various protocols for IoT and generic design methodology	Applying
CO5	Develop cloud based IoT Model for specific domains.	Applying
CO6	Develop a web based IoT Model for specific domains.	Applying

Module	Detailed Contents	Hrs
1	**Introduction to IoT and M2M** ● Introduction of Basic electronics and its components working ● 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 ● A brief background**,** ● M2M communication, ● 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	**8**

2	**IoT Architecture:** Introduction State of the Art ● European Telecommunications Standards Institute M2M/oneM2M ● International Telecommunication Union Telecommunication sector view ● Internet Engineering Task Force architecture fragments ● Open Geospatial Consortium Architecture. Architecture Reference Model ● Introduction, ● Reference model and architecture, IoT reference model ● IoT domain model, Information model, Functional model, ● Communication model, Safety, privacy, trust, security model ● IoTReference Architecture ● Introduction, Functional view, Information view, Deployment and operational view **Self-Learning Topics**: Other relevant architectural views	**11**
3	**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, 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	**6**
4	**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	**Domain SpecificIoTs:** HomeAutomation ● Smart Lighting ● Smart Appliances ● Intrusion Detection ● Smoke/Gas Detectors Cities ● Smart Parking ● Smart Lighting ● Smart Roads ● Structural Health Monitoring ● Surveillance ● Emergency Response Environment ● Weather Monitoring ● Air Pollution Monitoring ● Noise Pollution Monitoring ● Forest Fire Detection ● River Floods Detection Energy ● Smart Grids ● Renewable Energy Systems ● Prognostics Retail ● Inventory Management ● Smart Payments ● Smart Vending Machines Agriculture ● Smart Irrigation ● GreenHouse Control Industry ● Machine Diagnosis & Prognosis.w0-] ● Indoor Air Quality Monitoring **Self Learning Topics:** Case Study on Logistics and Health & Lifestyle	**6**
6	**IIOT and Cloud of Things:** Role of IIOT in Manufacturing Processes, Wireless sensor network (WSN) and Internet of Things (IoT), Business models: Saas, Paas, Iaas., big-data analytics infrastructures **Self Learning Topics:**Basics of Web and Cloud.	**4**

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

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE251	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	MT	Tot			
		20	20	40	25	60	125

Prerequisite: Knowledge about designing tools and basics of marketing

Course Objectives: Course is aim to

Sr.No.	Course Objective
01	Examine and explore the role and importance of Digital Marketing in the current business scenario.
02	Familiarize yourself 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.
05	Understand the various aspects of Social Marketing
06	Familiarize with Digital Analytics and its impact in Marketing

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 elements 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, and Content Marketing…	Creating

Module No.	**Detailed Contents**	**Hrs.**
1	Fundamentals of Digital Marketing: Origin and development of Digital Marketing. Digital Marketing Strategy. Skills Required in Digital Marketing, Digital Marketing Plan, Digital Marketing: Display Advertising Introduction to Display Advertising, Types of Display Ads, What Makes a Good Ad? Buying Models, Display Plan, Challenges Faced by Display Advertising. **Self Learning Topics:** Programmatic Digital Advertising, YouTube Advertising	04
2	Search Engine Advertising 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	07
3	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:** LinkedIn Sales Navigator	10

4	Mobile Marketing Mobile Usage, Mobile Advertising, Mobile Marketing Toolkit, Mobile Marketing Features, Mobile Analytics **Self Learning Topics**: Addressing the Diversity in India through Mobile	06
5	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	Digital Analytics Data Collection: Web logs, Benefits of Weblogs , Challenges with web logs, Key Metrics: Behaviours Analysis : visits/Session, Time on Site, Page views, Bounce Rate, Heat Map Analysis, Experience Analysis **Self Learning Topics**: Interpretation of various Charts available in Google Analytics. How to connect Offline with Online	06

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	The Art of SEO, Eric Enge, Stephan Spencer, Jessie Stricchiola, O'Reilly Media Inc,
7	Digital Marketing 2020, Danny Star,

Tutorial/Case Studies

Faculty can make the group of students according to class strength, Group has to present case studies based on the following topics. The Case Studies mentioned are indicative and not limited to given topics. The Teacher has the flexibility of taking similar Case Studies taking into consideration the current scenario and technological changes.

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

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks
The term work will be based on the Tutorial Performance.

Course	Course Name	Teaching Scheme			Credits Assigned		
MCAE252	Agile Project Management	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Tot			
		20	20	40	25	60	125

Prerequisite: Knowledge of Software Engineering

Course Objectives: course aim to

Sr.No.	Course Objective
01	Understand the concepts of Agile Project Management.
02	Familiarize Project Management framework and Agile estimation Tools.
03	Apply knowledge of Project Life Cycle to implement the projects.
04	Understand the techniques of project scheduling & project implementation.
05	Understand the Aspects of International Projects
06	Learn software Risk Management Process.

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	Applying the tools for Project Scheduling	Applying
CO3	Make use of estimation logic for Agile estimation of software size.	Applying
CO4	Managing Scope And Procurement with Agile	Analysing
CO5	Assess various factors involved in Team building and project conflict management.	Evaluating
CO6	Identifying and Analysing Risk Categories	Understanding

Module	Detailed Contents	Hrs
01	**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. **Self Learning Topics**: Evolving role of software.	**06**
02	**Software Project Planning & Agile Estimation:** Business Case, Creating the Work Breakdown Structures (WBS). Agile Software Estimation: Story points, Epics, Themes, Ideal time, Splitting the User Stories, Estimating size with story points, Estimating in Ideal Days, Techniques for estimating, choosing between story points and ideal days, splitting User stories **Self Learning Topics**: Function Point , COCOMO	**10**
03	**Project Scheduling and Agile Procurement Management:** Project Schedule, Schedule Control, Critical Path Method (CPM) (Numericals), Numerical on EVM, Basics of Procurement Management, Managing Scope And Procurement with Agile: Agile Project Scoping, Agile Procurement. **Self Learning Topics**: Change Management.	**08**
04	**Managing Participation , Teamwork and Conflict** Leadership in Project Management , Participative Management , Teams in Project Management , The Team Building Approach Origins of Conflict , Consequences of Conflict, Managing conflicts, Team Methods for resolving conflicts , Emotional Stress, Stress Management **Self Learning Topics** : Social Support to reduce Job Stress	**05**

05	**International Project Management** International Projects, Problems Managing International Projects, Local Institutions and Culture , Local Stakeholders, Geo-National Issues, Project Manager, Local Representative, Top Management, Committees, and PMO, Team and Relationship Building ,Project Definition, Project Monitoring ,Communication ,Risks and Contingencies **Self Learning Topics**: Law of Contracts and Rights at International level	**05**
06	**Risk Exposure and Risk Management Process** Risk Components, Risk Categories-Risk due to Product size, Technology, Business Impact. People, Process Maturity, risk exposure Risk Management Process-Risk management planning Risk identification Qualitative risk analysis Quantitative risk analysis **Self Learning Topics**: Risk Monitoring Tools	**05**

Reference Books:

Reference No.	**Reference Name**
1	Managing Information Technology Project, 6th edition, by Kathy Schwalbe, Cengage Learning publication.
2	Information Technology Project Management by Jack T Marchewka Wiley India Publication.
3	Agile project Management by Jason Bennett and Jennifer Bowen
4	Agile Estimating and Planning by Mike Cohn , Pearson edu

Web References:

Reference No.	Reference Name
1	**https://www.projectmanager.com**
2	**https://www.tutorialspoint.com**
3	**https://www.atlassian.com/agile/project-management/epics-stories-themes**
4	**https://technologyadvice.com**

Tutorials:-

Suggested Tutorials List, but not limited to the following Lists:-

Sr. No.	Detailed Contents	Hrs.
01	Business Case for Project (Case study).	**02**
02	Software Requirement Specification (SRS Case Study).	**02**
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.	**02**
04	Gantt chart, Critical Path Analysis.	**01**
05	Study of Agile Project Management Tool-Jira, Wrike, Monday.com,Trello, Click UP	**01**
06	Identifying Responsibilities and Qualification of Agile Project team Members for a Project (Case Study)	**01**
07	Case study on International Project	**02**
08	Identify the conflicts and stress involved in the Project undertaken	**01**

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Term Work : 25 marks
The term work will be based on the Tutorial Performance

Course	Course Name	Teaching Scheme			Credits Assigned		
MCAE253	Entrepreneurship Management	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Tot			
		20	20	40	25	60	125

Prerequisite: 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 an 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
CO2	Understand the growth and development strategies for venture and Social Responsibilities	Understanding
CO3	Identify the Role of Small-Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise.	Applying
CO4	Analyse the process of Business Idea generation and converting the idea into a Business Model.	Analyzing
CO5	Evaluate the effectiveness of different entrepreneurial strategies, policies and measures for promoting small industries.	Evaluating
CO6	Create presentations and marketing strategies that articulate financial, operational, organizational, market, and sales knowledge for value creation.	Creating

Module No.	Detailed Contents	Hrs
1	**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	**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	**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 the 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	**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	**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, Break Even Analysis, Pricing-Setting Techniques, Credit Policies, Promotions. **Self-learning topics:** Role of Digital Marketing for an entrepreneur as promoting their product.	**6**
6	**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

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks

3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work : 25 marks

The term work will be based on the Tutorial Performance

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL21	Artificial Intelligence & Machine Learning Lab	2	1	25	30	20	75

Prerequisite: Basic understanding of mathematical, data mining concepts and any programming Language.

Lab Course Objectives: Course Aims to

Sr.No.	Course Objective
1	Understand the 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 a model using appropriate machine learning algorithms for real world problems.
5	Build a model using appropriate advanced machine learning algorithms for real world problems
6	Deployment of model to be learned

Lab Course Outcomes: On the successful completion of the course, students will be able to

Sr. No.	Outcome	Bloom Level
CO1	Demonstrate the basic concepts of Artificial Intelligence and Machine Learning using various libraries in Python.	Applying
CO2	Implement basic Supervised and unsupervised machine learning algorithms and their applications.	Analyzing
CO3	Analyze dimensionality reduction techniques for feature extraction and selection.	Analyzing
CO4	Develop models using Support Vector machines and kernels for real world problems.	Creating
CO5	Develop models using appropriate advanced machine learning algorithms for real world problems.	Creating
CO6	Deploy the machine learning model for real world problems.	Creating

Description:

Module	Detailed Contents	Hrs
1	**Introduction to Python Programming:** Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, and Scikit Learn. **Self Learning Topic: -** Milk, Shogun.	6
2	**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
3	**Unsupervised Learning:** K-Means Clustering Algorithm, K-Medoid Clustering Algorithm **Self Learning Topic:** Other Clustering Algorithms.	2
4	**Classifying data using Support Vector Machines (SVMs):** SVM-RBF kernels. **Self Learning Topic**: -SVM-Kernels-Polynomial Kernel	2
5	**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
6	**Boosting Algorithms:** AdaBoost, Stochastic Gradient Boosting, Voting Ensemble. **Self Learning Topic**: - AdaBoost as a Forward Stage .	4
7	**Dimensionality Reduction:** Features Extraction, Feature selection, Normalization, Transformation, and Principal Components Analysis-visualizations of complex datasets . **Self Learning Topic:** - LDA (Linear Discriminant Analysis).	4

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	EthemAlpaydn, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6.
5	Peter Harrington, Machine Learning in Action. Manning Publications, April 2012 ISBN 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/

A suggested list of experiments

Practical No	Problem Statement
1	Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.
2	Implementation of Linear Regression, Logistic regression, KNN- classification.
3	Implementation of dimensionality reduction techniques: Features Extraction and Selection, Normalization, Transformation, Principal Components Analysis.
4	Implementation of K-Means and K-medoid clustering algorithm.
5	Implementation of classifying data using Support Vector Machines (SVMs).
6	Implementation of Bagging Algorithm: Decision Tree, Random Forest.
7	Implementation of Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL21

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL22	Soft Skills Development Lab	02	01	50	--	--	50

Prerequisite: 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 aims 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.
4	Awareness and etiquettes of Written communication skills
5	Inculcate the skills of facing Interview , group discussion
6	Provide understanding and ways of Effective Public speaking

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

Sr. No.	Outcome	Bloom Level
CO1	Develop interpersonal skills that help in communication, teamwork, leadership and decision making.	Applying
CO2	Methodically study, formulate and interpret different facets of organizational behavior.	Evaluating
CO3	Develop holistic leaders and technocrats helping in individual and organizational growth.	Creating
CO4	Students will be able to demonstrate Presentation Skills	Applying
CO5	Develop Business communication and etiquettes of written communication	Applying
CO6	Develop public speaking skills which help in building confidence.	Creating

Description:

Module No	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 **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) **Self LearningTopics :**Problems/Barriers in communication	**03**
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 Don'ts 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. Practical (Group Discussions) **Self LearningTopics: --**Ethics of group Discussion and Debates	**03**

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.

Suggested 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

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments/Assignments: 20-marks, Group Presentation :20 Marks Attendance Theory & Practical: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL**22**

Term Work: 50 marks

The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL23	IOT and IIOT Lab	02	01	25	30	20	75

Prerequisite: 1. Knowledge of C and C++ Programming.
2. Basics of Cloud.

Lab Course Objectives: Course is aim to

Sr. No.	Course Objective
1	Learn basic electronic components and to get familiar with arduino software/hardware.
2	Learn basic electronic components and to get familiar with arduino simulator.
3	Interface various I/O devices with arduino.
4	Interface various sensors with arduino.
5	Interface IoT device with cloud.
6	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.	Applying
CO 2	Identify basic electronic components and make use of arduino simulators.	Applying
CO 3	Experiment with various I/O devices with Arduino.	Applying
CO 4	Experiment with various sensors with Arduino.	Applying
CO 5	Build IoT applications using Cloud.	Creating
CO 6	Develop IoT based projects.	Creating

Description:

Module	Detailed Contents	Hrs
1	**Introduction to Basic Components** : Detail working of all the electronics components (resistor ,capacitors,transistor & IDE software 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.	4
2	**Switches, LEDs, and More:** Programs based on interfacing LEDs, 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	**Analog Values** Programs based on interfacing LEDs, 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 of Arduino **Self Learning Topics:** Basic of Analog values, PWM concepts	6
4	**Servo Motors:** Programs based on interfacing LEDs, Servo Motor, Potentiometer with Arduino **Self Learning Topics:** Basics of servo motors, potentiometer	2
5	**IoT in Cloud:** Interfacing IoT device with Cloud **Self Learning Topics:** Computer Network and Cloud Concepts	4

6	**Mini Project:** Mini projects such as Home automation, Robots, Wearable projects, art projects etc.(Remove) **Self Learning Topics:** Real life problem statement	**6**

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 with 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 Perspective,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 devices with the 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 2 different notes on a 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 a message on the LCD when the 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 the LCD.
10	To interface LEDs, 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, Photoresistor (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 LEDs 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.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCALE**232**

Term Work: 25 marks
The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL24	DevOps Lab	04	02	50	30	20	100

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, and Software Engineering

Lab Course Objectives:

Sr.No.	Course Objective
1	To understand DevOps practices which aim to simplify Software Development Life Cycle.
2	To be aware of different Version Control tools.
3	To familiarize with Jenkins build & test software Applications.
4	To understand Docker to build, ship and run containerized images.
5	To familiarize with the concept of Software Configuration Management.
6	To familiarize with the concept of Continuous Monitoring.

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options	Understanding
CO 2	Understand the concepts of different version control tools	Understanding
CO 3	Apply Jenkins to Build, Deploy and Test the Software Applications	Applying
CO 4	Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker	Analyzing
CO5	Deploy and Examine the Software Configuration management using Ansible/Chef.	Applying
CO6	Examine the Software Continuous monitoring using Nagios	Analyzing

Description:

Sr. No.	Module	Detailed Content	Hours
I	Introduction to Devops	Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications. **Self-Learning Topics: Scrum, Agile**	**06**
II	Version Control using GIT	GIT Installation, Version Control, working with remote repository, GIT Cheat sheet, Create and fork repositories in GitHub, apply branching, merging and rebasing concepts, implement different Git workflow strategies in real-time scenarios, Understand Git operations in IDE **Self-Learning Topics: AWS Codecommit**	**08**
III	Working with Jenkins and Testing using Selenium	Introduction to Jenkins (With Architecture), Introduction to Ant, Jenkins Management Adding a slave node to Jenkins, Build the pipeline of jobs using Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server, Introduction to Selenium, integrate Selenium with Jenkins and TestNG **Self-Learning Topics: GitLab, AWS CodePipeline**	**10**
IV	Continuous Deployment: Containerizatio n n with Docker	Introduction to Docker Architecture and Container Life Cycle, understanding images and containers, Create and Implement Docker images using Docker file, Container Lifecycle and working with containers, To Build, deploy and manage web or software application on Docker Engine, Publishing image on Docker Hub.	**10**

		Self-Learning Topics: Docker Compose, Docker Swarm.	
V	Software Configuration Management	Introduction to Software Configuration Management Introduction to Chef/Ansible, Installation, Environment, Roles, Commands **Self-Learning Topics: Puppet, Saltstack**	**09**
VI	Software Continuous Monitoring	Introduction to Continuous Monitoring Introduction to Nagios, Installing Nagios, Nagios Plugins (NRPE) and Objects Nagios Commands and Notification, Monitoring of different servers using Nagios **Self-Learning Topics: Splunk, Snort, Tenable**	**09**

Reference Books:

Reference No	Reference Name
1	Prem Kumar Ponuthorai, Jon Loeliger, Version Control with Git, 3rd Edition,O'Reilly Media.
2	Mastering Jenkins by Jonathan McAllister,Packt Publishing
3	Sanjeev Sharma and Bernie Coyne,"DevOps for Dummies", Wiley Publication
4	John Ferguson Smart,"Jenkins, The Definitive Guide", O'Reilly Publication.
5	Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
6	Russ McKendrick, Learn Ansible, Pakt Publication
7	Learning Chef: A Guide to Configuration Management and Automation

	by Mischa Taylor and Seth Vargo
8	Learning Nagios, Packt Publishing

Web References:

Reference No	Reference Name
1	https://www.javatpoint.com/devops
2	https://git-scm.com/docs/gittutorial
3	https://www.jenkins.io/doc/tutorials/
4	https://www.softwaretestinghelp.com/integration-of-jenkins-with-selenium-webdriver/
5	https://docs.docker.com/get-started/
6	https://docs.ansible.com/ansible/latest/getting_started/index.html
7	https://learn.chef.io/
8	https://www.guru99.com/nagios-tutorial.html

Suggested list of experiments

Practical No	Problem Statement
1	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2	To implement Version control for different files/directories using GIT, install git and create a GitHub account.
3	To implement version control using GITHUB to sync local GIT repositories and perform various related operations using GIT Cheat-Sheet
4	To deploy and test Java/web/Python application on Jenkins server
5	To implement Jenkins pipeline using scripted/declarative pipeline
6	To use Jenkins to deploy and run test cases for Java/Web application using Selenium/TestNG
7	To implement Jenkins Master/Slave architecture
8	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
9	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
10	To implement continuous deployment using Ansible/chef
11	To implement continuous monitoring using Splunk/NagiOS

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments: 30-marks, Attendance Theory & Practical: 10-marks, Assignments: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL24

Term Work : 50 marks

The term work will be based on the Continuous Assessment and Laboratory work

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**

Prerequisite: Basic knowledge of Web Technologies and Software Engineering.

Lab Course Objectives: Course is aim to

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
4	Learn techniques for Evaluating User Experience.
5	Understand the concept of Good UI and User Experience (UX).
6	Understand the importance of testing application design before actual implementation

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 a high fidelity prototype for an end to end solution.	Creating
CO4	Apply best practices for evaluating user experience.	Applying
CO5	Apply the concept of Good UI and User Experience (UX).	Applying
CO6	Write test cases for application design	Creating

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.Extracting Interaction Design Requirement **Self Learning Topics:**Contextual enquiry,contextual analysis.	4
3	**Analysis:** User analysis,Task analysis,Domain analysis	4
4	**Design:** Persona,Scenario, Storyboard designs Ideation,Sketching. **Self Learning Topics: Principles of good design, Mental model**	4
5	**Implementation:** Build Prototype(Low Fidelity and High Fidelity):Paper prototype, Wireframe prototype **Self Learning Topics:** Different tools to build the high fidelity prototype like figma , Adobe, Canva)	4
6	**Testing:** Evaluate the interface with a small user test and write a final reflection **Self Learning Topics : Testing Techniques**	6

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	**Requirement gathering and (Choose the project)** **Requirement gathering** 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** **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. □ A problem object model or entity-relationship diagram.
3	**Design** **Creation of Scenario,Persona and Storyboard** Write a scenario and story that involves all three of the tasks identified for the chosen project. □ Explain the Scenario,story □ Sketch the scenario and story (use any tool or hand sketches) □ Draw a mental model. Design persona as per the users of the application
4	**Prototype** Creating a Paper Prototype and High Fidelity prototype (Wire Frame)usingFigma tool. **Output** □ Paper prototype □ Wireframe.
5	**Usability Evaluation of the Design** Testing of User Interface from Third Party(**Test scripts) Output** □ Test Script

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL25

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL26	**AIM Development Tools Lab**	**02**	**01**	**25**	**30**	**20**	**75**

Prerequisite: Basic Understanding of SQL, Java Programming and Python

Lab Course Objectives:-Course is aim to

Sr.No.	Course Objective
1	Understand various components of AWS and identify the problem solution
2	Understand AWS Sagemaker fundamentals for data labeling, bounding boxes and Semantic Segmentation.
3	Apply various EDA techniques for Data Preprocessing and build Linear Regression Models for problem solving.
4	Apply various Hyperparameter Search Optimization strategies.
5	Build classification models to solve real life problem
6	Apply ChatGPT for the usage of code generation, optimization and debugging

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Apply various components of AWS for problem solutions.	Applying
CO 2	Apply AWS Sagemaker fundamentals for data labeling, bounding boxes and Semantic Segmentation	Applying
CO 3	Apply various EDA techniques for Data Preprocessing and create Linear Regression	Creating
CO 4	Apply various Hyperparameter Search Optimization strategies.	Applying
CO 5	Create classification models to solve real life problem	Creating
CO 6	Apply ChatGPT for the usage of code generation, optimization and debugging	Applying

Description:

Module No	Detailed Contents	Hrs.
1	Introduction to AWS sign up and Service Legal Agreement, Introduction to real-world problems for project-based Learning, Introduction to AWS sagemaker (Signup, free tier, billing, & Iam), AIML components in AWS, Simple Storage Service (S3) and Elastic Computing Cloud (EC2) Introduction.	4
2	Introduction to AWS SageMaker, Data Labeling in AWS Sagemaker GroundTruth, Labeling Text, Bounding Boxes and Semantic Segmentation in Ground Truth	4
3	EDA and AWS Data Wrangler, Feature Engineering, one hot Encoding, Normalization vs Standardization, Linear and Multiple Linear Regression using AWS Sagemaker.	4
4	Sagemaker XGBoost Algorithm, Data Split for Sagemaker, Hyperparameter Search Optimization, Hyperparameters Optimization Strategies, Bias Variance Tradeoff, L2 Regularization (Ridge Regression), L1 Regularization (Lasso Regression), Hyperparameters Optimization Using GridSearchCV.	6
5	Classifiers using AWS Sagemaker- SVM, Naive Bayesian, KNN Classification, Logistic Regression, Random Forest.	4
6	ChatGPT for Programmers, Nocode ML, Lambda Functions using AWS Console, Synchronous Vs. Asynchronous Invocations.	4

Reference Books:

Reference No	Reference Name
1	Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins 1st Edition, Kindle Edition.
2	AWS for Beginners: The Complete Beginner's Guide to Learn and Understand Amazon Web Services and Its Future in the Modern World by Vick Middleton.
3	Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation by Karen Tovmasyan.

Web References:

Reference No	Reference Name
1	https://aws.amazon.com/
2	https://aws.amazon.com/sagemaker
3	https://aws.amazon.com/getting-started/ha
4	https://aws.amazon.com/sagemaker/da

Suggested list of experiments

Practical no.	Problem Statement
1	Introduction to Project Based Learning and understand the problem statements.
2	Crete login credential and understand SLA, EC2, S3 of AWS.
3	Introduction to Sagemaker -Labeling data and text and bounding boxes.
4	Implementation of Exploratory Data Analysis (EDA).
5	Implementation of Linear and Multiple Linear Regression Analysis.
6	Implementation of Sagemaker XGBoost Algorithm
7	Implementation of Optimization strategy
8	Implementation of Regularization Techniques
9	Implementation of Classification Algorithms
10	Study of ChatGPT and Deployment of projects.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL26

Term Work: 25 marks
The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP21	**Project Stage- 1**	**02**	**01**	**50**	**-**	**--**	**50**

Prerequisite: NIL

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on teamwork, effective communication, critical thinking and problem-solving skills.
2	Acquainted with effective communication and problem-solving skills.
3	Adapt to rapidly changing critical thinking and problem-solving skills.
4	Adapt to a rapidly changing environment by having learned and applied new skills.
5	Adapt to applied new technologies effectively
6	Acquainted with the process of applying basic computer applications and providing 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 a team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating
CO5	Communicate and report effectively project related activities and findings.	Understanding
CO6	Students will be able to practice acquired knowledge within the chosen area of technology for project development	Applying

Guidelines for Project:

1. Students should 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.
2. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of the project.
3. 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. Faculty may give inputs during project activity; however, focus shall be on self- learning.
4. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with the Guide/ Supervisor.
5. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
6. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Project:

I) Term work (25 Marks):

- The progress of the 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) 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 Project and demonstrate their understanding of need/problem.
- Project shall be evaluated through a presentation and demonstration of the working model by the student project group to a panel of examiners at Institute level.
- 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 the 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 III

Program Structure for Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester III

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 - 2	3	--	--	3	--	--	3
MCAE34	Elective - 3	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 2 Lab	--	2	--	--	1	--	1
MCAL34	Skill based Lab Mobile Computing Lab	--	4	--	--	2	--	2
MCAL35	Software Testing and Quality Assurance Lab	--	2	--	--	1	--	1
MCAP31	Project Stage 2	--	2	--	--	1	--	1
Total		**12**	**14**	1	**12**	**07**	**1**	**20**

Program Structure for Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester III

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		CA	MT	Tot					
MCA31	Big Data Analytics and Visualization	20	20	40	60	2	--	--	100
MCA32	Distributed System and Cloud Computing	20	20	40	60	2	--	--	100
MCAE33	Elective – 2	20	20	40	60	2	--	--	100
MCAE34	Elective - 3	20	20	40	60	2	25	--	125
MCAL31	Big Data Analytics and Visualization Lab	--	--	--	--	--	25	50	75
MCAL32	Distributed System and Cloud Computing Lab	--	--	--	--	--	25	50	75
MCALE33	Elective 2 Lab	--	--	--	--	--	25	50	75
MCAL34	Skill based Lab Mobile Computing Lab	--	--	--	--	--	50	50	100
MCAL35	Software Testing Quality Assurance Lab	--	--	--	--	--	25	50	75
MCAP31	Project Stage 2	--	--	--	--	--	50	-	50
Total		**--**	**--**	**160**	**240**	**--**	**225**	**250**	**875**

Elective 2

Sr. No.	Course Code	Course Name	Lab Course Code
1	MCAE331	Block chain	MCALE331
2	MCAE332	Deep Learning	MCALE332
3	MCAE333	Ethical Hacking	MCALE333

Elective 3

Sr. No.	Course Code	Course Name
1	MCAE341	Sustainable Computing
2	MCAE342	Natural Language Processing
3	MCAE343	Computational Intelligence

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme</th><th colspan="3" rowspan="2">Credits Assigned</th></tr>
<tr><td rowspan="6">MCA31</td><td rowspan="6">Big Data Analytics and Visualization</td><td colspan="3">Contact Hours</td></tr>
<tr><td>Theory</td><td colspan="2">Tutorial</td><td>Theory</td><td>Tutorial</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td>3</td><td>--</td><td>3</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>MT</td><td>Total</td></tr>
<tr><td>20</td><td>20</td><td>40</td><td>--</td><td>60</td><td>100</td></tr>
</table>

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

Course Objectives: The Course aim to

Sr.No.	Course Objective
1	Provide an overview of exciting and growing field of big data analytics
2	Enhance the programming skills using big data technologies like map reduce.
3	Enhance the database and scripting skills using big data technologies NoSQL, Hbase
4	Understand the concept of HIVE and PIG for problem solving.
5	Use of Apache Kafka and Spark applications to explore, process, and analyze distributed data
6	Understand why visualization is important for data analysis, using various data visualization techniques.

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	Applying
CO3	Develop problem solving skills in fundamental enabling techniques using NoSQL, Hbase	Applying
CO4	Utilising HIVE and Pig, develop your problem-solving abilities in fundamental enabling approaches.	Applying

CO5	Use of Apache kafka RDD and Dataframe to create Application in Spark	Applying
CO6	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 **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**	**6**
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**	**6**

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**	**9**
5	**Apache Kafka:** Kafka Fundamentals, Kafka architecture, **Apache Spark:** Spark Basics, Working with RDDs in Spark, Spark Framework, Spark SQL and Data Frames. **Self-Learning Topics: KMeans and Page Rank in Apache Spark**	**6**
6	**Data Visualization:** Importance and benefits of data visualization, Principles of effective data visualization, Types of data visualization techniques, Tools and technologies for data visualization,Challenges of big data, visualization, Power BI as a Visualization tool, Creation of Dashboards - Power BI. **Self-Learning Topics: Splunk via web Interface.**	**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 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://powerbi.microsoft.com/en-in/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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	MT	Total			
		20	20	40	–	60	100

Prerequisite: Computer Networks, Operating Systems

Course Objectives: Course is 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 concepts of Distributed System management
5	Analyze the principles and paradigm of Cloud Computing.
6	Understand the various design issues and challenges in cloud computing

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

Sr.No.	Outcome	Bloom Level
CO 1	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 Distributed system management	Analyzing
CO 5	Analyze Cloud computing concepts	Analyzing
CO 6	Analyze cloud computing models	Analyzing

Module	Detailed Contents	Hrs
1	**Introduction to Distributed Computing Concepts:** Basic concepts of distributed systems, distributed computing models, issues in designing distributed systems **Inter Process Communication** Fundamental concepts related to inter process communication including message passing mechanism, Concepts of group communication **Remote Communication** Remote Procedure Call (RPC), Remote Method Invocation (RMI) **Self Learning Topics:** Case study on Java RMI	9
2	**Clock synchronization:** Introduction of clock synchronization, Global state, Mutual Exclusion Algorithms, Election algorithms. **Self Learning Topics:** Synchronization in Wireless Networks	4
3	**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	5
4	**Distributed System Management:** Resource Management Scheduling Algorithms, Task Assignment, Load balancing approach, Load sharing approach **Process Management** Process Migration Mechanism **Self Learning Topics:** Case Study of anyone distributed system	4
5	**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	7

6	**Classification of Cloud Implementations:** Amazon Web Services, Microsoft Azure & Google Cloud-- Compute Services, Storage Services, Database services. Google AppEngine (GAE), Comparative study 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:** Windows 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. Sunita Mahajan , 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/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

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	MT	Tot			
		20	20	40	--	60	100

Prerequisite:

Basic knowledge of cryptography, networking, distributed systems and expertise in object oriented programming.

Course Objectives (CO): Course aim to

Sr.No.	Course Objective
1	Provide the overview of the structure and mechanisms of Blockchain
2	Understand cryptographic techniques used in Blockchain
3	Understand cryptocurrency transactions and mining Bitcoin .
4	Understand and write the smart contracts in Ethereum .
5	Understand the applications of Blockchain technology
6	Understand the different case studies in Blockchain .

Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Explain Blockchain technologies and their components.	Understanding
CO2	Interpret the uses of cryptographic techniques in Blockchain	Understanding
CO3	Demonstrate the use of Bitcoin and its components	Understanding

CO4	Build the smart contracts in Ethereum	Applying
CO5	Analyze the use of Blockchain technology in various domains	Analyzing
CO6	Applying the use of Blockchain technology in various domains	Applying

Description

Module	Detailed Contents	Hrs
1	**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	06
2	**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 **Self-learning Topics:** Basics of data structure (Linked lists), Hash Functions	06
3	**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	**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	**Ethereum:** History, Architecture, Account 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 Management , Gossip Protocol	06
6	**Case Study:** Blockchain in Government (Digital Identity, Tax Payments, Land Registration , Audit and Compliances),case study on blockchain with iot security	06

References:

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 .om/wiki/Digital signature
3	https://www.usenix.org/legacy/events/osdi99/full_papers/castro/castro_html/castro.ht ml
4	httns://www .hvoerledrrer.om /oroi ects/fabric
5	https://hyperledger-fabric .readthedocs.io/en/release-2.01
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/homeworkl O/hashfuncs.html
11	https ://www .globalsign .com/en/ssl-information-center /what-is-public-key- cryptography
12	https://Isearchsecurity .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/leam /ethereum-101/how-ethereum-works
18	httns://www .coindesk.com/short-m1ide-blockchain-consensus-orotocols

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
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5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
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8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course	Course Name	Teaching Scheme			Credits Assigned				
		Contact Hours							
		Theory	Pract	Tut	Theory	Practical	Tut.	Total	
		3	-	-	3	-	-	4	
MCAE332	Deep Learning	Examination Scheme							
		Theory			End Sem Exam	Term Work	Practical	Oral	Total
		CA	MT	Total					
		20	20	40	60	-	-	-	100

Prerequisite: Basic knowledge of mathematical and machine learning concepts.

Course Objectives: Course aims to

Sr.No.	Course Objective
1	Understand the concepts of neural networks and deep learning.
2	Understand the appropriate learning rules for each of the architectures and learn several neural network paradigms.
3	Understand major deep learning algorithms and the problem settings for problem-solving
4	Learn about the different regularization techniques and apply them to the real world applications.
5	Understand the optimization algorithms used for training deep learning models.
6	Demonstrate deep learning algorithms -CNN and RNN to solve real-world problems.

Course Outcomes:

Sr. No.	Outcome	Bloom Level
CO1	Demonstrate the concepts, architectures, and algorithms of Neural Networks to solve real-world problems.	Understanding
CO2	Understand deep feed-forward networks and applications.	Applying
CO3	Understanding various regularization techniques and their importance in Deep learning .	Applying
CO4	Demonstrate different optimization algorithms used in Deep learning models	Analyzing
CO5	analyze the challenges in developing Convolutional Networks and apply them to real world-problems.	Analyzing
CO6	Analyze challenges in developing Recurrent and recursive networks and apply them to real world-problems.	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 Affecting Back-propagation Training, Unsupervised Learning Networks- MaxNet. **Self-learning Topic: -**Mexican Hat Net.	**8**
02	**Deep Feed-forward Networks**: Introduction to Deep Learning, Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, and 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. **Self-learning Topic:-**Regularized Linear Regression.	**6**
04	**Optimization for Training Deep Models-** Need for Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies. **Self-learning Topic**:-Conjugate Gradients Method.	**5**
05	**Convolutional Networks**: Motivation, Pooling, Convolutional layers, Additional layers, Residual Nets, Applications of deep learning. **Self-learning Topic:-**Application of CNN.	**6**
06	**Recurrent and Recursive Nets:** Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder -Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, and 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 No 0-07-115467-1.
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

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme</th><th colspan="3" rowspan="2">Credits Assigned</th></tr>
<tr><td rowspan="6">MCAE333</td><td rowspan="6">Ethical Hacking</td><th colspan="3">Contact Hours</th></tr>
<tr><th colspan="2">Theory</th><th>Tutorial</th><th>Theory</th><th>Tutorial</th><th>Total</th></tr>
<tr><td colspan="2">3</td><td>--</td><td>3</td><td>--</td><td>3</td></tr>
<tr><th colspan="6">Examination Scheme</th></tr>
<tr><th colspan="3">Theory</th><th rowspan="2">Term Work</th><th rowspan="2">End Sem Exam</th><th rowspan="2">Total</th></tr>
<tr><th>CA</th><th>MT</th><th>Total</th></tr>
<tr><td>20</td><td>20</td><td>40</td><td>--</td><td>60</td><td>100</td></tr>
</table>

Prerequisite: Networking concepts, Structured Query Language, encryption algorithms

Course Objectives: Course is 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 a 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.
5	understanding of security threats in the cyber world and provide countermeasures to curb hacking.
6	Provide a deep understanding of security 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 cyber laws.	Understanding
CO 3	Apply available hacking tools to find a solution to a given hacking issue.	Applying

CO 4	Analyze the real-world hacking cases	Analyzing
CO5	classify the real-world hacking situations.	Analyzing
CO6	Analyze and implement hacking cases and situations.	Analyzing

Description

Module	Detailed Contents	Hrs
1	**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 Amendments to the Indian IT Act(2008) ,Phases of hacking. **Self-Learning Topics:** ethical hacking tools	**04**
2	**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:** footprinting tools	**05**
3	**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? Wiretapping 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	**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	**Hacking web servers, web applications and sql injection: Session hijacking**: What is session hijacking? Why is session hijacking successful? session hijacking techniques, session hijacking process, Types of session hijacking, session hijacking countermeasures: protecting and preventing, Hacking web servers and web applications: Causes of web servers 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 countermeasures. 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.	**07**
6	**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,Cryptography attacks and cryptanalysis tools **Self-Learning Topics:** Tools of WEP/WPA, cloud computing, cryptography.	**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/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE341	Sustainable Computing	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Tot			
		20	20	40	25	60	125

Prerequisite:

1. Knowledge of computer peripherals
2. Knowledge of data storage devices
3. Some awareness towards Environment as a whole

Course Objectives: The course is aim to

Sr. No.	Course Objective
01	Explain why Green IT is important to the enterprise over all
02	Explain why Green IT is important to the enterprise over all 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 environments

Course Outcomes (CO): 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	Topics of Coverage	Hours
1	**Trends and Reasons to Go Green:** ● Overview and Issues ● Consumption Issues ○ Minimizing PowerUsage ○ Cooling **Self-Learning Topics:**Current Initiatives and Standards	05
2	**Introduction to Green IT**: ● GreenIT ● Holistic Approach to Greening IT ● Greening by IT (can be used for case study also) ○ Using RFID for Environmental Sustainability ○ Smart Grids ○ Smart Buildings and Homes ○ Green Supply Chain and Logistics ○ Enterprise-Wide Environmental Sustainability **Self-Learning Topics**:Awareness to Implementation	06
3	**Sustainable Hardware and Software** **Green Hardware** ● Introduction ● Life Cycle of a Device or Hardware ● Reuse, Recycle and Dispose **Green Software** ● Introduction ● Energy-Saving Software Techniques ● Sustainable Software Development **Self-Learning Topics**:Changing the way we work	07

4	**Sustainable IT Infrastructure and Management** **Green Data Centers** ● Data Centre ITInfrastructure ● 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 **Self-Learning Topics**:Refer some latest IEEE papers on the relevant topics	10
5	**Sustainable Enterprise IT Strategy and Readiness** **Enterprise Green IT Strategy:** ● Introduction ● Approaching Green IT Strategies ● Business Drivers of Green IT Strategy ● Organizational Considerations in a Green IT Strategy ● Steps in Developing a Green IT Strategy ● Metrics and Measurements in Green Strategies **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	06
6	**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 the Future ● Megatrends for Green Computing ● Tele-presence Instead of Travel ● Tele-commuting Instead of Commuting ● Deep Green Approach	05

	Self-Learning Topics: Green IT Regulations and Standards	

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

Tutorial: Tutorial List but not limited to the following suggested List of Tutorial

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

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	**Rubrics**	**Marks**
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on the tutorial performance of the student.

<table>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Teaching Scheme</td><td colspan="3" rowspan="2">Credits Assigned</td></tr>
<tr><td rowspan="7">MCAE342</td><td rowspan="7">Natural Language Processing</td><td colspan="3">Contact Hours</td></tr>
<tr><td colspan="2">Theory</td><td>Tutorial</td><td>Theory</td><td>Tutorial</td><td>Total</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>MT</td><td>Total</td></tr>
<tr><td>20</td><td>20</td><td>40</td><td>25</td><td>60</td><td>125</td></tr>
</table>

Prerequisite:

Probability

Python programming Data structure & Algorithms

Course Objectives: Course is 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
CO2	Understand the information retrieval techniques using NLP	Understanding
CO3	Apply mathematical techniques that are required to develop NLP applications.	Applying
CO4	Analyze various NLP algorithms and text mining NLP applications	Analyzing
CO5	Design real world NLP applications such as machine translation, text categorization, text summarization, information extraction by applying NLP techniques.	Creating
CO6	Implement innovative application using NLP components	Creating

Module No.	Detailed Contents	Hrs
1	**Introduction** History of NLP, Generic NLP system, levels of NLP , Knowledge in language processing , Ambiguity in Natural language , stages in NLP, challenges of NLP ,Applications of NLP **Self learning topics:** Empirical laws	**4**
2	**Word Level Analysis** Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST , Lexicon free FST Porter stemmer. N –Grams- N-gram language model.	**8**

	Self learning topics:N-gram for spelling correction	
3	**Syntax analysis** Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy **Self learning topics:** Conditional Random Field (CRF).	**8**
4	**Semantic Analysis** Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, Robust Word Sense Disambiguation (WSD),Dictionary based approach **Self learning topics:**WordNet	**10**
5	**Text Summarization, Text Classification** Text summarization- LEXRANK , Optimization based approaches for summarization , Summarization evaluation, Text classification **Self learning topics:** NLKT , Naïve Bayes Theorem	**5**
6	**Sentiment Analysis** Sentiment Analysis introduction , Sentiment Analysis - Affective lexicons,Learning affective lexicons **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=ud emyads&utm_campaign=DSA

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work : 25 marks
The term work will be based on the tutorial performance of the student**.**

Course Code	Course Name	Teaching Scheme			Credits Assigned		
MCAE343	Computational Intelligence	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	Test	Total			
		20	20	40	25	60	125

Prerequisite: calculus

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Understand the concept of soft computing techniques for problem solving.
2	Apply the concept of fuzzy set and fuzzy logic.
3	Apply the concept of Fuzzy Arithmetic & Fuzzy Inference system.
4	Understand the concept of Artificial neural network.
5	Understand Associative Memory and unsupervised learning network
6	Understand the concept of Genetic Algorithm and genetic operators.

Course Outcomes: On Successful Completion of course learner/students will be able to

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate the concept of soft computing.	Understanding
CO2	Model fuzzy logic techniques to find solution of uncertain problems	Applying
CO3	Demonstrate problem solving using Fuzzy Arithmetic & fuzzy inference systems	Understanding
CO4	Demonstrate the concept of neural network and its application	Understanding
CO5	Demonstrate the concept of Associative Memory and unsupervised learning network	Understanding
CO6	Apply the concept of Genetic Algorithm	Applying

Module No.	Detailed Contents	Hrs
1	**Concepts of Soft Computing** Hard computing Vs Soft Computing, Evolution of Computing, Soft Computing Constituents, From Conventional AI to Computational Intelligence , Machine Learning Basics Soft computing constituents – ANN, Fuzzy Logic, GA Applications of Soft Computing **Self Learning Topics :** Hybrid Systems	02
2	**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 **Self Learning Topics:** Fuzzy Arithmetic- Interval Analysis of Uncertain Values, Fuzzy Numbers	10
3	**Fuzzy Arithmetic Inference System** Fuzzy Arithmetic - Introduction, Fuzzy Arithmetic, Extension Principle Fuzzy Inference System: Construction and Working Principle of FIS **Self Learning Topics:** Methods of FIS, Overview of Fuzzy Expert System	06

4	**Module: Artificial Neural Network** Artificial Neural Network: Introduction, 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. **Self Learning Topics:** Unsupervised Learning Networks-	07
5.	**Module:Associative Memory and Unsupervised l Neural Network** Associative Memory Networks - Training Algorithm for Pattern Association, Auto associative Memory Network Unsupervised Learning Networks Fixed Weight Competitive Nets, Kohonen Self Organising Feature Maps **Self Learning Topics:**Adaptive Resonance Theory Network	05
6	**Module: 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, **Self Learning Topics:** Classification of Genetic Algorithm	09

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	Kumar Satish, "Neural Networks" Tata McGraw Hill
4	Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
5	Search, Optimization & Machine Learning by David E. Goldberg.

Tutorials:

Sr.No.	Detailed Contents	Hrs
1	Practice problems on Fuzzy Logic, Fuzzy membership functions	04
2	Practice Problems on Fuzzy relation, fuzzy Propositions and fuzzy Inference	02
3	Defuzzification techniques	01
4	Practice Problems on Supervised learning	02
5	Practice problems on ANN	02
6	Practice problems on Fuzzy Arithmetic	02

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Term Work : 25 marks

The term work will be based on the tutorial performance of the student**.**

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL31	Big Data Analytics and Visualization Lab	02	01	25	30	20	75

Prerequisite: Basic Understanding of SQL, Java Programming and Python

Lab Course Objectives: The Course aim to

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

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Demonstrate HDFS Commands in Hadoop	Understanding
CO2	Apply Map Reduce Programming Paradigm to solve the algorithmic problems	Applying
CO3	Build No SQL Database and Query it Using MongoDB	Applying
CO4	Analyze the Data Using Hadoop Ecosystem Projects: Hive and Pig	Analyze
CO5	Explain RDD and Dataframe Creation in Apache Spark	Evaluate
CO6	Create various Visualizations using Power BI.	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, Matrix Multiplication. **Self-Learning Topics**: Natural Join Programming Example	4
3	MongoDB: 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. Pig: Pig Latin Basic Pig Shell, Pig Data Types, Creating a Pig Data Model, Reading and Storing Data, Pig Operations **Self-Learning Topics**: Configure Hive Metastore to MySQL	8
5	Spark: RDD, Actions and Transformation on RDD , Ways to Create -file, data in memory **Self-Learning Topics:** Machine Learning Algorithms like K-Means using Spark.	2
6	Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Power BI **Self-Learning Topics:** Power BI using the 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:139788177228137
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://powerbihelper.org/

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 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:** Power BI: Tool Overview, Importing Data, Analyzing with Charts, Creating Dashboards, Telling Stories with Power BI

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL31

Term Work: 25 marks
The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCAL32	Distributed System and Cloud Computing Lab	02	01	25	30	20	75

Prerequisite: Basic overview of Distributed systems and Cloud Computing.

Lab Course Objectives: The Course is aim to

Sr.No.	Course Objective
1	Understand the concepts of Remote Process Communication
2	Understand the concepts of Remote Procedure Call
3	Understand the concepts of Remote Method Invocation.
4	Understand the concepts of Remote Object Communication.
5	Understand the implementation of Cloud Computing Services.
6	Learn implementation of Identity Management using Cloud Computing concept.

Lab Course Outcomes:

Sr.No.	Outcome	Bloom Level
CO1	Develop Remote Process Communication	Applying
CO 2	Develop Remote Procedure Call	Applying
CO 3	Develop Remote Method Invocation concepts.	Applying
CO 4	Develop Remote Object Communication programs.	Applying
CO 5	Implementation of Cloud Computing Services.	Applying
CO 6	Implementation of Identity management	Applying

Description:

Module	Detailed Contents	Hrs.
1	**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	**04**
2	**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 resumes execution after the server is finished. **Self Learning Topics:** Other types of call semantics	**04**
3	**Remote Method Invocation:** The Remote Method Invocation is an API that provides a mechanism to create distributed applications 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	**Remote Object Communication:** Pass remote objects from the server to the client. The client will receive the stub object (through remote interfaces) and save 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	**06**

5	**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	**06**
6	**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**

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, Wiley 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 the RPC concept. (Make use of datagram)
3	To implement a Date Time Server using the RPC concept. (Make use of datagram)
4	To retrieve day, time and date functions 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 creates a Library database. Create table Book (Book_id, Book_name, Book_author) and retrieve the Book information from the Library database using the 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 Storage as a Service using Google Docs
9	Implementation of Identity Management.
10	To develop Application for windows Azure / Amazon AWS using Windows Azure Platform Training Kit and Visual Studio.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL32

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

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

Prerequisite: Basic programming skill in Python/ Java Script/Java.
Lab Course Objectives: The Course is 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 Tokenization in ethereum
5	Understand the deployment of Dapp in Ethereum
6	Study use cases based on Hyperledger.

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 Ethereum Tokens	Applying
CO5	Develop and deploy Dapp in Ethereum	Applying
CO6	Discuss the Hyperledger Use Cases	Understanding

Description:

Module	Detailed Contents	Hrs.
1	**Cryptography:** Symmetric Encryption using Caesar Cipher, Asymmetric Encryption using RSA, Hash Functions (SHA-256), Merkle Tree (Implementation in Python/Java Script/C++)	4
2	**Cryptocurrency:** Concept of Bitcoin, block, blockchain, Immutable ledger**,** Public and Private Blockchain. (Implementation in Python/Java Script/C++)	4
3	**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	6
4	**Ethereum:**Ethereum Virtual Machine (EVM): Accounts, Transactions, Gas, Ether, Memory, Tokens in Ethereum	4
5	**DApp architecture:** Developing a DApp, Compile and Deploy the Smart Contract, Publish the DApp, Connecting to DApp, Ganache Output for Transaction Migration	4
6	**Case Study:** Use cases based on Hyper Ledger	4

Practical No	Problem Statement
1	Implementation of Caesar Cipher (Symmetric Encryption)
2	Implementation of RSA Algorithm (Asymmetric Encryption)
3	Implementation of SHA-256
4	Implementation of Binary Tree and Merkle 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	Simple Experiments using Solidity Program Constructs (if-then, while etc...)
9	Demonstrating Tokens in ethereum
10	Creation of smart contract in Ethereum
11	Creation of Dapp in Ethereum
12	Mini Project

References:

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 fromScratch, 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

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCALE331

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

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 datasets 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 techniques used in deep learning
4	To learn different optimization techniques used in deep learning
5	To learn CNN algorithms and analyze the results for respective real world applications
6	To learn RNN algorithms and analyze the results for respective real world 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
CO3	Analyze different regularization techniques used in deep learning.	Analyzing
CO4	Analyze different optimization techniques used in deep learning.	Analyzing
CO5	Build neural network models using deep learning algorithms-CNN to solve real-world problems.	Creating
CO6	Build neural network models using deep learning algorithms-RNN to solve real-world problems.	Creating

Description:

Module No	Detailed Contents	Hrs
1	**Introduction to Tensor flow/Keras**-Installation, Importing Libraries and Modules. **Self-Learning Topic:-**Setting up a deep-learning workstation.	**2**
2	**Data Preprocessing Techniques**- Loading the dataset, Feature Scaling, Handling Missing Values, Categorical Data and String Data Types, Encoding, and Data Splitting. **Self-Learning Topic: -** Outliers detection.	**2**
3	**Artificial Neural Networks-** McCulloch-Pitts neuron, single-layer perceptron network, multi-layer perceptron network, Back propagation network. **Self-Learning Topic:-** Adaline Network	**6**
4	**Regularization Techniques-** Dataset Augmentation, Early Stopping, Dropout. **Self Learning Topic:-** Optimization techniques(anyone)	**4**
5	**Deep Neural Network Algorithm: Convolutional Neural Network(CNN)-** Introduction to convnets, Adding a classifier, Training the convnet on the given data set, The convolution operation, The max-pooling operation, Evaluating the model, analyzing and visualizing results. **Self-Learning Topic: -** Pre-trained Convnet.	**6**
6	**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.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL332

Term Work : 25 marks
The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE333	Ethical Hacking Lab	02	01	25	30	20	75

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

Lab Course Objectives: The Course is aim to

Sr. No.	Course Objective
1	Study and understand how to gather and review information related using different footprinting 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	. Study different malware attacks and use the tools to practically understand how the attacks take place.
5	Study different web servers, web applications and wireless network hacking, sql injection techniques, session hijacking and use the tools to practically understand how the attacks take place.
6	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 footprinting tools for information gathering issues.	Applying
CO2	Applying tools for scanning networks, enumeration and sniffing.	Applying
CO3	Applying tools for malware attacks, web server and web applications and sql injection	Applying

CO4	Applying tools for session hijacking, wireless networking, cloud computing and cryptography.	Applying
CO5	Developing malwares and attack tools	Creating
CO6	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:** Use port scanning. network scanning tools, IDS tool, sniffing tool and generate reports.	**02**
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	**03**

6	**sql injection and Session hijacking** : SQL injection for website hacking, session hijacking. **Wireless network hacking, cloud computing security, cryptography :** Using Cryptool to encrypt and decrypt password, implement encryption and decryption using Caesar Cipher **Self Learning Topics:** using additional hacking tools and implementing additional encryption algorithms.	**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& 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.html
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 an analysis report.
2	Use software tools/commands to perform network scanning and sniffing and generate an analysis report.
3	Use software tools/commands to perform malware attacks and other cyber attacks and generates analysis reports.
4	Implementation of keyloggers, viruses and trojans.
5	Use of software tools/commands for web servers and web applications hacking and generating analysis report.
6	Use of software tools/commands for performing sql injection and session hijacking and generating analysis reports.
7	Use of software tools/commands to encrypt and decrypt password, implement encryption and decryption using Caesar Cipher.
8	Using Metasploit and metasploitable for penetration testing.
9	Demonstrating wireless Hacking Techniques
10	Demonstrating snort and firewall configuration

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCALE333

Term Work : 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
MCALE334	Computer Vision Lab	02	01	25	30	20	75

Prerequisite: Fundamental Knowledge of Computer Graphics and Image Processing

Lab Course Objectives: Course is aim to

Sr.No.	Course Objective
1	To learn the fundamental concepts of image processing for image enhancement
2	To Learn image processing techniques
3	To learn image segmentation techniques with practical applications.
4	To provide basic concepts of computer vision.
5	To Analyze Image Data Compression and morphological Operation
6	To develop application using computer Vision

Sr.No.	Outcome	Bloom Level
CO1	To perform basic image processing operations	Understanding
CO2	To explore different preprocessing technique	Understanding
CO3	Enhance the quality of image in spatial and frequency domain.	Applying
CO4	Students will be able to choose appropriate algo for segmentation	Applying
CO5	Compare various Image compression standards and morphological Operation	Analyzing
CO6	Extract various features from the scene for specified computer vision applications.	Creating

Description:

Module	Detailed Contents	Hrs
1	**OpenCV and Python** Running Python Programs, Frameworks for CV, UnderstandingOpenCV, Programs using OpenCV. **Self Learning Topics**: Basic operations on image.	02
2	**Basic Image Handling using python** Reading, Writing and Displaying Images, 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	06
3	**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	**Exploring Structure from Motion** Motion Detector Using OpenCV, Motion Detection using Video, Plotting the motion Direction Graph **Self Learning Topics**: Object Classification	04
5	**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	**Convolutional Neural Networks for CV** Object Detection and Identification using CNN, Building a CNN, Project **Self LearningTopics**: Dogs and cats case study.	**04**

Reference Books:

Reference No.	Reference Name
1	Rafael C. Gonzalez and Richard E.Woods, “Digital Image Processing,” Pearson Education, edition 4, 2018lications. Springer Science & Business Media, 2010. ISBN:1848829345
2	Anil K.Jain, “Fundamentals of Digital Image Processing,” Pearson Education, 2010
3	S. Jayaraman, T. Veerakumar, A. Esakkirajan, "Digital Image Processing," First Edition, McGraw Hill Education, 2017
4	JRobert J. Schallkoff , “Digital Image Processing and Computer Vision”, John Wiley and Sons, 1989.
5	JJ. R. Parker , “Algorithms for Image Processing and Computer Vision” John Wiley and Sons, 1997.
6	Richard Szeliski, "Computer Vision: Algorithms and Applications," 2nd edition, The University of Washington, 2022

Web References:

Reference No	Reference Name
1	**Learning OpenCV 3 Computer Vision with Python Second Edition, by Joe Minichino Joseph Howse Published by Packt Publishing Ltd.**
2	**http://iitk.ac.in/ee/computer-vision-lab**
3	**https://nptel.ac.in/courses/108103174**

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

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCALE334

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

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

Prerequisite: Basic understanding of java programming and xml.

Lab Course Objectives: Course is aim to

Sr.No	Course Objective
1	Install the framework for mobile app development with all the dependencies
2	Understand the Application development skills of Android and its Components.
3	Learn various Android application with different layouts and rich user interactive interfaces.
4	Develop Android application related to server-less database like SQLITE
5	Develop Android applications using Graphics and animation.
6	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
CO2	Implement various android applications using different layouts & rich user interactive interfaces	Applying
CO3	Demonstrate their skills of using SQLite database for android application database	Applying
CO4	Build android applications using multimedia.	Applying
CO5	Demonstrate use of location based services for android application.	Understanding
CO6	Demonstrate their ability to develop programs with dart programming and flutter	Applying

Description:

Module No.	Detailed Contents	Hours
1	**Introduction to Android and its components** The android platform, the layers of android, Creating an android application, Creating the activity, Design user interface with Views, Working with intents, fragments, services and different types of layouts components. Basic Controls and UI Components ,Text view, Radio button, Checkbox, Image Button, Edit Text, Slider and other controls **Self-Learning Topics:** Android components, understanding the androidManifest.xml file, Methods of all control class	**10**
2	**Database Connectivity** Persistence data using the file system (external, internal, SD card), working with shared preferences, Working with content providers, CRUD operation using SQLite database connection. **Self-Learning Topics:** Interface of Database	**8**
3	**Graphics and animation, Multimedia and Location Based Services** Drawing graphics in android, creating animations with androids graphics API, Playing audio & video. Display Maps, Getting location data, Building location tracker. **Self-Learning Topics:** Capturing media and photos, SMS and EMail messaging	**10**
4	**REST API integration** Consuming Web services using HTTP (http urlconnection), Consuming using JSON services using asynctask to perform network operations, working with ok http. **Self-Learning Topics:** Publishing Android applications on Google play store.	**8**
5	**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	**8**

	store	
6	**Data Handling** Understanding JSON Format, Using Database classes to write, read and serialize JSON. **Self-Learning Topics:** Flutter Form, Styling and Managing Widgets.	**8**

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/DeveliOSAppsSwift/
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 and different layouts and views.
2	Android program based on Intents
3	Android program for notifications and alert box
4	Android program to perform CRUD operation using SQLite DB
5	Android program using Shared Preferences, Internal and External Storage
6	Android program to work with graphics , animation , images and videos
7	Android program to work with google maps and locations
8	Android program based on RestAPI
9	Flutter program using layout widgets and state management
10	Flutter program to work with SQLite Database

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments: 30-marks, Attendance Theory & Practical: 10-marks, Assignments: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL34

Term Work: 50 marks
The term work will be based on the Continuous Assessment and Laboratory work

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

Prerequisite: Core Java, Web Technologies like HTML, CSS, XML, XPATH, DOM and JavaScript.

Lab Course Objectives: The Course is aim to

Sr.No.	Course Objective
1	Understand the basic concepts in Software Testing.
2	Understand the need for automation
3	Understand the essential characteristics, requirements and usage of Selenium Web Driver.
4	Understand the advanced Automation command.
5	Understand TestNg and automation framework basics.
6	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	Understanding
CO2	Implement Selenium tool to perform automation testing.	Applying
CO3	implement the essential characteristics, requirements and usage of Selenium Web Driver.	Applying
CO4	Demonstrate the advanced Automation command.	Applying
CO5	Demonstrate TestiNg and automation framework basics.	Applying
CO6	implement the basic concepts of software quality assurance.	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. **Self Learning Topics:** Requirement analysis and derive test scenarios Review of Project Document, Case Study.	2
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. **Self Learning Topics:** Implementation of web driver on safari	6
4	**Advanced automation Commands :** 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 in safari	6
5	**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	8

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 Validation testing
14	Perform regression testing

Note: At least 12-14 programs

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of MCAL35

Term Work: 25 marks

The term work will be based on the Continuous Assessment and Laboratory work

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP31	**Project Stage-2**	**02**	**01**	**50**	**-**	**--**	**50**

Prerequisite: NIL

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on teamwork, effective communication, critical thinking and problem-solving skills.
2	Acquainted with effective communication and problem-solving skills.
3	Adapt to rapidly changing critical thinking and problem-solving skills.
4	Adapt to a rapidly changing environment by having learned and applied new skills.
5	Adapt to applied new technologies effectively
6	Acquainted with the process of applying basic computer applications and providing 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 a team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating
CO5	Communicate and report effectively project related activities and findings.	Understanding
CO6	Students will be able to practice acquired knowledge within the chosen area of technology for project development	Applying

Guidelines for Project:

1. Students should 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.
2. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of the project.
3. 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. Faculty may give inputs during project activity; however, focus shall be on self- learning.
4. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with the Guide/ Supervisor.
5. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
6. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Project:

I) Term work (25 Marks):

- The progress of the 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) 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 the project and demonstrate their understanding of need/problem.
- Project shall be evaluated through a presentation and demonstration of the working model by the student project group to a panel of examiners at Institute level.
- 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 the 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

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract.	Theory	Pract.	Total
MCAI41	Industry Internship/ Research Internship at Research Institute/Incubation Center	--	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	
		Mid term Presentation I	Mid term Presentation II	Final Presentation	Total
MCAI41	Industry Internship/ Research Internship at Research Institute/Incubation Center	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.
* For ISR, One Credit will be assigned for UHV/IKS Course.Swayam/AICTE Student FDP Course and for another one credit student should complete at least 2 activities of ISR.

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
- @ Research Paper has to be Published before the Completion of the MCA(It will accounted in SEM IV)
- For Bridge Course Students, Subject MCABR3 and MCABR4 will be accounted for MOOC (04 Credits)which should be completed in SEM I and SEM II.

Course Code	Course Name	Group	Contact Hours		Credits Assigned	
					Presentation	Total
			40		15	15
MCAI41	Industry Internship/ Research Internship at Research Institute/Incubation Center	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.

Course Code	Course Name	Assessment (University/ Institute)	Teaching Scheme (Contact Hours)	Credits Assigned	
				Presentation	Total
			Presentation		
			01	01	01
MCAR42	Research Paper	Institute	Examination Scheme		
			Internal Assessment		Total
			Mid term Presentation I	Mid term Presentation II	
			25	25	50

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"(2nd 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 and Oracle academy.
    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 Grade fast - 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 First/Second Year Master of Computer Applications

Scheme for Autonomous Program

(With Effect from 2023-2024)

Bridge Course

For the graduates, not having graduation in Computer Science/Information Technology / Computer Application, need to complete the bridge course along with the MCA regular course

Course Code	Course Name	Group	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut	Total
MCABR1	Object Oriented Programming Methodology with Java	ICT	NPTEL/ Udemy Course#	2		--	--	--	---
MCABR2	Data Structures	ICT	NPTEL/ Udemy Course#	2		--	--	--	--
MCABR3	Operating System	ICT	04 Week NPTEL Certificate Course			--	--	--	--
MCABR4	Computer Network	ICT	04 Week NPTEL Certificate Course						
	Total			04	--	--	--	--	--

Course Code	Course Name	Group	Examination Scheme							
			Theory					Pract		
			Internal Assessment			End Sem.	Exam. Duration	Pract	Oral	Total
			CA	MT	Tot.		In Hrs			
MCABR1	Object Oriented Programming Methodology with Java	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–	100
MCABR2	Data Structures	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–	100
MCABR3	Operating System	ICT	Assessment will be according to the NPTEL Certificate Course and Credit							100
MCABR4	Computer Network	ICT	Assessment will be according to the NPTEL Certificate Course and Credit							100
	Total									400

#Course will be Suggested By the Subject Teachers