As Per NEP 2020

University of Mumbai

Master of Computer Application (MCA)

First Year MCA (Sem. I, II & Bridge Course)

(NEP-2020 Scheme) from Academic Year 2024-25

A-   PG Diploma in Computer Application   - 2027-28

B-   PG Degree: Master of Computer Application - 2024-25

C-   PG Degree: Master of Computer Application - 2028-29

Under

FACULTY OF SCIENCE & TECHNOLOGY

Ref: GR ……………………………………………………..

(As per AICTE & NEP 2020 Guidelines with effect
from the Academic Year 2024-25 Progressively)

(As per NEP 2020)

Sr. No.	Heading		Particulars
1	**Title of program**		
	O: _____A	A	**PG Diploma in Computer Application (PGDCA)**
	O: _____B	B	**MCA (Two Years)**
	O: _____C	C	**MCA (One Year)**
2	**Eligibility**		
	O: _____A	A	Passed any graduation degree (e.g.: B.E. / B.Tech./ B.Sc / B.Com. / B.A./ B. Voc./ BCA etc.,) preferably with Mathematics at 10+2 level or at Graduation level Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying examination.
	O: _____B	B	Same as A
	O: _____C	C	Graduate with 4 year U.G. Degree (Honours / Honours with Research) with Specialization in concerned subject or equivalent academic level 6.0 **OR** Graduate with four years UG Degree program with maximum credits required for award of Minor degree is allowed to take up the Post graduate program in Minor subject provided the student has acquired the required number of credits as prescribed by the concerned Board of Studies.
3	**Duration of program** R: _____	A	I Year
		B	2 Years
		C	1 Year
4	**R: _____** **Intake Capacity**		
5	R: _____ **Scheme of Examination**		NEP 50% Internal, 50% External, Semester End Examination Individual Passing in Internal and External Examination

6	**Standards of Passing** **R: _____**	40%	
7	**Credit Structure** **R: _____**	Attached herewith	
8	**Semesters**	A	Sem. I & II
		B	Sem. I, II, III & IV
		C	Sem. III & IV
9	**Program Academic Level**	A	6.0
		B	6.5
		C	6.5
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	A	2027-28
		B	2024-25
		C	2028-29

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Preamble

1) Introduction

The Master of Computer Application (MCA) is a professional master's degree in computer application that takes two years, or four semesters. The course was created in response to the increasing need in the Information Technology (IT) industry for skilled workers. MCA degree is primarily focused on software application development and places more of an emphasis on the latest programming languages, database management tools and technologies. The goal of the program is to meet the growing need for IT professionals with strong technical and managerial expertise in the workplace. The curriculum addresses every aspect of technology and combines with research domains.

National Education Policy, 2020 (NEP 2020) envisions a massive transformation in education. The NEP 2020 is founded on the five guiding pillars of Access, Equity, Quality, Affordability and Accountability. It will prepare our youth to meet the diverse national and global challenges of the present and the future. Therefore, a syllabus in alignment with NEP 2020 and industry requirement has been developed by MCA faculty under Faculty of Science and Technology of University of Mumbai. This syllabus incorporates philosophy of choice and outcome-based education in the process of curriculum development.

With a focus on the newest developments in computer science, the curriculum is designed as a combination of Major Mandatory and Major Elective courses. Students can select elective courses each semester according to their interests. While the electives broaden their knowledge for practical applications, the Major Mandatory courses provide a solid foundation in the core ideas of computer science and research. The utilization of industry-standard tools and simulators facilitates practical implementation. A strong laboratory component is a part of the curriculum. The laboratories, besides supplementing the theory course should also expose the student to the use of the latest software tools.

The curriculum includes a required On the Job Training (OJT) component to help improve the students' industrial readiness. This comprehensive training, which is the same as a full course, gives participants essential exposure to real-world situations in IT or IT-related businesses. Students obtain direct experience and acquire the abilities they need to succeed in the workplace by putting their theoretical and practical knowledge to solve real-world problems. Every MCA student is required to spend one semester in an industry developing a software system.

This curriculum emphasizes not just technical capabilities but also research ethics and a research-oriented mindset in students. Offering a Research Methodology (RM) course and Research Project (RP) during the second and third semester respectively fosters a strong research

mindset in students, empowering them to make significant contributions to the field of computer applications.

Inclusion of mini projects, research project and internship project in MCA program is with the intention to improve student's technical knowledge, understanding of IT environment and domain knowledge of various areas, which would help the students to build software applications. It will build right platform for students to become a successful Software professional.

Massive Open Online Courses (MOOC) are free online courses available on platforms such as NPTEL/ SWAYAM etc. for anyone to enroll. MOOC provide an affordable and flexible way to learn new skills and deliver quality educational experiences at scale. The MOOC included in the curriculum will definitely help learners to facilitate their enhanced learning based on their interest.

Institutional Social Responsibility (ISR) may be slightly impractical, especially in the modern competitive world, where everyone works for self-interest, but it will succeed if we take decisions based on what will benefit a large number of people and respect everyone's fundamental rights. As individuals we can make our small contributions to society by doing Field Projects (FP), social activities, individual or in association with Institute/Social organizations/NGOs/Clubs etc. To create awareness among students towards Institutional & Individual Social Responsibility (ISR) for societal development ISR activities are incorporated in new MCA syllabus.

2) Aims and Objectives

The aim of MCA program is to develop software professionals who are technically proficient and capable of making contributions to research and innovation. The main objectives of MCA Program is to prepare the students ready to be absorbed in the Industry as software developers, programmers, system analysts, software engineers, database administrators, data scientist and versatile IT corporate and academic faculty etc. in the area of computer applications.

Objectives:

- **Extensive Knowledge**: The aim of the course is to give students a thorough understanding of computer science's foundational ideas, methods, and techniques. Students can gain a thorough understanding of a variety of subjects, such as machine learning, data mining, data visualization, and data management.

- **Build Programming skills**: The curriculum gives students practical exposure with various tools and technologies with the goal of empowering them with excellent programming abilities.

Through the development of front-end and back-end design skills, students will become more adept at creating scalable and reliable apps.

- **Analytical Skills**: By teaching students to tackle real-world problems critically and imaginatively, the curriculum seeks to improve students' problem-solving skills. With these skills, students will be able to recognize issues, formulate sensible data analysis plans, and create creative solutions.

- **Participative Mindset**: Since interdisciplinary collaboration is required for projects, the curriculum seeks to help students develop their collaboration, communication and teamwork skills.

- **Industry Oriented**: The curriculum strives to be well versed of the developments in the field of technological advancements. Students will have the chance to obtain real-world experience and stay up to date on industry developments through industry collaborations and internships.

- **Comprehensive Development**: The program's goal is to get students ready to be absorbed in the Industry. Students will gain professional skills like leadership, project management, and teamwork in addition to technical skills. The program has the potential to augment students' market preparedness and employability by offering networking opportunities, internships, or partnerships with business entities.

- **Research Orientation**: By offering a Research Methodology Course and promoting student involvement in research projects, the program seeks to develop students' research skills. By conducting literature reviews, designing experiments, analyzing data, and presenting their findings, students will develop a research-oriented mindset and advance the field of computer science.

3) Learning Outcomes

- Conceptual and hands-on knowledge required to comprehend the intricate science and computer program design.
- The ability to deal with sophisticated online applications and administrative skills in software development analysis, design, development, and maintenance.
- Encourage a research-focused mindset and contribute in the advancement of computer technology.
- Work well in a multidisciplinary team as a team member or as a leader to achieve a shared objective.
- Become lifelong learners by preparing themselves to meet market demands and new technological advancements.
- Foster a sense of social responsibility, leadership, and professional attitudes.

4) Program Outcomes (POs)

1. **PO1 (Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

2. **PO2 (Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.

3. **PO3 (Development of Solutions):** Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.

4. **PO4 (Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

5. **PO5 (Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.

6. **PO6 (Project Management and Finance):** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

7. **PO7 (Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware

8. **PO8 (Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

5) Credit Structure of the MCA Program (Sem I, II, III & IV)

First Year MCA Semester I & II

Year (2 Yr PG)	Level	Sem.	Major				RM		OJT/ FP		RP	Cum. Cr.	Degree
			Mandatory		Electives Any one								
I	6.0	Sem I	MCA11	4	**MCAE15 (Cr:4)**		--		MCAP11	1		24	**PG Diploma in Computer Application (PGDCA)** **(After 3 Year Degree)**
			MCA12	3	MCAE151	4							
			MCA13	3	MCAE152	4							
			MCA14	3	MCAE153	4							
			MCAL11	2	MCAE154	4							
			MCAL12	1									
			MCAL13	1									
			MCAL14	2									
		Sem II	MCA22	3	**MCAE24 (Cr: 3)**		MCA21	4	MCAP21	1		26	
			MCA23	3	MCAE241	3							
			MCAL21	1	MCAE242	3							
			MCAL22	1	MCAE243	3							
			MCAL23	1	MCAE244	3							
			MCAL25	2	**MCALE24 (Cr:1)**								
			MCAL26	1	MCALE241	1							
			MCAL27	1	MCALE242	1							
					MCALE243	1							
					MCALE244	1							
					MCAE25 (Cr:4)								
					MCAE251	4							
					MCAE252	4							
					MCAE253	4							
					MCAE254	4							
Cumulative Credits for PG Diploma			**32**		**12**		**04**		**02**		**-**	**50**	
Exit option: PG Diploma 44-52 Credits after Three Year UG Degree (with additional 4 credits of OJT)													

Second Year MCA Semester III & IV

Year (2 Yr PG)	Level	Sem.	Major		RM	OJT/ FP	RP		Cum. Cr.	Degree
			Mandatory	**Electives Any one**						
II	**6.5**	**Sem III**	MCA31 3	**MCAE32 (Cr 3)**		MCAFP31 1	MCARP31	4	23	**MCA Degree** **After 3/4 Years UG**
			MCAL31 1	MCAE321 3						
			MCAL34 2	MCAE322 3						
				MCAE323 3						
				MCALE32 (Cr: 1)						
				MCALE321 1						
				MCALE322 1						
				MCALE323 1						
				MCAE33 (Cr: 3)						
				MCAE331 3						
				MCAE332 3						
				MCAE333 3						
				MCALE33 (Cr: 1)						
				MCALE331 1						
				MCALE332 1						
				MCALE333 1						
				MCAE34 (Cr: 4)						
				MCAE341 4						
				MCAE342 4						
				MCAE343 4						
		Sem IV		MCAMS43 6		MCAIP41 12	MCARP42	2	20	
Cumulative Credits for 1 Year PG Degree			**06**	**18**	**00**	**13**	**06**		**43**	
Cumulative Credits for 2 Year PG Degree			**38**	**30**	**04**	**15**	**06**		**93**	

Note: Bridge course for Non IT / CS students (audit courses to be offered in First Year)

Bridge Course for Non-IT /CS Students

Course Code	Course Name	Group	Examination Scheme							
			Theory					Practical		
			Internal Assessment			End Sem	Exam. Duration	Pract	Oral	Total
			CA	Test	Total		In Hrs			
MCABR1	Java Programming	Major	25	25	50	50	2	--	--	100
MCABR2	Data Structures	Major	25	25	50	50	2	--	--	100
MCABR3	Operating Systems	Major	25	25	50	50	2	--	--	100
MCABR4	Computer Networks	Major	25	25	50	50	2	--	--	100
MCABR5	Discrete Mathematics	Major	25	25	50	50	2	--	--	100
	Total									**500**

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MCA SEMESTER I

Course Code	Category	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total Credits
MCA11	Major (Mandatory)	Mathematical Foundation for Computer Science	3	--	1	3	--	1	4
MCA12	Major (Mandatory)	Advanced Java	3	--	--	3		--	3
MCA13	Major (Mandatory)	Advanced Database Management System	3	--	--	3	--	--	3
MCA14	Major (Mandatory)	Software Project Management	3	--	--	3	--	--	3
MCAE15	Major (Elective)	Elective - 1	3		1	3		1	4
MCAL11	Major (Mandatory)	Advanced Data Structures Lab	--	4	--	--	2	--	2
MCAL12	Major (Mandatory)	Advanced Java Lab	--	2	--	--	1	--	1
MCAL13	Major (Mandatory)	Advanced Database Management System Lab	--	2	--	--	1	--	1
MCAL14	Major (Mandatory)	Web Technologies Lab	--	4	--	--	2	--	2
MCAP11	OJT/FP	Mini Project – 1A	--	2	--	--	1	--	1
		Total	**15**	**14**	**2**	**15**	**7**	**2**	**24**

MCA SEMESTER I

Course Code	Category	Course Name	Examination Scheme						Total Marks
			Theory			Practical		End Term Exam	
			Internal Assessment			Term Work	Practical Exam		
			CA	Test	Total				
MCA11	Major (Mandatory)	Mathematical Foundation for Computer Science	25	25	50	25	--	50	125
MCA12	Major (Mandatory)	Advanced Java	25	25	50	--	--	50	100
MCA13	Major (Mandatory)	Advanced Database Management System	25	25	50	--	--	50	100
MCA14	Major (Mandatory)	Software Project Management	25	25	50	--	--	50	100
MCAE15	Major (Elective)	Elective - 1	25	25	50	25	--	50	125
MCAL11	Major (Mandatory)	Advanced Data Structures Lab	--	--	--	50	50	--	100
MCAL12	Major (Mandatory)	Advanced Java Lab	--	--	--	50	50	--	100
MCAL13	Major (Mandatory)	Advanced Database Management System Lab	--	--	--	50	50	--	100
MCAL14	Major (Mandatory)	Web Technologies Lab	--	--	--	50	50	--	100
MCAP11	OJT/FP	Mini Project – 1A	--	--	--	25	25	--	50
		Total	**125**	**125**	**250**	**275**	**225**	**250**	**1000**

MCA Semester I Electives

Elective - 1		
Sr. No.	**Course Code**	**Course Name**
1	MCAE151	Accounting & Managerial Economics
2	MCAE152	Optimization Techniques
3	MCAE153	Digital Marketing and Business Analytics
5	MCAE154	e-Commerce

MCA SEMESTER II

Course Code	Category	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total Credits
MCA21	Research Methodology (RM)	Research Methodology	3	--	1	3	--	1	4
MCA22	Major (Mandatory)	Artificial Intelligence and Machine Learning	3	--	--	3	--	--	3
MCA23	Major (Mandatory)	Information Security	3	--	--	3	--	--	3
MCAE24	Major (Elective)	Elective - 2	3	--	--	3	--	--	3
MCAE25	Major (Elective)	Elective - 3	3	--	1	3	--	1	4
MCAL21	Major (Mandatory)	Soft Skill Development	--	2	--	--	1	--	1
MCAL22	Major (Mandatory)	Artificial Intelligence and Machine Learning Lab	--	2	--	--	1	--	1
MCAL23	Major (Mandatory)	Devops Lab	--	2	--	--	1	--	1
MCALE24	Major (Elective)	Elective - 2 Lab	--	2	--	--	1	--	1
MCAL25	Major (Mandatory)	Advanced Web Technologies (AWT) Lab	--	4	--	--	2	--	2
MCAL26	Major (Mandatory)	User Interface Lab	--	2	--	--	1	--	1
MCAL27	Major (Mandatory)	Networking with Linux Lab	--	2	--	--	1	--	1
MCAP21	OJT/FP	Mini Project – 1B	--	2	--	--	1	--	1
		Total	**15**	**18**	**2**	**15**	**9**	**2**	**26**

MCA SEMESTER II

Course Code	Category	Course Name	Theory Internal Assessment			Term Work	Practical Exam	End Term Exam	Total Marks
			CA	Test	Total				
MCA21	Research Methodology (RM)	Research Methodology	25	25	50	25	--	50	125
MCA22	Major (Mandatory)	Artificial Intelligence and Machine Learning	25	25	50			50	100
MCA23	Major (Mandatory)	Information Security	25	25	50			50	100
MCAE24	Major (Elective)	Elective - 2	25	25	50			50	100
MCAE25	Major (Elective)	Elective - 3	25	25	50	25		50	125
MCAL21	Major (Mandatory)	Soft Skill Development				50			50
MCAL22	Major (Mandatory)	Artificial Intelligence and Machine Learning Lab				50	50		100
MCAL23	Major (Mandatory)	Devops Lab				50	50		100
MCALE24	Major (Elective)	Elective - 2 Lab				50	50		100
MCAL25	Major (Mandatory)	Advanced Web Technologies (AWT) Lab				50	50		100
MCAL26	Major (Mandatory)	User Interface Lab				50	50		100
MCAL27	Major (Mandatory)	Networking with Linux Lab				50	50		100
MCAP21	OJT/FP	Mini Project – 1B				25	25		50
		Total	**125**	**125**	**250**	**425**	**325**	**250**	**1250**

MCA Semester II Electives

Elective - 2				
Sr. No.	**Course Code**	**Course Name**	**Lab Course Code**	**Lab Course Name**
1	MCAE241	Internet of Things	MCALE241	Internet of Things Lab
2	MCAE242	Robotic Process Automation	MCALE242	Robotic Process Automation Lab
3	MCAE243	Natural Language Processing	MCALE243	Natural Language Processing Lab
4	MCAE244	Design and Analysis of Algorithm	MCALE244	Design and Analysis of Algorithm Lab

Elective - 3		
Sr. No.	**Course Code**	**Course Name**
1	MCAE251	Green Computing & Sustainability
2	MCAE252	Management Information System
3	MCAE253	Cyber Security
4	MCAE254	Soft Computing

MCA SEMESTER III

Course Code	Category	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total Credits
MCA31	Major (Mandatory)	Big Data Analytics and Visualization	3	--	--	3	--	--	3
MCAE32	Major (Elective)	Elective - 4	3	--	--	3	--	--	3
MCAE33	Major (Elective)	Elective - 5	3	--	--	3	--	--	3
MCAE34	Major (Elective)	Elective - 6	3	--	1	3	--	1	4
MCAL31	Major (Mandatory)	Big Data Analytics and Visualization Lab	--	2	--	--	1	--	1
MCALE32	Major (Elective)	Elective - 4 Lab	--	2	--	--	1	--	1
MCALE33	Major (Elective)	Elective - 5 Lab	--	2	--	--	1	--	1
MCAL34	Major (Mandatory)	Mobile Computing Lab	--	4	--	--	2	--	2
MCARP31	Research Project (RP)	Research Project (RP)	--	--	--	--	4	--	4
MCAFP31	Field Project (FP)	Individual Social Responsibility (ISR)							1*
Total			**12**	**10**	**1**	**12**	**9**	**1**	**23**

* Credits allotted in semester III based on the (ISR) work done during program

MCA SEMESTER III

Course Code	Category	Course Name	Examination Scheme						
			Theory			Practical		End Term Exam	Total Marks
			Internal Assessment			Term Work	Practical Exam		
			CA	Test	Total				
MCA31	Major (Mandatory)	Big Data Analytics and Visualization	25	25	50			50	100
MCAE32	Major (Elective)	Elective - 4	25	25	50			50	100
MCAE33	Major (Elective)	Elective - 5	25	25	50			50	100
MCAE34	Major (Elective)	Elective - 6	25	25	50	25		50	125
MCAL31	Major (Mandatory)	Big Data Analytics and Visualization Lab				50	50		100
MCALE32	Major (Elective)	Elective - 4 Lab				50	50		100
MCALE33	Major (Elective)	Elective - 5 Lab				50	50		100
MCAL34	Major (Mandatory)	Mobile Computing Lab				50	50		100
MCARP31	Research Project (RP)	Research Project (RP)				75	75		150
MCAFP31	Field Project (FP)	Individual Social Responsibility (ISR)							
Total			**100**	**100**	**200**	**300**	**275**	**200**	**975**

MCA Semester III Electives

Elective - 4				
Sr. No.	**Course Code**	**Course Name**	**Lab Course Code**	**Lab Course Name**
1	MCAE321	Computer Vision	MCALE321	Computer Vision Lab
2	MCAE322	Deep Learning	MCALE322	Deep Learning Lab
3	MCAE323	Distributed System and Cloud Computing	MCALE323	Distributed System and Cloud Computing Lab

Elective - 5				
Sr. No.	**Course Code**	**Course Name**	**Lab Course Code**	**Lab Course Name**
1	MCAE331	Software Testing Quality Assurance	MCALE331	Software Testing Quality Assurance Lab
2	MCAE332	Ethical Hacking	MCALE332	Ethical Hacking Lab
3	MCAE333	Blockchain	MCALE333	Blockchain Lab

Elective - 6		
Sr. No.	**Course Code**	**Course Name**
1	MCAE341	Design Thinking & Innovation Skills
2	MCAE342	Digital Forensics
3	MCAE343	Entrepreneurship Management

MCA SEMESTER IV

Course Code	Category	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical	Theory	Practical	Total Credits
MCAIP41	On Job Training (OJT)	Internship Project	--	40	--	12	12
MCARP42	Research Project (RP)	Research Paper / Product / Patent	2	--	2	--	2
MCAMS43	MOOCS	Massive Open Online Course (MOOC)	6#	--	6	--	6!
		Total	**6**	**40**	**8**	**12**	**20**

MOOC: SWAYAM-NPTEL/MKCL /NITTER/ISRO/NIELIT/Institute having NIRF ranking within 100/Government Institutions etc.
Work load only for students
! Credits transferred from MOOC courses

Note: Internal assessment of tutorials to be done separately and term work marks to be given out of 25 for those courses where tutorial is mentioned.
*For guides of Sem 3 & 4 Research Project as well as Sem 4 Internship Project one hour workload per week can be considered for 5 to 6 students.

MCA SEMESTER IV

Course Code	Category	Course Name	Examination Scheme			Total Marks
			Internal Assessment		University Assessment	
			Mid term Presentation I	Mid term Presentation II	Final Presentation	
MCAIP41	On Job Training (OJT)	Internship Project	75	75	150	300
MCARP42	Research Project (RP)	Research Paper / Product / Patent	50	50	--	100
MCAMS43	MOOCS	Massive Open Online Course (MOOC)	--	--	--	--
		Total	**125**	**125**	**150**	**400**

Semester - I

Semester I

Course Code	Course Name				
MCA11	**Mathematical Foundation for Computer Science**				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem.** **Examination**	**Term** **Work**	**Total** **(Marks)**
Continuous **Assessment CA)**	**Test**	**Total (IA)** **(CA+Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite: Student must know data collection and representation, Set theory, Basic principles of counting.

Course Objectives: Course aim to learn and perform

Sr. No.	Course Objective
1	Statistical measures on various types of data
2	Correlation and regression techniques for estimation
3	Probability aspects to take proper decision
4	Understand the concepts of random variable and expectation
5	Application of discrete and continuous probability distributions
6	Various methods of hypothesis testing

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

Sr. No.	Course Outcome	Bloom Level
CO1	Apply different statistical measures on various types of data	Applyin
CO2	Evaluate using regression analysis.	Evaluati
CO3	Analyze different types of Probability and their applications.	Analyzi
CO4	Apply the concepts of random variables to expectation and	Applyin
CO5	Apply probability distribution to real world problems	Applyin
CO6	Formulate and test the hypothesis for business problem using various methods	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to measures of central tendency, dispersion and Skewness:** Central tendency of raw data, Discrete and grouped frequency data, Absolute measures and relative measures of dispersion, Karl Pearson's coefficient of skewness and Bowley coefficient of skewness **Self Learning Topics:** Graphical representation of	8	1	1-3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	data and Find various central tendencies of Real data			
2	**Correlation and Regression:** **Correlation:** Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient. **Regression:** Linear regression and two lines of regression. least square methods of linear regression. **SelfLearningTopics:**Applycorrelationandregressio nonrealworlddataanditsgraphical representation	6	2	1-7,8
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	3	1-6
4	**Random variable and Expectation:** 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	4	1-4
5	**Theoretical probability distributions:** Binomial, Poisson, Normal. **Self Learning Topics:** Study of properties of standard normal variate.	6	5	1-4,8
6	**Testing of hypothesis:** Hypothesis testing, Type I and Type II errors. Tests of significance–Student's t-test, large sample test (z-test), Chi-Square test **Self Learning Topics:** Study of elementary sampling methods.	4	6	1-4,7-8

Reference Books:

Reference No	Reference Name
1	S.C. Gupta, Fundamentals of Statistics, Himalaya Publishing house, 7th edition.
2	S.C. Gupta, V. K. Kapoor, S. Chand, Fundamentals of Mathematical Statistics,Sultam and Chand sons publication, First Edition
3	Kishore Trivedi, Probability and Statistics with Reliability, Queuing, And Computer Science Applications, PHI, First Edition
4	Schaum's Outline of Probability and Statistics, 4th Edition, 4th Edition By Murray Spiegel, R. Srinivasan and John Schiller

5	J.Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics, Tata Mc Graw Hill, Fourth Edition
6	Dr.J. Ravichandran, Probability & Statistics for Engineers, Wiley
7	Dr. Seema Sharma, Statistics for Business and Economics, Wiley
8	Ken Black, Applied Business Statistics, Wiley, Seventh Edition

Web References:

Reference No	Reference Name
1	IIT Kharagpur–Probability and Statistics by Dr. Somesh Kumar https://nptel.ac.in/courses/111105041/
2	IIT Madras – Introduction to Probability and Statistics by Dr. G. Srinivasan https://nptel.ac.in/courses/111/106/111106112/
3	IIT Kanpur – Descriptive Statitics with R Software by Prof. Shalabh https://nptel.ac.in/courses/111/104/111104120/
4	IIT Roorkee – Business Statistics by Prof. Mukesh Kumar Barua https://nptel.ac.in/courses/110/107/110107114/
5	MIT – Introduction to Probability and statistics by Jeremy Orloff and Jonathan Bloomhttps://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	Hrs
1	Find Mean, median , mode and coefficient of deviation of given data	1
2	Find Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness	1
3	Calculate Karl Pearson's coefficient of correlation	1
4	To fit linear regression and estimate	1
5	Examples on addition and multiplication theorem of probability	1
6	Examples based on Bayes" theorem	1
7	Examples based on independence of discrete random variables.	1
8	Examples based on independence of continuous random variables.	1
9	Example on Poisson distribution	1
10	Example on normal distribution	1
11	Example on t-test	1
12	Example on Chi-square test	1

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments / Quiz / Case studies / Presentations / Projects / Any other measure with the permission of the Director/ Principal / HOD / Coordinator.

- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCA12	**Advanced Java**				
Teaching Scheme: Contact Hours (Per Week)			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**-**	**3**	**3**	**-**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA+Test)**			
25	**25**	**50**	**50**	**-**	**100**

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

Course Objectives: Course 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
3	Understand Spring Framework and build Java EE applications and services.
4	Apply Data Access using Spring Framework
5	Understand how to simplify Spring applications using Spring Boot and spring Boot RESTful WebServices.

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

Sr.	Course Outcome	Bloom Level
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.	Understanding
CO2	Develop JSP using standard actions, custom tags	Applying
CO3	Understand and develop applications using Spring Framework, Lightweight Container and Dependency Injection with Spring	Applying
CO4	Develop applications using Aspect Oriented Programming with Spring.	Applying
CO5	Apply JDBC Data Access with Spring and demonstrate Data access operations with Jdbc Template and Spring.	Understanding
CO6	Build Spring Boot Web Application and Spring Boot RESTful WebServices and Database	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Collection and Generic**: Introduction to Generics, Generics Types and Parameterized Types, WildCards, Java Collection Framework, Collections (Basic Operations, Bulk Operations, Iteration) List, Set, Maps **Lambda Expressions**: Lambda Type Inference, Lambda Parameters, Lambda Function Body, Returning a Value, From a Lambda Expression. **Self-learning topics:** Collection Queues and Arrays	9	CO1	1
2	**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 **Self-learning topics:** Simple Application using Servlet	8	CO2	6
3	**Spring Frameworks:** Introduction to Spring Framework, POJO Programming Model, Lightweight Containers(Spring IOC container, Configuration MetaData, Configuring and using the Container) Dependency Injection with Spring- Setter Injection, Constructor Injection, Overriding Bean, Auto Wiring **Self-learning topics**: Bean Definition Profiles and Inheritance	7	CO3	7
4	**Spring and AOP:** Aspect Oriented Programming with Spring, Types of advices, Defining Point Cut Designator, Annotations. **Self-learning topics** : AspectJ	4	CO4	7
5	**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	CO5	7
6	**Getting Started with Spring Boot :** Spring Boot and Database, Spring Boot Web Application Development, Spring Boot RESTful WebServices and Database **Self-learning topics:** Understanding Transaction Management in Spring	6	CO6	7

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: 978-8177229
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 Kenan Sevindik Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, IN 46256 www.wiley.com

Web References:

Reference No	Reference Name
1	https://docs.oracle.com
2	Spring.io

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:

- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks

- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks

- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

29

End Semester Theory Examination:

1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module wil l be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCA13	**Advanced Database Management System**				
Teaching Scheme: Contact Hours (Per Week)			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**-**	**3**	**3**	**-**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examinatio n**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA+Test)**			
25	**25**	**50**	**50**	**-**	**100**

Pre-requisite: Database Management System.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Explain the concept of parallel, distributed & ORDBMS and understand their applications.
2	Explain the architecture of Data Warehouse and perform ETL and data preprocessing tasks.
3	Understand Dimensional Modeling and OLAP architecture.
4	Analyze data, identify the problems , choose relevant data mining models and algorithms for respective applications
5	Understand different web mining techniques.

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

Sr.	Course Outcome	Bloom Level
CO1	Demonstrate complex database systems like parallel, distributed &object-oriented databases.	Understanding
CO2	Model data warehouse with ETL process and dimensional	Analyzing
CO3	Discover Association among items using Association rule mining.	Applying, Analyzing
CO4	Evaluate different data mining techniques like classification, prediction, clustering and understanding web mining techniques.	Applying, Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Parallel Database Distributed Database and ORDBMS**: Architecture for Parallel Databases, Types of Distributed Databases, Distributed DBMS Architecture, Storing Data in a Distributed DBMS.ORDBMS: Structured Data Types, Operations on Structured Data, Objects, Inheritance, Object oriented versus Object relational database. **Self-Learning Topics**: Mapping OODBMS to ORDBMS.	5	CO 1	1
2	**Data warehousing and OLAP:** Data warehouse: Introduction to DW, DW architecture, ETL Process, Top-down and bottom-up approaches, characteristics and benefits of data mart. Dimensional Modeling: Star, snowflake and fact constellation schema. OLAP in the data warehouse: Major features and functions, OLAP models-ROLAP and MOLAP, Difference between OLAP and OLTP **Self-Learning Topics**: Study any one DW implementation	6	CO2	1
3	**Data Mining and Preprocessing**: Introduction to data mining, Knowledge discovery-KDD process. Data Preprocessing: Types of attributes, Data Cleaning - Missing values, Noisy data, data integration and transformations. Data Reduction - Data cube aggregation, dimensionality reduction, data compression, Numerosity reduction, discretization and concept hierarchy. **Self-Learning Topics**: Application of data mining in Business Intelligence.	5	CO4	2
4	**Module: Data Mining Algorithm- Association rules:** Association rule mining: support and confidence and frequent item sets, market basket analysis, Apriori algorithm, Associative classification- Rule Mining. **Self-Learning Topics:** Association Rule Mining applications	6	CO3	2
5	**Data Mining Algorithm-Classification:** Classification methods: Statistical-based algorithms-Linear Regression, Naïve Bayesian classification, Distance- based algorithm- K Nearest Neighbor, Decision Tree-based algorithms - ID3, C4.5, CART. **Self-Learning Topics:** Comparative study of classification algorithms.	8	CO4	2

6	**Data Mining Algorithm-Clustering:** Clustering Methods: Partitioning methods- K-Means, Hierarchical- Agglomerative (single link) and divisive methods **Self-Learning Topics:** Clustering algorithm applications.	6	CO4	2
7	**Web Mining:** Web content mining: crawlers Web structure mining: Page rank algorithm Web usage mining: Data structure. **Self-Learning Topic:** Text mining.	4	CO5	2

Reference Books:

Reference No	Reference Name
1	Ramakrishnan, Raghu, Johannes Gehrke, and Johannes Gehrke, Database management systems, Vol. 3, McGraw-Hill, 2003.
2	Gupta, Gopal K, Introduction to data mining with case studies, PHI LearningPvt. Ltd., 2014.
3	Dunham, Margaret H, Data mining: Introductory and advanced topics, Pearson Education India, 2006.
4	Han, Jiawei, Jian Pei, and Micheline Kamber, Data mining: concepts and techniques, Second Edition, Elsevier, Morgan Kaufmann, 2011.
5	Ponniah, Paulraj, Data warehousing fundamentals: a comprehensive guide for IT professionals, John Wiley & Sons, 2004.
6	Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan, Database system concepts, Vol. 5,McGraw-Hill, 1997.

Web References:

Reference No	Reference Name
1	https://www.guru99.com/data-mining-vs-datawarehouse.html
2	https://www.tutorialspoint.com/dwh/dwh_overview
3	https://www.geeksforgeeks.org/
4	https://blog.eduonix.com/internet-of-things/web-mining-text-mining-depth-mining-guide/

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name		
MCA14	**Software Project Management**		
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3		3	3		3

Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem.** **Examination**	**Term** **Work**	**Total** **(Marks)**
Continuous **Assessment** **CA)**	**Test**	**Total (IA)** **(CA+Test)**			
25	**25**	**50**	**50**		**100**

Pre-requisite: Basic knowledge of software engineering

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the concepts of Software Engineering and Project Management.
2	Familiarize Project Management framework and Tools.
3	Apply knowledge of Project Life Cycle to implement the projects.
4	Apply the requirement specification and designing tools along with UML.
5	Understand the techniques of project scheduling & project implementation.
6	Learn software cost estimation and software quality assurance techniques.

Course Outcomes (CO):

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Software Project Management.	Remembering
CO2	Use various SDLC models to implement the projects.	Applying
CO3	Demonstrate understanding of the requirements Analysis and Application of UML Models.	Understanding
CO4	Make use of estimation logic for estimation of software size as well as cost of software.	Applying
CO5	Analyze the need of scheduling and change management during software development.	Analyze
CO6	Assess various factors influencing project management, quality assurance and risk assessment.	Evaluate

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**An Overview of Software Project Management:** An Overview of IT Project Management: Define project, project management framework, The role of project Manager, Life Cycle of Project, Systems View	04	CO1	2

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	of Project Management, Stakeholder management, Leadership in Projects: Modern Approaches to Leadership & Leadership Styles. **Self-Learning Topics:** Project implementation techniques.			
2	**Software Process Models:** Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model, Agile Development Model: Extreme programming, Lean Model, SCRUM: Introduction, Three pillars of empiricism, Framework, Artifacts and role of SCRUM master. DevOps Model **Self-Learning Topics:** Iterative approach, RAD model Comparison among models.	06	CO2	1 & Web Ref. 1, 2, 3
3	**Software Requirement Analysis and Design:** Types of Requirement, Feasibility Study, Requirement Elicitation Techniques: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), Requirement Analysis and Design: Data Flow Diagram (DFD), Data Dictionary, Software Requirement Specification (SRS). Object Oriented Analysis and Design: UML Overview, The Nature and purpose of Models, UML diagrams(Use Case diagram, Activity Diagram, Class & Object Diagram, Sequence Diagram, State Transition Diagram, Deployment Diagram). **Self Learning Topics:** Case study for complete UML diagram.	09	CO3	4, 5, 6
4	**Software Project Planning & Software Cost Estimation:** Business Case, Scope Management Software Estimation: Size Estimation: Function Point (Numericals). Cost Estimation: COCOMO I (Numericals), COCOMO-II Application Composition model, Early design model (Numericals), Post Architecture Model. **Self Learning Topics:** Project selection and Approval, Project charter.	07	CO4	2, 3
5	**Project Scheduling and Procurement Management:** Relationship between people and Effort, Staffing Level Estimation, Effect of schedule Change on Cost, Project Schedule, Schedule Control, Creating the Work Breakdown Structures (WBS), Critical Path Method (CPM) (Numericals), Resource Allocation, Basics of Procurement Management, Change Management. **Self Learning Topics:** 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.	07	CO5	1, 3
6	**Software Quality Assurance:** Software and System Quality Management: Overview of ISO 9001, SEI Capability Maturity Model, Six	07	CO6	1, 3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Sigma, Formal Technical Reviews. Software Risk Management: Identify IT Project Risk, Risk Analysis and Assessment, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation. **Self Learning Topics:** Software Reliability Metrics, Reliability Growth Modeling.			

Reference Books:

Reference No	Reference Name
1	Software Engineering: A Practitioner's Approach, 8th edition, by Roger S Pressman, McGraw Hill publication.
2	Managing Information Technology Project, 6 edition, by Kathy Schwalbe, Cengage Learning publication.
3	Information Technology Project Management by Jack T Marchewka Wiley India publication.
4	Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
5	The Unified Modelling Language Reference manual, Second Edition, James Rambaugh,Iver Jacobson, Grady Booch, Addition- Wesley.
6	Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI(2005).

Web References:

Reference No	Reference Name
1	https://premieragile.com/the-three-pillars-of-empiricism/
2	https://youtu.be/DbCvs-60ytM?si=nimTplzr4Lpd6Ahc
3	https://youtu.be/oTZd2vo3FQU?si=BcFqDUVXjTAzNvvo

Assessment:
Continuous Assessment (CA): 25 marks
 Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE151	Accounting and Managerial Economics				
Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
3	1	4	3	1	4
Examination Scheme (Marks)					
Internal Assessment (IA)			End Sem. Examination	Term Work	Total (Marks)
Continuous Assessment CA)	Test	Total (IA) (CA+Test)			
25	25	50	50	25	125

Pre-requisite: Some basic knowledge of accounting and good mathematical skills is recommended.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Develop students' abilities to record, classify, and summarize financial transactions through the accounting cycle to prepare financial statements
2	Introduce students to management accounting techniques, focusing on cost accounting and financial decision-making.
3	Introduce students to the fundamental concepts of managerial economics and its application in business decision-making.
4	Analyze market structures, pricing strategies, and production costs within different economic contexts.
5	Provide students with an understanding of macroeconomic principles, including GDP, business cycles, and economic policies.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understanding knowledge of basic accounting principles and the ability to interpret them in recording transactions and preparing financial statements.	Remembering / Understanding
CO2	Apply management accounting techniques such as cost sheet preparation, marginal costing, and break-even analysis to support financial decision-making.	Applying, Analyzing
CO3	Analyze demand and supply factors, market structures, and pricing strategies and the concepts of managerial economics to make informed business decision	Analyzing
CO4	Evaluate macroeconomic indicators and policies to assess their impact on the business environment and organizational strategies.	Analyzing, Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Accounting** 1. **Basics of Accounting** • Definition and Importance (Accounting definition, role of accounting) • Users of Accounting Information (Internal and external users) • Accounting Principles • Types of Accounts (Personal, real, nominal accounts) **2. Accounting Cycle** • Journal Entries (Recording transactions) • Ledger Posting (T-accounts, balancing accounts) • Trial Balance (Ensuring debits equal credits) **Self Learning:** Study of basic accounting concepts.	8	CO1	1,2
2	**Financial Accounting** **Financial Statements (Sole Trading Concern)** • Trading Account • Profit and Loss Account • Balance Sheet • Adjustment :Closing stock, Outstanding and Prepaid expenses and Depreciation **Self-Learning:** Basic understanding of financial statements and Tally software.	6	CO1	1,2
3	**Management Accounting** 1. **Introduction to Management Accounting** Definition and Scope of Management Accounting, Objectives and Importance of Management Accounting, Differences between Financial Accounting and Management Accounting 2. **Cost Sheet Preparation** Purpose and Importance of Cost Sheets, Components of a Cost Sheet: Direct Costs and Indirect Costs, Preparation of a Simple Cost Sheet: Format and Example 3. **Marginal Costing and Break-Even Analysis** Concept of Marginal Costing, Contribution Margin and Break-Even Point : Simple numericals 4. **Capital Budgeting** Meaning and Significance of Capital Budgeting, Methods of Capital Budgeting: **Payback Period Method** Definition and Calculation, the Payback Period Method: Simple numericals **Net Present Value (NPV) Method** Concept and Calculation, the NPV Method: Simple numericals **Self Learning:** Evaluating the Application of Marginal Costing and Break-Even Analysis in Real-World Business	8	CO2	3,4, 5, 6

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Decisions.			
4	**Introduction to Managerial Economics** 1. **Basics of Managerial Economics** Definition and Scope (Economic principles, business decision-making), Relationship with Other Disciplines (Economics, finance, marketing) 2. **Demand Analysis** Law of Demand (Demand curve, price effect), Determinants of Demand (Income, preferences, prices of related goods) Elasticity of Demand (Price elasticity, income elasticity) : Simple numericals 3. **Supply Analysis** Law of Supply (Supply curve, price effect), Determinants of Supply (Production cost, technology, number of sellers) **Self Learning:** Exploring the Interplay Between Demand, Supply, and Market Equilibrium in Managerial Decision-Making Processes	6	CO3	8
5	**Market Structures and Pricing** 1. **Market Structures** Perfect Competition (Characteristics, price takers), Monopoly (Characteristics, price makers), Monopolistic Competition (Characteristics, product differentiation) 2. **Pricing Strategies** Pricing under Different Market Conditions (Market structure impact), Cost-Based Pricing (Markup pricing, cost-plus pricing with simple numerical problems) 3. **Production and Cost Analysis** Production Functions (Input-output relationship), Short-Run Production Function, Types of costs **Self Learning:** Comparative Analysis of Pricing Strategies Across Different Market Structures and Their Impact on Business Profitability	8	CO3	11
6	**Macroeconomics and Business Environment** 1. **Introduction to Macroeconomics** Key Concepts: GDP, GNP, National Income (Measurement, components), Business Cycles (Phases), Inflation (Causes, effects) 2. **Economic Policies** Monetary Policy (Meaning, Objectives, Central bank role, tools of monetary policy), Fiscal Policy (Meaning, Objectives and tools) **Self Learning:** Analyzing the Impact of Monetary and Fiscal Policies on Macroeconomic Stability and Business Operations	4	CO4	8

Reference Books:

Reference No	Reference Name
1	Financial Accounting Concepts, Methods and Applications, Carl S. Warren, James M. Reeve and Jonathan E. Duchac, Cengage Learning India Pvt. Ltd. (3rd Edition)
2	Financial Accounting for Business Managers, Ashish Bhattacharya, PHL Learning Pvt. Ltd.
3	Cost and Management Accounting, Dr. Satish Inamdar, Everest Publishing House (12th Edition)
4	Management Accounting, Prof. A. P . Rao, Everest Publishing House (12th Edition)
5	Introduction to Management Accounting, Charles T. Horngrem, Gary L. Sundem, Jeff O. Schatzberg, Dave Burgstathler, Pearson (16th Edition)
6	Management Accounting, M.Y. Khan, P.K. Jain, Tata McGraw Hill Education Pvt. Ltd. (5th Edition)
7	Managerial Economics, Christopher R. Thomas, S. Charles Maurice, Sumit Sarka, Tata McGraw Hill Education Pvt. Ltd. (9th Edition)
8	Managerial Economics, Suma Damodaran, Oxford University Press (2nd Edition)
9	Managerial Economics, Dominic Salvatore, Ravikesh Srivastava, Oxford University Press (7th Edidition)
10	Managerial Economics and Business Strategy, Michael R. Baye, Jeffrey T. Prince, McGraw Hill Education (India) Pvt. Ltd. (8th Edition)
11	Managerial Economics, Dr. D.D Chaturvedi, Dr. S.L.Gupta, International Book House Pvt. Ltd.(3rd Edition)

Web References:

Reference No	Reference Name
1	**Introduction to Accounting** • Accounting Coach • https://kb.icai.org/pdfs/PDFFile5b27976545f667.12985834.pdf • https://www.toppr.com/guides/fundamentals-of-accounting/accounting-process/types-of-accounts/
2	**Financial Accounting** • https://www.toppr.com/guides/accounting-and-auditing/preparation-of-final-accounts-of-sole-proprietor/
3	**Management Accounting** • https://www.investopedia.com/terms/m/managerialaccounting.asp • https://www.toppr.com/guides/fundamentals-of-accounting/fundamentals-of-cost-accounting/format-of-cost-sheet/ • https://www.accounting-tuition.com/grade-12/marginal-costing-break-even-analysis • https://www.investopedia.com/terms/p/paybackperiod.asp • https://www.investopedia.com/terms/n/npv.asp

	Introduction to Managerial Economics	
4	• https://www.jaroeducation.com/blog/scope-of-managerial-economics/ • https://theintactone.com/2019/09/28/me-u1-topic-2-managerial-economics-relationship-with-other-subjects/ • https://www.khanacademy.org/economics-finance-domain/microeconomics/supply-demand-equilibrium/demand-curve-tutorial/a/law-of-demand • https://www.investopedia.com/terms/p/priceelasticity.asp • https://study.com/academy/lesson/determinants-demand-overview-shifters-examples.html • https://unacademy.com/content/cbse-class-11/study-material/economics/determinants-of-supply/	
5	**Market Structures and Pricing** • https://corporatefinanceinstitute.com/resources/economics/market-structure/ • https://en.wikipedia.org/wiki/Pricing_strategies • https://hmhub.in/managerial-economics/production-and-cost-analysis/	
6	**Macroeconomics and Business Environment** • https://www.jagranjosh.com/general-knowledge/what-is-national-income-basic-concepts-1418635306-1 • https://corporatefinanceinstitute.com/resources/economics/business-cycle/ • https://cleartax.in/s/inflation-deflation • https://byjusexamprep.com/upsc-exam/what-are-the-6-tools-of-monetary-policy • https://www.nextias.com/blog/fiscal-policy/	

Tutorials:

Sr. No.	Topic	Hrs
1	Analyze different types of accounts (personal, real, nominal) and categorize a list of given transactions accordingly.	1
2	Record a series of transactions in journal entries and post them to ledger accounts to create a trial balance.	1
3	Create a complete set of financial statements for a sole trading concern, including the Trading Account, Profit and Loss Account, and Balance Sheet.	1
4	Adjust the given financial statements for closing stock, outstanding expenses, prepaid expenses, and depreciation.	1
5	Develop a cost sheet for a hypothetical company, detailing direct and indirect costs and providing a clear example.	1
6	Conduct a marginal costing and break-even analysis for a new product, explaining the process and implications for decision-making.	1
7	Analyze a case study to explore the relationship between demand, supply, and market equilibrium in a business context.	1
8	Discuss the application of elasticity of demand in determining pricing strategies and business decision-making.	1
9	Identify and analyze the characteristics of different market structures through a comparative study, providing examples from current markets.	1
10	Conduct a production and cost analysis for a short-run production function, highlighting the impact of fixed, variable, and total costs.	1

11	Examine the phases of the business cycle and their impact on GDP, GNP, and National Income, with historical examples.	1
12	Evaluate the tools and effectiveness of monetary and fiscal policies in achieving macroeconomic stability and their impact on business operations.	1

Assessment:
Continuous Assessment (CA): 25 marks
 Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE152	**Optimization Techniques**				

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**

Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA+Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite: Basic knowledge of Mathematics and Statistics

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Study the formulation of Linear programming problems and obtain the optimum solution using various methods
2	Solve the transportation, assignment problems and obtain their optimal solution
3	Use competitive strategy for analysis and learn to take decisions in various business environments
4	Understand simulation models and analyze their performance in real world systems

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

Sr. No.	Course Outcome	Bloom Level
CO1	Formulate mathematical model 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 various choices in real world problems	Applying
CO3	Think strategically and decide the optimum alternative from various available options	Evaluating
CO4	Evaluate performance parameters of real system using simulation.	Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**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	1-2	1-7

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
2	**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	1-2-3	1-7
3	**Assignment Problem & Travelling Salesman Problem**: Definition of assignment Problem : Hungarian method (minimization & maximization), Travelling Salesman Problem: Hungarian method. **Self Learning Topics:** Simple applications in daily life	6	1-2-3	1-7
4	**Game Theory** : Rules of Game Theory, Two person zero sum game, solving simple games (2x2 games), solving simple games (3x3 games) **Self Learning Topics :** Solution of game theory problem by graphical method	6	1-2-3	1-7
5	**Decision Theory:** Decision making under certainty, under uncertainty, Maximax Criterion, Maximin Criterion, Savage Minimax Regret criterion, Laplace criterion of equal Likelihoods, Hurwicz criterion of Realism **Self Learning Topics:** Decision tree for decision-making problem	6	2-3	1-7
6	**Simulation**: Introduction to simulation, steps in simulation, advantages of simulation, limitations of simulation, applications of simulation, Monte-Carlo method: simple examples, single server queue model. **Self Learning Topics:** Generation of pseudo random numbers and their properties.	6	4	8

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, IITROORKEE, https://nptel.ac.in/courses/112107220/
5	Game Theory, Prof. K. S. MallikarjunaRao, IIT-BOMBAY, https://nptel.ac.in/courses/110/101/110101133/

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	Linear programming problem using Two Phase Method	1
5	Finding the basic feasible solution using North West Corner Cell Method and Least Cost Method	1
6	Finding the basic feasible solution using Vogel's Approximation Method	1
7	Finding the optimal solution using Modi Method	1
8	Assignment Problem using Hungarian method	1
9	Travelling salesman Problem using Hungarian method	1
10	Solving Two person zero sum game	1
11	Decision Making Under Uncertainty	1
12	Monte-Carlo Method	1

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.

- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE153	Digital Marketing and Business Analytics				

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
3	1	4	3	1	4

Examination Scheme (Marks)					
Internal Assessment (IA)			End Sem. Examination	Term Work	Total (Marks)
Continuous Assessment CA)	Test	Total (IA) (CA + Test)			
25	25	50	50	25	125

Pre-requisite: Nil
Course Objectives: Course aim to

Sr. No.	Course Objective
1	Examine and explore the role and importance of Digital Marketing in the current business scenario.
2	Familiarize with the various Digital Marketing Tools.
3	Apply social media marketing platforms for formulating a Digital Marketing Strategy.
4	Understand the need and practices of trending technologies in Digital Marketing.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand the role of Digital Marketing and key elements of Digital Marketing Strategy.	Remembering, Understanding
CO2	Demonstrate use of various Digital Marketing Tools for digital marketing campaigns.	Applying and Analyzing
CO3	Assess/Evaluate the effectiveness of social media marketing strategies for improving business.	Evaluating
CO4	Demonstrate web analytics using trending technologies in Digital Marketing.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Fundamentals of Digital Marketing:** Digital Marketing. Digital Marketing Strategy. Skills Required in Digital Marketing, Digital Marketing Plan, Dignified Digital Marketing – Ethics and Data Privacy **Display Advertising:** Introduction to Display Advertising, Types of Display Ads, Buying Models, Display Plan	5	CO1	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self Learning Topics: What makes a Good Ad?			
2	**Search Engine Advertising and Optimization:** Introduction, Understanding Ad Placement, Understanding AdRanks, Creating First Ad Campaign, Enhance Your Ad Campaign, Performance Reports. **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,SEO – Visual Search	8	CO2	1,6
3	**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 **LinkedIn Marketing:** Importance of LinkedIn Presence, LinkedIn Strategy, Sales Leads Generation Using LinkedIn, Content Strategy, LinkedIn Analytics, Targeting, Ad Campaign **Self Learning Topics:** Campaign Management, Running Campaigns, Lead Generation, Qualified Leads	9	CO3	1,2,4
4	**Twitter Marketing:** Getting Started with Twitter, Building a Content Strategy, Twitter Usage, Twitter Ads, Twitter Analytics, Twitter Tools and Tips for Marketers **Instagram:** Getting started with Instagram, content strategy, different features of Instagram, Promo Codes in Ads, Message Editing and Pinning, Multiple Links in Bio, Scheduling Posts, Reels Templates and Interactive Elements, Instagram Threads **YouTube Marketing:** YouTube Channel, Optimize Your YouTube Videos for SEO, YouTube Ads, YouTube Analytics **Mobile Marketing:** Mobile Usage, Mobile Advertising, Mobile Marketing Toolkit, Mobile Marketing Features, Mobile Analytics **Self-Learning Topics:** Addressing the Diversity in India through Mobile	9	CO3	1,2,4
5	**Web Analytics:** Data Collection, Key Metrics, Making Web Analytics Actionable, Multi- Channel Attribution, Types of Tracking Codes, Competitive Intelligence **Self Learning Topics:** Interpretation of various Charts available in Google Analytics. How to connect Offline with Online.	5	CO4	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
6	**Technological advancements in digital marketing:** Voice Search, AI in advertising, AI for Social Media marketing, Chatbots, Big data in marketing, Virtual Reality, Augmented Reality **Self Learning Topics:** Marketing automation	4	CO4	1

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

Web References:

Reference No	Reference Name
1	Digital Marketing Strategy - Course (swayam2.ac.in)
2	Basics of Digital Marketing - Course (swayam2.ac.in)
3	Digital Marketing - Course (swayam2.ac.in)
4	https://www.hubspot.com/youtube-marketing

Tutorial:

Sr. No.	Detailed Contents	Hrs
1.	Digital Marketing – Case Study : Ariel Fashion Shoot	1
2.	Display Advertising – Case Study : Anything for Jetta	1
3.	Search Engine Advertising – Case Study : Kotak Services	1
4.	SEO – Case Study : Barclays Business Banking SEO Campaign	1
5.	Social Media Marketing – Case Study : The Fall and Rise of Maggie	1
6.	Facebook Marketing – Case Study : ICICI Bank – Building India's Most Social Bank on Facebook	1
7.	LinkedIn Marketing – Case Study : Mercedes Benz, DELL	1
8.	Twitter Marketing – Case Study : Mercedes-Benz (2011)	1
9.	Instagram – Case Study : H & M	1
10.	Video Marketing – Case Study- BMW	1

11.	Web Analytics – Case Study : Conversion Tracking through URL Builder – A Hotel Brand	1
12.	How Does Netflix Leverage Big Data and Analytics?	1

Note: The Case Studies mentioned above are indicative and not limited to. The Teacher has the flexibility of taking similar Case Studies taking into consideration the current scenario and technological changes.

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class test of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE154	e-Commerce				

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
3	1	4	3	1	4

Examination Scheme (Marks)					
Internal Assessment (IA)			End Sem. Examination	Term Work	Total (Marks)
Continuous Assessment CA)	Test	Total (IA) (CA+Test)			
25	25	50	50	25	125

Pre-requisite: Knowledge of Internet, Web design and Network Systems.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Introduction to Electronic Commerce –Evolution and Models.
2	Payment transactions in a secured network.
3	Different payment modes of e-Commerce like Electronic data interchange
4	Manage different E-business Enterprise.
5	Understand Mobile commerce and security of e-Commerce.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Identify the anatomy of e-Commerce applications and it process models.	Apply
CO2	Categorize different Electronic payment system	Analyze
CO3	Analyze various marketing strategies of e-Commerce for an online business.	Analyze
CO4	Understanding the operations of e-enterprises.	Understand
CO5	Discuss mobile application and payment method of m-	Create
CO6	Understand various security issues and opportunities in e-Commerce.	Understand

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Electronic Commerce:** Definition, categories & nature of e-Commerce, advantages and disadvantages of e-Commerce, e-Commerce Opportunities for Industries, benefits to Organization and Society. Traditional Commerce v/s e-Commerce: Traditional business commerce, differences b/w e-Commerce and traditional commerce, Technical and nontechnical limitations. e-Commerce Models: Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Consumer(C2C), Consumer-to-Business (C2B), Business-to-Government (B2G), Government to Business (G2B), Government –to- Citizen (G2C),Intra organization e-Commerce and Inter organization e-Commerce **Self-Learning topics:** History of e-Commerce, Internet & WWW	8	**CO1**	1, 2
2	**e-Payment System:** Electronic Payment System: Types of electronic payment system, cost involved in electronic payment system, Legal issues of e-Payment Systems, Risk and Electronic Payment Systems. Designing Electronic Payment systems. Electronic Data Interchange (EDI) :Concept of EDI, Benefits of EDI, How EDI works, legal and security and privacy issues in EDI, Applications of EDI **Self-Learning topics:** Internet Banking, Digital Signatures, SET	8	**CO2**	2, 3
3	**Corporate Digital Library:** Document Library, digital Document types, corporate Data warehouses. Advertising and Marketing – Information based marketing, Advertising on Internet, On-line marketing process, market research. Consumer Search and Resource Discovery- Information search and Retrieval, Commerce Catalogues, Information Filtering. Multimedia –Key multimedia concepts, Desktop video processing, Desktop video conferencing **Self-Learning topics:** E-marketing, E-advertising, E-branding	8	**CO3**	4
4	**Managing the e-Enterprise**: Introduction of e-Enterprise, building the e-Enterprise: e-Transformation, Methodology, Org Models, e-Enterprise Architecture: Introduction, Business Architecture & Technology Architecture, E-Enterprise Technology Components: Technology Components &Technology Standards **Self-Learning topics:** e-Organization, e-ROI and e-	6	CO4	5

54

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Measurement			
5	**m-Commerce**: Introduction to Mobile commerce, Applications, Advantages, Limitations, architecture, transaction model, payment methods, Payment operations, future trends. **Self-Learning topics:** Difference between e-Commerce& m-Commerce, Value Chain & Life Cycle	5	CO5	2
6	**e-Commerce Security Implications and Opportunities:** Security Implications: Introduction, Security Policy, EDI Security Concepts, Security Mechanism, Internet Security. Issues and Opportunities in Implications: Introduction, Commercial Issues, Security Issues, Infrastructure Issues, Social and Cultural Issues. **Self-Learning topics:** e-Commerce: Role of Government and Policy Recommendations**.**	5	CO6	6

Reference Books:

Reference No	Reference Name
1	E-COMMERCE An Indian Perspective 3rd Edition, P. T. Joseph, S. J., PHI Learning Private Limited
2	E-COMMERCE AND MOBILE COMMERCE TECHNOLOGIES, Dr. U. S. Pandey, S Chand Publishing, S Chand & Company Limited
3	Fundamentals of e-Commerce, Manjot Kaur
4	Frontier of e Commerce, Ravi Kalakota& Andrew B. Whinston
5	Business Models, Architecture and Components, Faisal Hoque, Cambridge University Press
6	e-Commerce "A Manager's Guide to E_BUSINESS" by Parag Diwan & Sunil Sharma Published by Anurag Jain for Excel Books.

Web References:

Reference No	Reference Name
1	https://www.scribd.com/doc/20489539/Corporate-Digital-Library
2	https://www.researchgate.net/publication/228854622_e-Commerce_and_Digital_Libraries
3	https://www.coursehero.com/file/52491570/32pdf/
4	https://www.google.co.in/books/edition/E_COMMERCE_SEVENTH_EDITION/G8fAEAAAQBAJ?hl=en&gbpv=1
5	https://www.google.co.in/books/edition/E_Enterprise/gOWsBfEZ5TMC?hl=en&gbpv=1&dq=Books+for+e-Enterprise+in+e-Commerce&printsec=frontcover

Tutorials:

Sr. No.	List of Tutorials	Hrs
1	Browse various E-Commerce Applications: Business-to-Consumer (B2C), Consumer-to-Consumer (C2C), Business-to-Business (B2B)	1
2	Discussion about the technological aspects of E-commerce. Find out the various companies engaged in online business and discuss about their strategies.	1
3	Case study on E-Commerce Payment Systems	1
4	Case study on electronic data interchange.	1
5	Case study of Digital Government, Marketplaces, and Communities.	1
6	Case study of E-Commerce Marketing Techniques	1
7	Find and discuss other online transactions with its advantages and disadvantages	1
8	Discuss Two real life case study on E-enterprise.	1
9	Case study on Mobile advertising (SMS, in-app ads, mobile web ads)	1
10	Case Study on Technology and Innovation in E-Commerce	
a)	Role of AI and machine learning in personalization and recommendations	1
b)	Integration of augmented reality (AR) and virtual reality (VR) for virtual try-ons	1
c)	Impact of mobile commerce on the fashion industry	1

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:

- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks

- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks

- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

Term Work: 25 marks

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

End Semester Theory Examination:

1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAL11	**Advanced Data Structures Lab**				
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
4	**2**	**50**	**30**	**20**	**100**

Pre-requisite: Basic understanding of fundamentals of any programming language.
Lab Course Objectives:

Sr. No.	Course Objective
1	Understand concepts of searching and sorting algorithms.
2	Learn hashing techniques and collision resolution
3	Impart a thorough understanding of linear data structures
4	Impart a thorough understanding of non-linear data structures
5	Make Use of appropriate data structure for solving real world problems

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

Sr. No.	Course Outcome	Bloom Level
CO1	Apply searching and sorting algorithms.	Applying
CO2	Implement linear data structures	Applying
CO3	Implement non-linear data structures	Applying
CO4	Analyse hashing technique for data storage and retrieval problems	Analysing
CO5	Choose the appropriate data structures to solve complex real life problems	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Sorting& Searching Techniques:** Bubble Sort, Insertion Sort, Selection Sort, Shell Sort, Linear Search, Binary Search. **Self-Learning Topics:** Quick sort, Radix Sort.	6	CO1	2
2	**Hashing Techniques:** Methods for Hashing: Modulo Division, Digit extraction, Linear Probe for Collision Resolution **Self-Learning Topics**: Direct, Subtraction hashing, Fold shift, Fold Boundary	4	CO4	2
3	**Stacks & Queue:** Array implementation of Stack, ordinary and circular queue. Conversion of infix notation to postfix notation, Evaluation of postfix expression and balancing of parenthesis. **Self-Learning Topics:** Conversion of infix to prefix, Other queue applications	10	CO2	2
4	**Linked List:** Singly Linked Lists, Circular Linked	12	CO2	2

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	List, and Doubly Linked Lists: Insert, Display, Delete, Search, Count, Reverse (SLL), Polynomial Addition. Linked List implementation of stack, ordinary queue, priority queue, Double ended queue. **Self-Learning Topics :** Comparative study of arrays and linked list			
5	**Trees:** Binary search tree: Create, Recursive traversal: preorder, postorder, inorder, Search Largest Node, Smallest Node, Count number of nodes, Heap: MinHeap, MaxHeap: reheapUp, reheapDown, Delete. **Self Learning Topics:** Expression Tree, Heapsort	8	CO3	2
6	**Graphs:** Represent a graph using the Adjacency Matrix, BFS& DFS, Find the minimum spanning tree (using any method Kruskal's Algorithm or Prim's Algorithm) **Self-Learning Topics :** Shortest Path Algorithm	8	CO3	2
7	**Group proje**ct (3 to 4 members) to be given to work on one application to a real world problem.	4	CO5	

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - Experiments 25 marks
  - Group Project 15 marks
  - Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia, Second Edition, ISBN No. 978-81-203-1177-0
2	Richard F Gilberg Behrouz A Forouzan , Data Structure A Pseudocode Approach with C, Cengage India, Second Edition, ISBN No. 978-81-315-0314-0
3	S. Lipchitz, Data Structures, Mc-Graw Hill Education, ISBN No. 978-12-590-2996-7
4	Ellis Horowitz, S. Sahni, D. Mehta, Fundamentals of Data Structures in C++, Galgothia Publication, ISBN No. 978-81-751-5278-6
5	Michael Berman, Data structures via C++, Oxford University Press, First Edition, ISBN No. 978-01-980-8952-0

Web References:

Reference No	Reference Name
1	https://www.digimat.in/nptel/courses/video/106106133/L25.html
2	https://www.youtube.com/watch?v=zWg7U0OEAoE
3	https://www.digimat.in/nptel/courses/video/106106145/L01.html
4	https://www.cs.auckland.ac.nz/software/AlgAnim/ds_ToC.html
5	https://nptel.ac.in/courses/106/101/106101208/

Suggested list of experiments:

Practical No	Problem Statement
1	Implementation of different searching & sorting techniques.
2.	Perform various hashing techniques with Linear Probe as collision resolution
3	Implementation of Stacks ,Ordinary Queue & Circular queue (Using arrays)
4	Implementation of Stack Applications like: ○ infix to postfix ○ Postfix evaluation ○ Balancing of Parenthesis
5	Implementation of all types of linked lists.
6	Demonstrate application of linked list (eg.Sparse matrix,Stack,Queue,Priority & Double ended Queue)
7	Create and perform various operations on BST.
8	Implementing Heap with different operations.
9	Create a Graph storage structure (eg. Adjacency matrix)
10	Implementation of Graph traversal. (DFS and BFS)
11	Create a minimum spanning tree using any method Kruskal's Algorithm or Prim's Algorithm
12	Group project (3 to 4 members) to be given to work on one application to a real world problem like: a) Bus routes of school buses for XYZ school b) Creating a To-do list c) Building a Phonebook d)Students grade checker e) Game like Sudoku solver f) Carpooling application etc.

Note: At least 10 programs

Course Code	Course Name			
MCAL12	**Advanced Java Lab**			
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**		
		Term Work	**Practical**	**Oral**	**Total**
02	**01**	**50**	**30**	**20**	**100**

Pre-requisite:
1. Basic understanding of Core Java Programming.
2. Basics of web technology.

Lab Course Objectives: Course aims to

Sr. No.	Course Objective
1	Write programs based on Java Generics, Collection framework and Lambda expressions.
2	Develop web applications using JSP.
3	Demonstrate use of with Java Framework - Spring.
4	Build an application using Spring Framework.
5	Develop Spring applications using Spring Boot and Spring Boot RESTful Web Services.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.	Understanding
CO2	Build JSP web applications using standard actions and custom tags.	Applying
CO3	Develop application using Spring Framework, Lightweight Container sand 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 and database.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Java Collections and Generics**: Programs based on Generic classes. Java Collection Framework, List, Set and Map, Wildcards and Lambda expressions. **Self Learning Topics:** Collection Queues and Arrays	4	1	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
2	**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. **Self Learning Topics:** Simple Application using Servlet	4	2	1
3	**Spring Framework**: Programs based on using Spring Framework, dependency injection. **Self Learning Topics:** Bean Definition Profiles	4	3	7,8
4	**Aspect Oriented Programming**: Programs based on Spring AOP– Before, After, Around, After Returning and After Throwing advice, PointCuts. **Self Learning Topics:** AspectJ	4	4	7
5	**JDBC Data Access with Spring using Oracle / MySQL database**: Programs based of Spring JDBC, Jdbc Template, PreparedStatement, Callback, ResultSetExtractor and RowMapper interface. **Self Learning Topics:** Basic JDBC Program using DML operation	6	5	7
6	**Getting Started with Spring Boot:** Programs based on Spring Boot Programs based on Database and RESTful Web Services with Spring Boot. **Self Learning Topics:** Understanding Transaction Management in Spring	4	6	9

Assessment:

Term Work: Will be based on Continuous Assessment

- Laboratory work will be based on the syllabus with minimum 10 experiments.
  The experiments should be completed in the allotted time duration.
  - o Experiments 40 marks
  - o Attendance   10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1.	Java, The Complete Reference, Ninth Edition,Herbert Schildt, Oracle Press
2.	Java 6 Programming Black Book, Wiley–Dreamtech ISBN 10:

	817722736X ISBN 13: 9788177227369
3.	Web Enabled Commercial Application Development using java 2.0, Ivan Byaross ISBN-10: 8176563560 / ISBN-13: 978-8176563567
4.	Java Server Programming java EE6, Black book, Dreamtech press. ISBN-10: 8177229362 / ISBN-13: 978-8177229
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 , MertCalıskan and KenanSevindik Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, IN 46256 www.wiley.com
10.	SpringRecipesAProblemSolutionApproach,GaryMak,JoshLongandDanielRubio, Apress

Web References:

Reference No	Reference Name
1.	https://docs.oracle.com
2.	https://spring.io/
3.	https://www.javatpoint.com/pojo-in-java
4.	https://www.tutorialspoint.com/spring/index.htm
5.	https://docs.spring.io
6.	https://www.geeksforgeeks.org/spring/
7.	https://www.geeksforgeeks.org/spring-boot/
8.	https://spring.io/guides/gs/spring-boot

Suggested list of experiments:

Practical No.	Problem Statement
1	**Assignments on Java Generics**
	1. Write a Java Program to demonstrate a Generic Class. 2. Write a Java Program to demonstrate Generic Methods. 3. Write a Java Program to demonstrate Wildcards in Java Generics.
2	**Assignments on List Interface**
	1. Write a Java program to create List containing list of items of type String and use for-each loop to print the items of the list. 2. Write a Java program to create List containing list of items and use ListIterator interface to print items present in the list. Also print the list in reverse / backward direction.
3	**Assignments on Set Interface**
	1. Write a Java program to create a Set containing list of items of type String and print the items in the list using Iterator interface. Also print the list in reverse / backward direction. 2. Write a Java program using Set interface containing list of items and

Practical No.	Problem Statement
	perform the following operations:
	a. Add items in the set.
	b. Insert items of one set in to other set.
	c. Remove items from the set
	d. Search the specified item in the set
4	**Assignments on Map Interface**
	1. Write a Java program using Map interface containing list of items having keys and associated values and perform the following operations:
	a. Add items in the map.
	b. Remove items from the map
	c. Search specific key from the map
	d. Get value of the specified key
	e. Insert map elements of one map in to other map.
	f. Print all keys and values of the map.
5	**Assignments on Lambda Expression**
	1. WAP using Lambda Expression to print "Hello World".
	3. WAP using Lambda Expression with single parameters.
	4. Write a Java program using Lambda Expression with multiple parameters to add two numbers.
	5. Write a Java program using Lambda Expression to calculate the following:
	a.Convert Fahrenheit to Celsius
	b.Convert Kilometers to Miles.
	6. Write a Java program using Lambda Expression with or without return keyword.
	2. Write a Java program using Lambda Expression to concatenate two strings.
6	**Assignments based on web application development using JSP**
	1. Create a Telephone directory using JSP and store all the information within a database, so that later could be retrieved as per the requirement. Make your own assumptions.
	2. Write a JSP page to display the Registration form (Make your own assumptions)
	3. Write a JSP program to add, delete and display the records from StudentMaster (RollNo, Name, Semester, Course) table.
	4. Design Loan calculator using JSP which accepts Period of Time (in years) and Principal Loan Amount. Display the payment amount for each loan and then list the loan balance and interest paid for each payment over the term of the loan for the following time period and interest rate:
	a) 1 to 7 year at 5.35%
	b) 8 to 15 year at 5.5%
	c) 16 to 30 year at 5.75%
	5. Write a program using JSP that displays a webpage consisting an Application form for change of Study Center which can be filled by any student who wants to change his/ her study center. Make necessary assumptions.
	6. Write a JSP program that demonstrates the use of JSP declaration, scriptlet, directives, expression, header and footer.

Practical No.	Problem Statement
7	**Assignment based Spring Framework**
	1. Write a program to print "Hello World" using spring framework. 2. Write a program to demonstrate dependency injection via setter method. 3. Write a program to demonstrate dependency injection via Constructor. **4.** Write a program to demonstrate Autowiring.
8	**Assignment based Aspect Oriented Programming**
	1. Write a program to demonstrate Spring AOP – before advice. 2. Write a program to demonstrate Spring AOP – after advice. 3. Write a program to demonstrate Spring AOP – around advice. 4. Write a program to demonstrate Spring AOP – after returning advice. 5. Write a program to demonstrate Spring AOP – after throwing advice. **6.** Write a program to demonstrate Spring AOP – pointcuts.
9	**Assignment based Spring JDBC**
	1. Write a program to insert, update and delete records from the given table. 2. Write a program to demonstrate PreparedStatement in Spring JdbcTemplate 3. Write a program in Spring JDBC to demonstrate ResultSetExtractor Interface **4.** Write a program to demonstrate RowMapper interface to fetch the records from the database.
10	**Assignment based Spring Boot and RESTful Web Services**
	1. Write a program to create a simple Spring Boot application that prints a message. 2. Write a program to demonstrate RESTful Web Services with spring boot. **3.** Write a program to demonstrate Database Connection with spring boot.

Note : At least 12-14 programs

Course Code	Course Name				
MCAL13	Advanced Database Management System Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
2	1	50	30	20	100

Pre-requisite: Database Management System, SQL

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understanding functioning of advanced databases like distributed and ORDBMS.
2	Understand basic OLAP Operations.
3	Understand ETL transformations.
4	Understand the different data preprocessing techniques.
5	Identify the real-world problems, choose relevant data mining algorithms and analyze the results for respective applications.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate distributed and ORDBMS concepts	Applying
CO2	Demonstrate and analysis various OLAP operations	Analyzing
CO3	Perform ETL transformations used in building data warehouse	Applying
CO4	Demonstrate data preprocessing techniques	Applying
CO5	Implement and evaluate different data mining techniques like classification, prediction, clustering and association rule mining in R	Applying, Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Distributed Database:** Implementation of Partitions: Hash, Range, List, **Self-Learning Topics:** Composite partition	2	CO1	1
2	**OLAP with Oracle:** Analytical Queries Roll_UP, CUBE, First, Last, Lead, Lag, Rank AND Dense Rank, Windowing functions ROWS-N-PRECEDING AND FOLLOWING **Self-Learning Topics:** Cume_list, Percent_rank	4	CO2	3
3	**ORDBMS:** Implementation of, Abstract Data Type, Object table, Inheritance **Self-Learning Topics:** Nested ADT, Reference, Varray	2	CO1	1
4	**ETL through Pentaho:** ETL Transformation with Pentaho	4	CO3	4

66

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self-Learning Topics: Any two more-transformation operation in Pentaho beyond the syllabus			
5	**Basics of R programming and Data Preprocessing:** Introduction to R, Data Types and Objects, Reading and writing data, reading data from the console Packages, loading packages, Attach, and detaching data. Loading Data from different Data Source, Data preprocessing techniques in R **Self-Learning Topics:** Operators, Conditional Statements and Loops, Functions, Loading data from Relational Databases, XML, Sorting, Date Conversion	4	CO4	5
6	**Data Mining Classification using R-Programming:** Implementation and Analysis of – Regression - Linear Regression, Classification Models (Naïve bayes, KNN, Decision Trees-ID3, C4.5) **Self-Learning Topics:** Implement One classification algorithm in Weka	6	CO5	5,6
7	**Data Mining Clustering and Association using R-Programming:** Implementation of Market Basket Analysis and Clustering. APRIORI, KMEAN, AGGLOMERATIVE **Self-Learning Topics:** Implementation clustering, association in Weka	4	CO5	5,6

<u>**Assessment:**</u>
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - Experiments   40 marks
  - Attendance   10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Ramakrishnan, Raghu, Johannes Gehrke, Database Management Systems, Vol. 3, McGraw-Hill, 2003.
2	Ponniah, Paulraj, Data warehousing fundamentals: a comprehensive guide for IT professionals, John Wiley & sons, 2004.
3	SQL & PL/SQL for ORACLE 11g Black Book by P.S. Deshpande, DreamTech Press Publishing, ISBN NO: 9788177229400
4	Pentaho Data Integration Cookbook Second Edition. PACKT

	Publishing, Second Edition ISBN 978-1-78328-067-4
5	John M. Quick, "Statistical Analysis with R", PACKT Publishing, 2015ISBN NO: 9781849512084, 9781849512084
6	G.K. Gupta, "Introduction to data mining with case studies", PHI Learning Publishing, ISBN: 9788120350021, 8120350022

Web References:

Reference No	Reference Name
1	https://docs.oracle.com/en/database/oracle/oracle-database/19/vldbg/ partition- concepts.html
2	https://docs.oracle.com/en/database/oracle/oracle-database/21/olaxs/olap-functions.html
3	https://docs.oracle.com/cd/A97630_01/server.920/a96524/c14ordb.htm
4	http://cookbook-r.com
5	https://www.r-project.org/about.html
6	"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
7	https://www.rstudio.com/
8	http://www.r-project.org/doc/bib/R-books.html

Suggested list of experiments:

Practical No	Problem Statement
1	Implementation of Data partitioning through Hash, Range and List partitioning
2	Implementation of Analytical queries like Roll_UP, CUBE, First, Last, Lead, Lag, Rank AND Dense Rank and Windowing functions- preceding rows, following and rows between
3	Implementation of ORDBMS concepts like ADT (Abstract Data Types), Object table and Inheritance
4	Implementation of ETL transformation with Pentaho like Copy data from Source (Table/Excel/ Oracle) and store it to Target (Table / Excel / Oracle), Adding sequence, Adding Calculator, Concatenation of two fields, splitting of two fields, Number Range, String Operations, Sorting data, Implement the merge join transformation on tables, Implement data validations on the table data.
5	Introduction to basics of R programming: - Install packages, loading packages Data types, checking type of variable, printing variable and objects (Vector, Matrix, List, Factor, Data frame, Table) cbind-ing and rbind-ing, Reading and Writing data. setwd (), getwd (), data (), rm (), Attaching and Detaching data. Reading data from the consol. Loading data from different data sources. (CSV, Excel)
6	Implementation of Data preprocessing techniques like, Naming and Renaming variables, adding a new variable. Dealing with missing data. Dealing with categorical data. Data reduction using subsetting
7	Implementation and analysis of Linear regression.
8	Implementation and analysis of Classification algorithms - Naive Bayesian

9	Implementation and analysis of Classification algorithms - K-Nearest Neighbor
10	Implementation and analysis of Classification algorithms - ID3, C4.5
11	Implementation and analysis of Apriori Algorithm using Market Basket Analysis.
12	Implementation and analysis of clustering algorithms - K-Means
13	Implementation and analysis of clustering algorithms - Agglomerative

Note: At least 12-14 programs

Course Code	Course Name				
MCAL14	Web Technologies Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
04	02	50	30	20	100

Pre-requisite: Basic understanding of fundamentals of Web Technologies and JavaScript

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Create simple websites based on Node.js features
2	Demonstrate database connectivity and operations
3	Construct basic applications using ReactJS
4	Design SPA using ReactJS

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

Sr. No.	Course Outcome	Bloom Level
CO1	Build websites making use of various Node.js features	Applying
CO2	Design a dynamic web application enabled with database connectivity	Creating
CO3	Demonstrate React fundamentals and components of ReactJS	Applying
CO4	Build an end to end application using ReactJS	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Node.js, Modules and Events:** 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 Standard Callback Pattern, Event Emitter Pattern, Event Types, Event Emitter API, Creating an Event Emitter, Defer Execution of a Function, Cancel Execution of a Function **Self-Learning Topics:** *Additional Events*	08	CO1	
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*	08	CO1	

70

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
3	**Databases :**Connect and Communicate with a MySQL Database, Adding data to the database, CRUD operations **Self-Learning Topics:** Working with any other database	**06**	CO2	
4	**Introduction to ReactJs:** Setting up React environment, Create React App, Hello World, understanding JSX **Self-Learning Topics:** XML	**06**	CO3	
5	**Components and Events:**Component Life cycle, Functional, class and rendering components, components in files, Props: react props and passing and accessing props, DOM events(click, change, blur, keyup) **Self-Learning Topics:** CSS, SCSS	**12**	CO3 CO4	
6	**Forms, Hooks and Routing:** Forms–Handling user input with forms, Form validation techniques, Hooks- useState, useEffect, useContext, React Router **Self-Learning Topics:** Custom Hooks	**12**	CO4	

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments.
  The experiments should be completed in the allotted time duration.
    - Experiments 40 marks
    - Attendance   10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

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	ReactJS by Example: Building Modern Web Applications with React, Vipul A M, Prathamesh Sonpatki: PACKT publications
6	React Front to Back 2022, byBrad Traversy, Packt publication
7	Beginning ReactJs Foundations, Building User Interfaces with ReactJS, An approachable Guide by Chris Minnick

Web References:

Reference No	Reference Name
1	https://www.coursera.org/learn/server-side-nodejs
2	https://www.w3schools.com/nodejs/
3	https://www.w3schools.com/react/
4	https://react.dev/
5	https://softchris.github.io/react-book/#/
6	https://www.tutorialspoint.com/reactjs/index.htm

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 in ReactJS to implement component life cycle
8	Create an application to implement class and functional component in ReactJS
9	Create an application in ReactJSto import and export the files (components)
10	Create an application to implement state and props
11	Create an application in ReactJSto use DOM events
12	Create an application in ReactJSform and add client and server side validation
13	Create an application to implement React Hooks
14	Create SPA using React Router

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP11	Mini Project 1A	02	01	25	-	25	50

Pre-requisite: 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	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquaint with the process of applying basic computer applications and provide solutions to the problems in various application domains.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate the ability to produce a technical document.	Understanding
CO2	Apply software project management skills during project work.	Applying
CO3	Build small groups to work effectively in team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating

Guidelines for Mini Project:
1. Students shall form a group of 2 to 3 students.
2. Students should do survey and identify needs, which shall be converted into problems in consultation with the faculty Supervisor / Guide / HOD / Internal Committee of faculties. The project contact hours shall be allotted in the 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 mini project.
4. A log book to be prepared by each group, wherein the group can record weekly work progress, Guide / Supervisor can verify and record notes/comments.
5. Faculty may give inputs during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with Guide / Supervisor.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

Assessment of Mini Project:

I) Term work (25 Marks):

- The progress of the mini project to be evaluated on a continuous basis.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Termwork marks shall be as below;

Marks awarded by guide / supervisor based on log book	10 Marks
Self contribution and use of skillset in project	10 Marks
Quality of Project report	05 Marks

II) Mini Project Examination (Oral 25 Marks):

- Mini project evaluation will be done at Institute level by alumni or industry experts
- Report should be prepared as per the guidelines issued by the University of Mumbai.
- The students shall present a seminar on Mini project and demonstrate their understanding of need / problem.
- Mini Project shall be evaluated through a presentation and demonstration of working model by the student project group to a panel of examiner at Institute level.
- Mini Project shall be assessed based on following points:
  - o Quality of survey / need identification.
  - o Clarity of Problem definition based on need.
  - o Innovativeness in solutions.
  - o Feasibility of proposed problem solutions and selection of best solution.
  - o Cost effectiveness.
  - o Societal impact.
  - o Full functioning of working model as per stated requirements.
  - o Effective use of skill sets.
  - o Contribution of an individual as a member or leader.
  - o Clarity in written and oral communication.

Semester - II

Semester II

Course Code	Course Name				
MCA21	**Research Methodology**				
Teaching Scheme: Contact Hours (Per Week)			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite: Basic knowledge of Mathematics for Data Analysis, Software, Internet

Course Objectives: The Course aim to

Sr. No.	Course Objective
1	Understand Research and Research Process and their types
2	Identify Research Methodology for suitable research design ,data collection and analysis.
3	Acquaint students with identifying problems for research and apply them.
4	Promote Ethical Research Practices.
5	Compare and conclude research findings .
6	Illustrate role of AI in Research.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate knowledge of research concepts and processes	Understanding
CO2	Perform literature reviews, prepare the key elements of a research proposal	Applying
CO3	Compare and contrast quantitative and qualitative research	Analyzing
CO4	Define and develop a possible research interest area using specific research design	Applying
CO5	Explain the rationale of research ethics and its importance	Understanding
CO6	Identify use of AI and plagiarism detection tools for report writing	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction and Basic Research Concepts:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs	8	CO1	Ref.2 Chapter 1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Methodology, Need of Research in Business and Social Sciences, Objectives of Research, Issues and Problems in Research, **Self Learning Topics**: Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical			
2	**Research types and Design**: Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches **Research Design:** Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors **Self Learning Topics**: types of Sampling	8	CO3 CO4	Ref.2 Chapter 3
3	**Research Methodology** Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design, Data Collection, Data Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report **Self Learning Topics**: types of Hypothesis	8	CO2	Ref.6 Chapter 13
4	**Formulating Research Problem** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization, Interpretation, and analysis Validity Testing **Self Learning Topics**: importance of interpretation	6	CO4	Ref.2 Chapter 2
5	**Ethics:** Ethical Issues, Ethical Committees, Commercialization, copyright, royalty, Intellectual Property rights and patent law, Track Related aspects of intellectual property Rights, Reproduction of published material, Plagiarism, Citation and Acknowledgement, Reproducibility and accountability. **Self Learning Topics:** Steps of patent filing	5	CO5	Ref 3, 5
6	**Testing & Report writing** Preparation of the report on conclusion reached, Suggestions and Recommendation **Leveraging AI Tools and Plagiarism Detection** Introduction: Overview of AI tools and their impact on research, Importance of plagiarism detection in maintaining academic integrity. Idea Generation and Background Research	5	CO6	Ref.2 Chapter 19

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	E.g Research Rabbit, Iris.ai, scite.ai Writing Research e.g Jasper AI, WriteSonic Grammar and style improvement e.g Grammarly, Memrise Plagiarism Check e.g. Quetext, GPTZero Citation and Reference Management e.g trianka.ai, scholarcy Editing and Proofreading e.g trianka.ai, proofreader			

Reference Books:

Reference No	Reference Name
1	Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2	Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
3	Pruzan, Peter , Research Methodology, The Aims, Practices and Ethics of Science , ISBN 978-3-319-27167-5
4	Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors
5	Wadehra, B.L.2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
6	Kumar Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Web References:

Reference No	Reference Name
1	https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355.html
2	https://academicguides.waldenu.edu/library/srmo/tutorials
3	https://onlinecourses.nptel.ac.in/noc24_ge41/preview
4	https://alison.com/topic/learn/125426/definition-and-types-of-scientific-research
5	https://www.classcentral.com/course/research-methodologies-89903

Research Methodology Tutorials

Sr. No.	Detailed Content	Hrs
1	Defining a Research Problem in the area of interest	1
2	Literature Review of the Research Problem - Case Study	1
3	Research Design of the problem - Case Study	1
4	Sampling Design of the problem - Case Study	1
5	Measurement And Scaling Techniques to be used - Case Study	1
6	Formation of hypothesis Methods of Data Collection for the research problem - Case Study	1
7	Processing & Analysis Of Data for the research problem - Case Study	1

8	Hypothesis testing - Case Study	1
9	Interpretation & Report Writing - Case Study	1
10	Overview of AI technologies and their applications in research case study	1
11	Leveraging **Google Scholar** for AI-powered literature searches case study	1
12	Using **Grammarly f**or plagiarism detection and grammar checking case study	1

Assessment:
Continuous Assessment (CA): 25 marks
 Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCA22	Artificial Intelligence and Machine Learning				
Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
3	--	3	3	--	3
Examination Scheme (Marks)					
Internal Assessment (IA)			End Sem. Examination	Term Work	Total (Marks)
Continuous Assessment (CA)	Test	Total (IA) (CA + Test)			
25	25	50	50	--	100

Pre-requisite:
- Mathematical Foundation for Computer Science
- Advanced Database Management System

Course Objectives: The course aims to

Sr. No.	Course Objective
1	Understand different AI concepts and Develop an understanding of problem-solving techniques in Artificial Intelligence
2	Acquire knowledge of artificial intelligence search strategies.
3	Learn to design and build neural network models
4	Provide an understanding of the foundational principles of Machine Learning Techniques.
5	Acquaint regression methods, classification methods, and clustering methods.
6	Understand how to enhance accuracy and resilience in forecasting by merging predictions from multiple models

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand different AI concepts and Develop an understanding of problem-solving techniques in Artificial Intelligence	Understanding
CO2	Apply Artificial intelligence techniques for problem-solving and acquire knowledge of artificial intelligence search strategies	Applying
CO3	Identify and analyze different types of models of artificial neural networks	Applying
CO4	Analyze the fundamentals of machine learning, the learning algorithms, and the paradigms of supervised and unsupervised learning	Analyzing
CO5	Analyze and interpret the predictive performance of machine learning models	Applying
CO6	Identify methods to enhance accuracy and resilience in forecasting by merging predictions from multiple models	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
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. Syntax & Semantic for Propositional logic, Syntax & Semantic for First Order Predicate Logic, Properties for Well-Formed Formula (WFF), Resolution: Resolution Basics, Conversion to clausal form, Resolution of proposition logic, Unification of predicates. **Self-Study Topics:** Expert systems	6	CO1	2,3
2	**Search Strategies:** Solving problems by searching, Search- Issues in the Design of Search Programs, Un-Informed Search- BFS, DFS; Informed Search (Heuristic Search Techniques) - Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha-beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis **Self-Study Topics:** Tabu search	8	CO2	1,2,3
3	**Neural Networks**: Neural Networks- Introduction to Neural Networks, Model of Artificial Neuron, Learning rules, and various activation functions. Perceptron Networks, Adaline, Multilayer Perceptrons, Optimization algorithm- Gradient decent, Tuning the Network Size **Self-Study Topics:** Maxnet algorithm	6	CO3	1,2, 4,6
4	**Introduction to Machine Learning:** Introduction. Motivation and role of machine learning in computer science and problem-solving, Different types of learning, Hypothesis space and inductive bias, Training and test sets, cross-validation, Evaluation Confusion Matrix, Precision, Recall Bias and Variance, Concept of overfitting, underfitting, Parameters, Hyper parameters **Feature Selection:** forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis) Supervised Learning and Unsupervised Learning, Introduction to reinforcement learning **Self-Study Topics:** Density Based Clustering, K-medoid, Feature selection – feature ranking and subset selection	6	CO4	7,8,9, 11,12
5	**Forecasting and Learning Theory**: Regression: Non-linear regression, Logistic regression, Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Bayesian Belief networks, Introduction, Optimal Separating Hyperplane, Separating data with	8	CO5	7,8, 9,10

81

	maximum margin, Support Vector Machine (SVM), Finding the maximum margin, The Non-Separable Case: Soft Margin Hyperplane, Kernel Trick, Defining Kernels **Clustering:** Expectation – Maximization Algorithm, Supervised Learning after Clustering, Choosing the number of clusters Bias/variance tradeoff, Tuning Model Complexity **Self-Study Topics:** Maximum Likelihood Estimation			
6	**Ensemble Methods:** Mixture Models, Classifier using multiple samples of the data set, Random forest, Improving classifier by focusing on error, weak learner with a decision stump, Bagging, Stacking, Boosting, AdaBoost algorithm, Classifying with AdaBoost Bootstrapping and cross-validation. **Self-Study Topics:** SMO Algorithm	6	CO6	7,10

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: 9780136042594
3	Elaine Rich, Kevin Knight, S.B. Nair, Artificial Intelligence, 3rd Edition, Tata McGraw Hill-2008., ISBN 10: 0070087709 / ISBN 13: 9780070087705
4	Anandita Das, Artificial Intelligence and Soft Computing for Beginners- ,2nd Edition, Shroff Publication, ISBN- 9789351106159
5	Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers, Harcourt Asia Pvt. Ltd., 2000, ISBN-1-55860-535-5
6	Kumar Satish, Neural Networks, Second edition Tata McGraw Hill-,2013, ISBN1259006166, 9781259006166
7	Ethem Alpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6. (this can be made in the textbook)
8	Peter Harrington, Machine Learning in Action . Manning Publications, April 2012, ISBN 9781617290183
9	Tom Mitchell, Machine Learning, McGraw-Hill, First Edition, ISBN No. 0-07115467-1.
10	Christopher M. Bishop, Pattern Recognition and Machine Learning, McGraw-Hill, ISBN No. 978-81-322-0906-5
11	Shai Shalev-Shwartz and Shai Ben David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, First Edition, ISBN No. 978-1-107-05713-5
12	Margaret H.Dhunam- Datamining Introductory and Advanced topics

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 – Balaraman Ravindran, IIT Madras

Assessment:

Continuous Assessment (CA): 25 marks
 The following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class test of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module wil l be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCA23	**Information Security**				

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**--**	**3**	**3**	**--**	**3**

Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment (CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**--**	**100**

Pre-requisite: Computer Networks
Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the concepts of Information Security, cryptography and its applications
2	Familiarize various authentication and integrity techniques available
3	Understand firewalls and intrusion detection systems.
4	Familiarize relevant security parameters in the web, internet, database and operating systems

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

Sr. No.	Outcome	Bloom Level
CO1	Discuss the requirement of information security , private and public key algorithms and to examine the mathematics of cryptography	Understanding
CO 2	Analyze authentication and integrity techniques available	Analyzing
CO 3	Interpret the importance of firewalls and intrusion detection systems and signatures.	Understanding
CO 4	Relate to the security issues and technologies used in the web, internet, database and operating system	Understanding

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction:** Introduction to Information Security, principles, services and attacks, functional requirements of security, Symmetric and Asymmetric Cryptography. Mathematics of cryptography: Modular Arithmetic Additive Inverse, Multiplicative Inverse **Self- learning topics**: Need for security, Security approaches, current trends in security	5	CO1	1
2	**Cryptography and Authentication:** **Cryptography**: Euclidean Algorithm and Extended	8	CO2	3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Euclidean Algorithm. Stream Cipher and Block Cipher, Concept of Confusion and Diffusion. Modes of Operation of Block Cipher: ECB, CBC, OFB, CFB, DES, RSA, Numerical on RSA **Authentication**: Types of Authentication, Biometric Authentication and Third Party Authentication using KDC and Kerberos Version 5, Mutual Authentication, Reflection Attack **Self- learning topics:** Variations of DES – 2DES and 3DES, Symmetric and Asymmetric Key Cryptography together			
3	**Digital certificates and integrity** Digital Signature Concept, Compare Digital Signature with Public Key Cryptography, Digital Signature Schema. Public Key Infrastructure (PKI): Private key management, Public Key Cryptography Standards (PKCS). Digital Certificate Creation Steps, X.509 Certificate, Certificate Revocation **Integrity**: Message Integrity, Hash functions Properties **Algorithm**: MDC, MAC, HMAC, MD5, SHA -512 **Self-learning topics**: PKIX model, Data integrity threats	8	CO2	1,6
4	**Internet and web security** SSL, IP Sec, Email Security- PGP, PEM, Email attacks Web services Security: web app versus web service concept, WS-Security, SOAP web service, SAML assertion **Self-learning topics**: Browser attacks, web attacks, obtaining user or website data. SET, SSL Vs SET, S/MIME	8	CO3	1,6
5	**Firewall and IDS:** **Firewall**: Introduction, Characteristic, Types : Packet Filter, Stateful and Stateless Packet Filter, Attacks of Packet Filter, Circuit Level and Application Level Firewall, Bastion Host, Firewall Configurations. **Intrusion**: What is Intrusion, Intruders, Intrusion Detection, Behavior of Authorized user and Intruder, Approaches for Intrusion Detection: Statistical Anomaly Detection and Rule based Detection. Audit Record and Audit Record Analysis. **Self-learning topics**: Virtual Private Network (VPN), Honey Pot	6	CO3	2,5
6	**Database and OS Security:** Introduction to database, Security requirements of	5	CO4	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	database, sensitive data, Database access control, inference, Security in operating systems: Operating System Structure, Security Features of Ordinary Operating Systems, Operating System Tools to Implement Security Functions **Self–learning topics:** Cryptographic Toolkits, Rootkit: Phone Rootkit, TDSS Rootkits			

Reference Books:

Reference No	Reference Name
1	Cryptography and Network Security: Principles and Practice, William Stallings
2	Atul Kahate, "Cryptography and Network Security", Mc Graw Hill
3	Cryptography and Network Security, Behrouz A Forouzan
4	Computer Security, WilliamStallings,Edition6
5	Cryptography And Information Security,V.K. Pachghare
6	Network Security and Cryptography: Bernard Menezes, CENGAGE Learning
7	Cryptography and Network Security, Behrouz A Forouzan
8	Information Systems Security: Security Management, Metrics, Frameworks and Best practices: Nina Godbole
9	The complete reference Information Security by Mark Rhodes-ousley

Web References:

Reference No	Reference Name
1	https://www.tutorialspoint.com/cryptography/data_integrity_in_cryptography.htm
2	https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH15-OS8e.pdf
3	https://www.w3.org/Security/security-resource
4	https://www.sophos.com/en-us/labs/security-threat-report.aspx
5	https://www.tutorialspoint.com/cryptography/data_integrity_in_cryptography.htm

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies / Presentations / Projects /Any other measure with the permission of the Director / Principal / HOD / Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.

- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE241	**Internet of Things**				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**-**	**3**	**3**	**-**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**--**	**100**

Pre-requisite: 1. Knowledge of Computer Networks.
　　　　　　　　　2. Basics of Cloud.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Explain the basics of IoT, M2M, IoT enabling technologies, characteristics of IoT systems and IoT levels.
2	Explain IoT reference models and Architecture Reference Model (ARM) for IoT.
3	Explain the IoT protocols, IoT security aspects. generic design methodology.
4	Identify various phases in IoT generic design methodology.
5.	Explain the concept of Cloud and Web of Things
6	Discuss IoT applicability in various domains.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Compare M2M and IoT; characteristics of IoT systems, discuss applicability of IoT enabling technologies, and IoT levels.	Understanding
CO2	Explain IoT reference models and Architecture Reference Model (ARM) for IoT.	Understanding
CO3	Examine various protocols for IoT and IoT security aspects.	Analyzing
CO4	Identify various phases in IoT generic design methodology.	Apply
CO5	Utilize cloud and web based concepts in IoT.	Apply
CO6	Identify the applications of IoT in various domains.	Apply

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Introduction to IoT and M2M**: M2M to IoT – The Vision: Introduction: From M2M to IoT o A brief background**,** o M2M communication, o Differing characteristics 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 :- Level-1 to 6 **Self-Learning Topics:** M2M to IoT – A Market Perspective M2M to IoT – An Architectural Overview	9	1	1

2	**Module: IoT Architecture:**
	Introduction
	State of the Art
	   o European Telecommunications Standards Institute M2M/oneM2M
	   o Open Geospatial Consortium architecture
	Architecture Reference Model: Introduction,
	o Reference model and architecture,
	o IoT reference model
	   IoT domain model, Information model, Functional model, Communication model, Safety, privacy, trust, security model.
	o IoT Reference Architecture: Introduction, Functional view, Information view, Deployment and operational view
	Self-Learning Topics: Other relevant architectural views
		9	2	3

3	**Module: IoT Protocols and Security:** o **IoT Protocols**: Protocol Standardization for IoT Efforts, M2M and WSN Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACnet Protocol, Modbus, KNX, ZigBee Architecture, Network layer, APS layer. o **IoT Security**: Need for IoT Security, IoTVulnerabilities, Elements of IoT Security, IoT Security best practices, Threat Modelling an IoT system. **Self-Learning Topics:** Basics of Internet Protocols, Basic understanding of cryptography.	6	3	4, 2
4	**Module: IoT Platform Design Methodology:** o Purpose and requirement specification	4	4	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	o Process specification o Domain model specification o Information model specification o Service specifications o IoT level specification o Functional view specification o Operational view specification o Device and component integration o Application development **Self-Learning Topics:** Basics of DFD, UML Modelling.			
5	**Module: Web of Things and Cloud of Things:** **Web of Things:** Web of Things versus Internet of Things, Two Pillars of the Web, WoT Portals and Business Intelligence. **Cloud of Things**: Introduction to Cloud Computing, Cloud Middleware, Mobile Cloud Computing, The Cloud of Things Architecture. **Self-Learning Topics:** Basics of Web and Cloud, Cloud Standards.	6	5	4
6	**Module: Domain Specific IoTs:** **Home Automation** o Smart Lighting o Smart Appliances o Intrusion Detection o Smoke/Gas Detectors **Cities** o Smart Parking o Smart Roads o Structural Health Monitoring **Environment** o Weather Monitoring o Air Pollution Monitoring o Forest Fire Detection o River Floods Detection **Health Care** o Clinical Care o Remote Monitoring o Healthcare Solutions Using Smartphones **Energy** o Smart Grids o Renewable Energy Systems o Prognostics **Retail** o Inventory Management o Smart Payments o Smart Vending Machines **Agriculture** o Smart Irrigation o Smart Greenhouses	6	6	1,7 , Web Ref 1-6

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	o Cattle monitoring and management o Smart farming (e.g. Precision Farming, Agricultural Drones, and Predictive Analytics etc.) **Military** o Gather Battlefield awareness in advance o Augmented Reality Remote Training o Target Recognition and Autonomous Reconnaissance **Industrial IoT -(IIoT)** o Predictive Maintenance o Worker & Plant Safety o Remote Monitoring **Self-Learning Topics: Environment, Agriculture,** Case Study on Logistics and Health & Lifestyle			

Reference Books:

Reference No	Reference Name
1	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
2	IoT Security for Dummies, Lawrence Miller, John Wiley & Sons Ltd.
3	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
4	The Internet of Things in the Cloud:A Middleware Perspectiv,By Honbo Zhou
5	Practical Internet of Things Security, Brian Russell, Drew Van Duren, PACKT publishing
6	The Internet of Things: Connecting Objects,HakimaChaouchi
7	Internet of Things in Healthcare -Sankeerthana Neelam Chapter 2

Web References:

Reference No	Reference Name
1	https://www.analyticssteps.com/blogs/7-applications-iot-defence-and-military#google_vignette
2	https://vikaspedia.in/agriculture/ict-applications-in-agriculture/iot-in-agriculture
3	https://www.iotforall.com/smart-farming-future-of-agriculture
4	https://nix-united.com/blog/top-10-industrial-iot-applications-with-real-life-examples/
5	https://www.analyticssteps.com/blogs/7-applications-iot-defence-and-military
6	extension://efaidnbmnnnibpcajpcglclefindmkaj/https://hospitecnia.com/sites/default/files/15882919973158829199 7.pdf

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module wil l be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE242	**Robotic Process Automation**				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**----**	**3**	**3**	**----**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**----**	**100**

Pre-requisite: Software Engineering, Basics of Computer Science
Course Objectives: Course aim to

Sr. No.	Course Objective
1	Explain the concepts of Robotic Process Automation
2	Explain the process methodologies for BOT development
3	Apply knowledge BOT development for intelligent automation
4	Explore various RPA tools with their specifications

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

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Robotic Process Automation and evolution.	Remembering
CO2	Demonstrate development of BOT with specific tools	Understanding
CO3	Apply RPA implementation cycle considering security and scaling	Applying
CO4	Examine specifications of RPA tools and justify applications of appropriate tool for problem.	Analyzing
CO5	Assess performance of BOTs in context of intelligent automation	Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to RPA:** What is RPA, Flavors of RPA, History of RPA, Benefits of RPA, RPA compared to BPA, BPM and BPO, Levels of RPA, Skills Required for RPA, RPA Lifecycle, RPA Use Cases **Self-Learning Topics:** Evolution of RPA Current Status of RPA Utilization and Value	5	1,2	1
2	**Process Methodologies and Planning:** Lean, Six Sigma, Applying Lean and Six Sigma to RPA, Agile technology for RPA, Relationship between RPA and Workload Automation	5	1,2	3,4

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self-Learning Topics: Other relevant architectural views Planning: ROI for RPA,			
3	**BOT Development** Analysis of Business Process and development of BOT, Packages used in Automation Anywhere , Packages used in UIPath, Best practices for BOT Development, Evaluating BOT Performance Error Handling **Self-Learning Topics:** Learning UiPath Studio	8	1,2	2
4	**Data Preparation, Testing, Monitoring and Deployment for RPA:** Testing, Monitoring, Type of Data for RPA, Process Mining with RPA, Managing RPA Implementation Cycle. **Self-Learning Topics:** Security, Scaling for RPA Types of Algorithm	6	2	3
5	**Intelligent Automation & BOT Management** Cognitive Automation, Intelligent Process Automation or IPA, Examples of cognitive RPA Web Scrapping Types of BOTs, Examples of BOTs, **Self-Learning Topics:** Difference between RPA BOT and ChatBOTs	6	2,4,5	3
6	**Security of BOT:** Security Challenges for RPA, Secured BOT Development and Secured BOT Deployment, secured BOT architecture design, security requirements through threat modeling **Self-Learning Topics:** Risks for RPA.	2	2,3,4	4
7	**RPA Technologies & Case Studies:** RPA Tools: UIPath, Automation Anywhere, Open Source RPA, Resilient Automation, Case studies of RPA implementation **Self-Learning Topic:** RPA Best Practice	8	2,4,5	5,6

Reference Books:

Reference No	Reference Name
1	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 1st Edition, 2019
2	Mathias Kirchmer, Peter Franz and Danny Bathmaker, "Value-Driven Robotic Process Automation Enabling Effective Digital Transformation" , October 2019
3	Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks and Become an RPA Consultant", May 2018.
4	GerardusBlokdyk, "Robotic Process Automation Rpa A Complete

	Guide - 2020 Edition", 1st Edition, 5STARCooks, 2019.
5	Alok Mani Tripathi, " Learning Robotic Process Automation", 2018, Packt Publishing
6	Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide", November 2018, Packt Publishing

Web References:

Reference No	Reference Name
1	https://resources.automationanywhere.com/articles
2	https://www.automationanywhere.com/in/solutions
3	https://www.infobeans.com/robotic-process-automation-lifecycle
4	https://university.automationanywhere.com/rpa-courses/
5	https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future
6	https://university.automationanywhere.com/rpa-learning-trails/business-analyst/
7	https://www.chatbot.com/blog/6-types-of-bots-that-can-serve-your-clients/
8	https://university.automationanywhere.com/?ReturnUrl=%2fcourse%2f 1324366%2fmodule%2f371981 8%2fScorm%3fLPId%3d0&LPId=0
9	https://university.automationanywhere.com/?ReturnUrl=%2fcourse%2f 1324366%2fmodule%2f371981 8%2fScorm%3fLPId%3d0&LPId=0
10	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-universityessential-level-prep-courses-mba-students/
11	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-universityessential-level-prep-courses-mba-students/
12	https://university.automationanywhere.com/rpa-learning-trails/technical-support-specialist/
13	https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-secure-botdeveloper/
14	https://www.onesourcevirtual.com/resources/blogs/technology-andinnovation/prepare-for-robotic-process-automation-with-lean-six-sigma.html
15	https://www.ibm.com/topics/process-mining
16	https://research.aimultiple.com/rpa-vs-process-mining/#what-is-process-mining

Assessment:

Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE243	**Natural Language Processing**				
Teaching Scheme: Contact Hours (Per Week)			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**-**	**3**	**3**	**-**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**-**	**100**

Pre-requisite: Understanding of Linguistics, Basics of Machine Learning and Programming Skills (Python)

Course Objectives: Course aims to

Sr. No.	Course Objective
1	Introduce the students to the field of Language Computing and to learn its applications
2	Get acquainted with the basic concepts and algorithmic description of the main language levels: Morphology, Syntax, Semantics, and Pragmatics.
3	Study and implement various approaches to tackle morphology/syntax of a Language.
4	Design and implement various language models and POS tagging techniques.
5	Compare and contrast use of different statistical approaches for carrying out NLP tasks.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.	Understanding
CO2	Apply various Grammer formalisms and mathematical techniques in different fields of studies.	Applying
CO3	Analyze various algorithms and approaches for the given task, dataset, and stage of the NLP product.	Analyze
CO4	Evaluate various techniques of machine learning, text categorization, text summarization and information extraction.	Evaluate

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction:** History of NLP, Generic NLP system, levels of NLP, Ambiguity in Natural language, stages in NLP, challenges of NLP,	4	CO1	1,2

97

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Applications of NLP **Self learning topics:** Python libraries for NLP (NLTK, spaCy)			
2	**Word Level Analysis:** Morphology analysis – survey of English Morphology, Inflectional morphology & Derivational morphology, Tokenization, Stemming and Lemmatization, Stop word removal, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST, N –Grams- N-gram language model. **Self learning topics:** N-gram for spelling correction	9	CO2	4,5
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. Named Entity Recognition (NER), Introduction to CFG, Sequence labeling: Markov Model, Hidden Markov Model (HMM) **Self learning topics:** WordNet	10	CO2	1,2,3
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, Bag of Words (BoW), Term Frequency-Inverse Document Frequency (TF-IDF), Word embeddings (Word2Vec, GloVe), Robust Word Sense Disambiguation (WSD), Dictionary based approach **Self learning topics:** Word2Vec Model	7	CO3	1,2,4
5	**Pragmatic & Discourse Processing:** Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coreference **Self learning topics:** Anaphora Resolution	4	CO1	1,3
6	**Text Summarization, Classification and** **Opinion Mining:** Text classification, Text summarization- LEXRANK, Optimization based approaches for summarization, Sentiment Analysis introduction, Sentiment Analysis-Affective lexicons, Sentiment analysis techniques, Aspect based sentiment analysis **Self learning topics:** Question Answering systems	6	CO4	3,4

Reference Books:

Reference No	Reference Name
1	Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.CRC Press Taylor and Francis Group Siddiqui and Tiwary U.S., Natural

	Language Processing and Information Retrieval, Oxford University Press (2008).
2	Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
3	Introduction to Natural Language Processing by Jacob Eisenstein, MIT Press, 2019
4	Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall / CRC Press, 2010.
5	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.
6	Alexander Clark, Chris Fox, Shalom Lappin ― The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
7	Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications, Pearson, 2013
8	Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009

Web References:

Refere nce No	Reference Name
1	http://www.cse.iitb.ac.in/~cs626-449
2	http://cse24-iiith.virtual-labs.ac.in/#
3	https://nptel.ac.in/courses/106105158
4	https://www.coursera.org/learn/language-processing
5	https://www.udemy.com/course/natural-language-processing/? trk=profile _certification_title&utm_source=adwords&utm_medium=udemyads&utm_ campaign=DSA

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation must be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:

1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE244	**Design and Analysis of Algorithm**				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**--**	**3**	**3**	**--**	**3**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**--**	**100**

Pre-requisite: Data Structure and must have knowledge of C++

Course Objectives: Course aim to Design and implement various types of Algorithms

Sr. No.	Course Objective
1	Analyze asymptotic notations &performance of various algorithms.
2	Analyze various Advanced design and analysis techniques such as greedy algorithms, Dynamic programming
3	Analyze different algorithmic based on backtracking and branch & bound.
4	Analyze & compare string matching algorithms & introduction of NP hard, NP complete.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Analyze the time and space complexity of various algorithms.	Analyze
CO2	Analyze divide and conquer, greedy and dynamic programming strategies.	Analyze
CO3	Analyze backtracking, branch and bound algorithms	Analyze
CO4	Explain and Analyze NP hard NP complete problem and string matching algorithm.	Analyze

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction:** Notion of an Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency, Asymptotic Notations (BIG O, Omega & Theta) and their properties & Comparisons. Analysis Framework, Mathematical analysis for Recursive and Non-recursive algorithms, Substitution method and growth of function. **Self-Learning Topics**: Concept of Nested Loops & Recursion	6	CO1	1,2,4 ,7,9

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
2	**Divide And Conquer:** Divide and Conquer Methodology, Binary Search, Merge sort, Quick sort, Heap Sort, Multiplication of Large Integers, Closest- Pair and Convex- Hull Problems, Optimal storage on tape. **Self-Learning Topics**: Basics of recursive & non recursive searching & sorting techniques.	6	CO1	1,2,4 5,6,7 ,9
3	**Greedy Technique:** Introduction, Control Abstraction for Greedy Algorithms, Fractional knapsack, Minimum cost spanning tree (Kruskal, Prims), Single source shortest path (Dijkstra's algorithm), Huffman Codes, **Self-Learning Topics**: Theoretical foundation for greedy Methods, A task scheduling Problem	6	CO2	1,2,4 ,6
4	**Dynamic Programming:** Introduction, Control Abstraction for Dynamic Programming, Knapsack (0/1), Matrix chain multiplication, Longest common subsequence, All pair shortest path (Floyd Warshall), DFS and BFS. **Self Learning Topics**: Elements of Dynamic Programming	6	CO2	1,2,3 ,6
5	**Backtracking And Brach And Bound:** Introduction to Backtracking, n-Queen problem (4 Queens Problem), Graph coloring problem, Hamiltonian cycle. Branch and Bound, LIFO Search and FIFO search, Least cost search, 15 puzzles, Travelling Salesman Problem. **Self Learning Topics:** Subset Sum Problem.	8	CO3	1,4,5 6
6	**String Matching & Approximation Algorithms:** Brute force string matching, Knutt-Morris-Pratt algorithm, Rabin-Karp algorithm, Boyer Moore algorithm, Applications of string matching, Finite automata (DFA & NDFA, Conversion from NDFA to DFA) NP Hard and NP –complete problem. **Self Learning Topics:** Study of applications of string matching, Study of open ended problems.	8	CO4	1,2,8

Reference Books:

Reference No	Reference Name
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, ―Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012 ISBN 978-0-262-03384-8.
2	Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012 ISBN 978 0 13 231681 1
3	Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R. Tamassia, John Wiley and sons.

4	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran - Computer Algorithms / C++, Second Edition, Universities Press, 2007 ISBN: 9788173716126
5	Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education.
6	S. Sridhar ―Design of Algorithms and Analysis, Oxford university press, 2014.
7	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, Reprint 2006
8	Harsh Bhasin, ―Algorithms Design and Analysis, Oxford university press, 2016.
9	Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Ed, 2008, ISBN: 8177585959, Pearson Education.

Web References:

Reference No	Reference Name
1	http://nptel.ac.in/courses/106101060/
2	https://onlinecourses.nptel.ac.in/noc16_cs04/preview
3	http://www.nptelvideos.in/2012/11/design-analysis-of-algorithms.html

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE251	**Green Computing & Sustainability**				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**
Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem.** **Examination**	**Term** **Work**	**Total** **(Marks)**
Continuous **Assessment CA)**	**Test**	**Total (IA)** **(CA + Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite:
- Knowledge of computer peripherals
- Knowledge of data storage devices
- Some awareness towards Environment as a whole

Course Objectives: The course aim to

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

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

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

Course Contents:

Module	Detailed Contents	Hrs.	CO No.	Ref No.

1	**Trends and Reasons to Go Green:**
	Overview and Issues Consumption Issues
	  o Minimizing Power Usage
	  o Cooling
	Self-Learning Topics: Current Initiatives and Standards
		05	CO1
			CO2
				1,2

2	**Introduction to Green IT:**
	GreenIT, Holistic Approach to Greening IT Greening by IT **(can be used for case study also)**
	  o Using RFID for Environmental Sustainability
	  o SmartGrids
	  o Smart Buildings and Homes
	  o Green Supply Chain and Logistics
	  o Enterprise-Wide Environmental Sustainability
	Self-Learning Topics: Awareness to Implementation
		06	CO3	1,2,3

3	**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	CO3 CO4	1,2,4
4	**Green Data Centers:** Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management Green Data Centre Metrics **Green Data Storage:** Introduction, Storage Media Power Characteristics, Energy Management Techniques for HardDisks 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	08	CO4	2

5	**Enterprise GreenIT 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	CO3 CO5	2
6	**Managing Green IT:** Introduction, Strategizing Green Initiatives Implementation of GreenIT Information Assurance Communication and Social Media **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 **Self-Learning Topics:** Green IT Regulations and Standards	08	CO5 CO6	2,3

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, BudE. Smith, 2014, CRC Press.
4	GREEN IT FOR SUSTAINABLE BUSINESS PRACTICE, Mark G. O'Neill, An ISEB Foundation Guide.
5	Green Computing and Green IT Best Practices, 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 Taylorand Francis Company (2010)
8	Foundations of Green IT, Marty Poniatowski, Prentice Hall, 2009

Web References:

Reference No	Reference Name
1	http://www.carbonfootprint.com
2	https://www.energystar.gov/

Tutorials

Note: Solve any six tutorials.

Sr. No.	Detailed Contents	Hrs.
1	Calculating the Energy Consumption or Carbon Footprint for a given location (eg: your College, Residence, or a specific building) and suggesting means of reducing Energy consumption or Carbon Footprint respectively	2
2	Use of Greening by IT Tools in a live location and submitting a report which indicates Before and After effects.	2
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.	2
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	2
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	2
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.	2
7	Students preparing a report on recycling initiatives taken up by XXX Housing society: A Case Study	2
8	Waste management: Evaluate how to reduce packaging waste at home.	2
9	What are the e waste management rules implemented by Ministry of Electronics and Information Technology Government of India.	2
10	Making best out of E-waste.	2

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:

- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks

- Assessment consists of one class tests of 25 marks.

- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	
MCAE252	**Management Information System**	

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**

Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite: Knowledge of foundational business and information systems

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the nature of management information systems and their applications in business.
2	Identify the major management challenges in building and using information systems.
3	Learn and explore IT security and Infrastructure of management information systems.
4	Understand the ERP and its components.
5	Applying BI to enhance decision making

Course Outcomes (CO): On successful completion of course, learner/student will be able to

Sr. No.	Course Outcome	Bloom Level
CO1	Understand theoretical aspects of Management Information Systems and its global perspective.	Understand
CO2	Recognize the procedures and practices for handling information systems effectively.	Apply, Analyze
CO3	Apply BI to enhance Decision making.	Apply
CO4	Recognize the necessity of IT security and Infrastructure in Management Information Systems.	Analyze

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Management Information Systems (MIS):** Perspectives on Information Systems, Nature and scope of MIS, Characteristics of MIS, Need and Role of MIS, Impact of MIS, functions and future of MIS, MIS: A support to the management, MIS: organization effectiveness, MIS for a digital firm **Self Learning Topics**: Role of information system	6	CO1	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	in business.			
2	**Information System, Organization and Strategy:** **Organizations and Information Systems:** Modern Organization, Information Systems in Organizations, Managing Information Systems in Organizations **Concepts of Management Information Systems:** Data and Information, Information as a Resource, Information in Organizational Functions, Types of Information Technology, Types of Information Systems, Decision Making with MIS, Communication in Organizations. **Strategies and Planning:** Using information Systems to achieve competitive Advantage **Self Learning Topics:** Challenges posed by strategic information systems and how should they be addressed	7	CO2	1, 2, 3, 4
3	**Decision Support System, Knowledge Management System and Enterprise Management System** Decision Support System (DSS), DSS Models, Group Decision Support System (GDSS) Knowledge based Expert System (KBES), Enterprise Resource Planning (ERP) System, ERP Model and Modules, Benefits of ERP Supply Chain Management (SCM), Information Management in SCM, Customer Relationship Management (CRM) **Self Learning Topic:** Systems for different levels of organization	9	CO2, CO3	1
4	**Enhancing Decision Making** **Business Value of Improved Decision Making:** Types of Decisions, The Decision making Process, Managers and Decision making in the Real World **Business Intelligence and Business Analytics support Decision Making:** What is Business Intelligence? The Business Intelligence environment, Business intelligence and Business analytics capabilities **Self Learning Topics:** Data Analysis using open BI Tool	5	CO3	3
5	**Managing Global Information System and IT Infrastructure** Managing Global Systems: Internationalization of business, Strategies for developing global business, Challenges posed by global information systems and management solutions for these challenges. IT Infrastructure Components of IT Infrastructure, Current trends in Computer hardware and software platforms, Challenges of managing IT infrastructure. **Self Learning Topics:** Computing Platforms and	6	CO4	2, 3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Systems Integration			
6	**Securing Information System** **System Vulnerability and Abuse:** Why Systems Are Vulnerable, Malicious Software, Hackers and Computer Crime, Internal Threats: Employees, Software Vulnerability. **Business Value of Security and Control:** Business Value of Security and Control, Legal and Regulatory Requirements for Electronic Records Management, Electronic Evidence and Computer Forensics. **Establishing a Framework for Security and Control: I**nformation Systems Controls, Risk Assessment, Security Policy, Disaster Recovery Planning and Business Continuity Planning, The Role of Auditing. **Controlling and Managing Security Threats and Vulnerabilities** **Self Learning Topics:** Management Challenges of Security and Control	7	CO4	1, 3

Reference Books:

Reference No	Reference Name
1	Management Information Systems- A global digital Enterprise perspective, 5th edition - By W.S.Jawdekar, TMG Publications
2	Management Information System, James O'Brien, 7th edition, TMH
3	Management Information Systems - Kenneth C. Laudon, Jane P. Laudon - 14e
4	MIS: Managing Information Systems in Business, Government and Society, 2ed by Rahul De, Wiley

Web References:

Reference No	Reference Name
1	https://archive.nptel.ac.in/courses/110/105/110105148/

MIS: Tutorial

Sr. No	Detail Contents	Hrs.
1	Case study of MIS for functional area and service sector (Banking, Health care, Aviation etc.)	1
2	Who's the world's top retailer? Walmart and Amazon	1
3	Social CRM – Connecting with Customers through Social Networks	1
4	CRM Case study – Airtel	1
5	Ranbaxy: Taking the ERP Pill Case study	1
6	HDFC Banking on Business intelligence and analytics technology.	1

7	The Analytics behind matrimony.com	1
8	One organization, One data, One information: ONGC's Global System	1
9	RFID – enabled Library Management System	1
10	Bring your own device (BYOD): It's not so safe – Discuss with suitable Case	1
11	Securing Information: The HSBC way	1
12	Case study on Information Security Threats and Policies in Europe	1

Note: The Case Studies mentioned above are indicative and not limited to. The Teacher has the flexibility of taking similar Case Studies taking into consideration the current scenario and technological changes.

Assessment:

Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE253	Cyber Security				
Teaching Scheme: **Contact Hours (Per Week)**			**Credits Assigned**		
Theory	Tutorial	Total	Theory	Tutorial	Total
3	1	4	3	1	4
Examination Scheme (Marks)					
Internal Assessment (IA)			End Sem. Examinatio n	Term Work	Total (Marks)
Continuous Assessment CA)	Test	Total (IA) (CA + Test)			
25	25	50	50	25	125

Pre-requisite: Basics of computers and knowledge of computer security and internet.

Course Objectives: Course aims to

Sr. No.	Course Objectives
1	Understand basic concepts of cyber security.
2	Remember cyber laws and amendment act with respect to Indian perspective as well as global perspective.
3	Acquire the knowledge of various tools and methods used in cyber security and cyber crime.
4	An understanding of Cyber offenses & Cybercrime, its issues and challenges, implementation of security policies to mitigate the cyber offenses and cybercrime.
5	Understanding organizational guidelines for Internet Usage and Computer Usage, incident handling in case of web treats and challenges posed for Organizations, protecting people's privacy in the organization, risks and challenges, and counter measures adopted in Social Media Marketing.
6	Analyzing applications and case studies based on cybercrimes and cyber laws.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understanding of basic concepts of cyber security	Understanding
CO2	Remember cyber laws and amendment act with respect to Indian perspective as well as global perspective.	Remember
CO3	Make use of various tools and methods used in cybercrime	Applying
CO4	Analyze various cybercrimes and real life case studies and identify in which section of cyber laws the case can be registered.	Analyzing

Course Contents:

Unit No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Cyber Security and cybercrime:** Cybercrime and origins of the world, Cybercrime and information security, Cyber security and its types, Cyber criminals, Classifications of cybercrime. **Self-learning Topic:** Categories of Cybercrime.	5	CO1	1
2	**Cybercrimes and Cyber security: The Legal Perspectives:** Introduction to cyber laws: Indian context, The Indian IT Act 2000 and Amendments to the Indian IT Act(2008), Children's Online Privacy Protection Act (COPPA), The Children's Internet Protection Act (CIPA Sexual Predator Laws), The Child Online Protection Act (COPA), The Communications Decency Act (CDA), Intellectual Property in the cyberspace: Copyright, Patent, Trademarks, Trade secret, Trade name, Domain name. **Self-learning Topics:** Global perspective of Cybercrime, Legal implications of cybercrimes, Compliance requirements and regulatory frameworks.	7	CO2	1, 2, 3 and Web Ref 5
3	**Tools and Methods Used in Cybercrime:** Proxy Servers and Anonymizers, Password Cracking, Keyloggers and Spywares, Steganography, DoS and DDoS Attacks, SQL Injection, Attacks on Wireless Networks, Phishing and Identity Theft (ID Theft). **Self-learning Topics:** Various types of viruses, worms and trojans, Buffer Over Flow -Types and how to minimize buffer overflow.	6	CO3	1
4	**Cyber offenses & Cybercrime: Issues and challenges:** Criminal plans and attacks, Social Engineering, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Attacks on Mobile/Cell Phones, **Self-learning Topics:** Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	8	CO1	1

5	**Cyber security: Organizational Implications:** Cost of Cybercrimes and IPR Issues: Lesson for Organizations. Security and Privacy Implications from Cloud Computing, Organizational Guidelines for Internet Usage, Safe Computing Guidelines and Computer Usage Policy, Incident Handling: An Essential Component, Importance of Endpoint Security in Organizations, Web Treats for Organizations: The Evils and Perils, Social Computing and the Associated Challenges for Organizations. **Self-learning Topics:** Protecting People's Privacy in the Organization, Social Media Marketing: Security Risk and Perils for Organization	8	CO1	1
6	**Applications and case studies on cybercrimes and cyber laws:** Analyse case studies based on cyber laws, cybercrimes and penalties under various sections of cyber laws.	6	CO4	1, 2

Reference Books:

Reference No	Reference Name
1	Nina Godbole, Sunit Belapur Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Publications Released:April2011
2	Suresh T. Vishwanathan-The Indian Cyber Law; Bharat Law House New Delhi
3	University of Richmond Law Review: A Summary of Internet Pornography Laws Protecting Children and Possible Solutions By Susan Hanley Kosse (Article)
4	KAHATE, "Cryptography and Network Security", TMH
5	Cyber Security, Edward Amoroso, Silicon Press, First Edition William Stallings, Cryptography and Network Security, Pearson Publication
6	Cyber Security & Global Information Assurance, Kennetch J. Knapp, Information Science Publishing.

Web References:

Reference No	Reference Name
1	https://www.researchgate.net/publication/308646775_An_introduction _to_steganogr aphymethods
2	https://www.edureka.co/blog/steganography-tutorial
3	https://www.researchgate.net/publication/306301164
4	https://www.guru99.com/how-to-hack-using-social-enginering.html
5	https://scholarship.richmond.edu/cgi/viewcontent.cgi?article=2559& context=lawreview

Tutorials

Sr. No.	Detailed content	Hrs.
1.	Cyberlaw section under IT act 2000 - 43, 65, 66A, 66B, 66C, 66D, 66E, 66F, 67A, 67B , 71, 72, 73 and 74, Penalty and preventive measures to be taken for the crime associated with each case if any and real life cybercrime cases under each section.	1
2.	Given a list of cases, identify whether theit falls under the category of virus, worms or trojans.	1
3.	Two real life casestudy related to data diddling, salami attack and social engineering. Also, explaining what precautions needs to be taken from these attacks.	1
4.	List 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 cybercrimes; explain in detail as a presentation. Also download its related video to demonstrate it in the class.	1
7.	Explain google hacking commands.	1
8.	Demonstrate steganography using S-Tools.	1
9.	Implement keylogger program in python or any programming language.	1
10.	Given video references explain stepwise in your own words and with diagrammatic representation the following : Denial of Service Attacks_ The Ping of Death-3_D_1 Denial of Service Attacks (Part 3)_ TCP SYN Flooding-3_D_2	1
11.	Make presentation slide of different types of cloud computing techniques.	1
12.	Using Cryptool to encrypt and decrypt password.	1

Assessment:
Continuous Assessment (CA): 25 marks
Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.
- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:

1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name				
MCAE254	**Soft Computing**				

Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	**Tutorial**	**Total**	**Theory**	**Tutorial**	**Total**
3	**1**	**4**	**3**	**1**	**4**

Examination Scheme (Marks)					
Internal Assessment (IA)			**End Sem. Examination**	**Term Work**	**Total (Marks)**
Continuous Assessment (CA)	**Test**	**Total (IA) (CA + Test)**			
25	**25**	**50**	**50**	**25**	**125**

Pre-requisite: Fundamental understanding of computational practices and algorithms.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Explore the components and applications of soft computing.
2	Study different unsupervised neural network algorithms.
3	Explain fuzzy logic, membership functions and Fuzzy Inference system
4	Provide comprehensive knowledge of Genetic Algorithm
5	Understand Hybrid Soft Computing techniques

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

Sr. No.	Course Outcome	Bloom Level
CO1	Explain the components and applications of soft computing.	Understanding
CO2	Use different training algorithms of neural networks.	Applying
CO3	Apply fuzzy logic techniques to find solution of uncertain problems.	Applying
CO4	Analyze the genetic algorithms and their applications	Analyzing
CO5	Understanding Hybrid Soft Computing techniques	Understanding

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Soft Computing:** Hard computing Vs Soft Computing, Soft computing constituents – ANN, Fuzzy Logic, GA, Applications of Soft Computing **Self Learning topics:** Real world case studies of Soft Computing	03	1	1

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
2	**ANN:** Comparison Between Biological Neuron and Artificial Neuron (Brain vs. Computer), Unsupervised learning-Maxnet, Mexican Hat Net, Hamming Network. **Self Learning topics:** Special Networks	07	2	1,3
3	**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 decision making	10	3	1,2,3,5
4	**Fuzzy Inference System:** Truth Values and Tables in Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules (Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Inference Systems (FIS)-Construction and Working Principle of FIS, Methods of FIS **Self Learning topics:** Fuzzy expert system	08	3	1,2,3,5
5	**Genetic Algorithm:** Basic concepts, Difference between genetic algorithm and traditional methods, Simple genetic algorithm, Working principle, Procedures of GA, Genetic operators- Encoding, Selection, Crossover, Mutation. Stopping condition for GA **Self Learning topics:** Genetic Programming	08	4	1,4
6	**Hybrid Soft Computing techniques:** Neuro-Fuzzy hybrid systems: Comparison of fuzzy system with neural network, Characteristics of Neuro-Fuzzy hybrids. Genetic Neuro-Hybrid systems: Properties of Genetic Neuro-Hybrid Systems **Self Learning topics**: Applications of Hybrid Soft Computing techniques	04	5	1

Reference Books:

Reference No	Reference Name
1	Dr. S. N. Sivanandam and Dr. S. N. Deepa, "Principles of Soft Computing", 3rd Edition, John Wiley
2	Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd

	Edition, Wiley India.
3	S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.
4	Search, Optimization & Machine Learning by David E. Goldberg.
5	Artificial Intelligence and Soft Computing for Beginners- Anandita Das, Shroff Publication.

Web References:

Reference No	Reference Name
1	Soft Computing Tools in Engineering, http://vlabs.iitkgp.ernet.in/scte/
2	Fuzzy Logic Toolbox, https://www.mathworks.com/help/fuzzy/
3	Genetic Algorithms in Matlab, https://github.com/franciscoserdio/ Genetic-Algorithms-Toolbox

Soft Computing: Tutorials

Sr. No	Detail Contents	Hrs.
1	Applications of Soft Computing	1
2	Problem solving on Maxnet	1
3	Algorithm and applications of Mexican hat net, Hamming network	1
4	Apply union, intersection, difference, complement, algebraic sum, and algebraic product, bounded sum and bounded product on Fuzzy sets.	1
5	Cartesian product on Fuzzy sets, max-min composition, max-product composition on Fuzzy relations.	1
6	Problem solving on methods of membership value assignments	1
7	λ-cut sets for Fuzzy sets and λ-cut for Fuzzy relation.	1
8	Problem solving using defuzzification methods	1
9	Study of Fuzzy propositions and decomposition rules	1
10	Study of Mamdani FIS Vs Takagi-Sugeno Fuzzy model	1
11	Use of various operators in Genetic Algorithm	1
12	Compare Neuro-Fuzzy Hybrids and Genetic Fuzzy Hybrid systems	1

Assessment:

Continuous Assessment (CA): 25 marks

Following measures can be used for the continuous assessment as:
- Assignments /Quiz /Case studies /Presentations /Projects /Any other measure with the permission of the Director/Principal/HOD/Coordinator.
- The continuous evaluation has to be done throughout the Semester.

- The faculty can use the flexibility of the mode as per the requirement of the course.

Test: 25 marks
- Assessment consists of one class tests of 25 marks.
- The class test is to be conducted when approx. 40 -50% of the syllabus is completed.
- Duration of the class test shall be one hour.

Internal Assessment (IA): 50 marks
- The Internal Assessment marks (out of 50) will be the total of the class test and the continuous assessment.

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

End Semester Theory Examination:
1. Question paper will comprise of total 05 questions.
2. First question carrying 20 marks and remaining 4 carrying 15 marks each.
3. Total 03 questions (Including first question) need to be solved.
4. Question No: 01 will be compulsory and based on the entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
5. Remaining questions will be randomly selected from all the modules.
6. First question will be compulsory and Students can attempt any two from the remaining four questions.
7. Weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name			
MCAL21	Soft Skills Development			
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)		
		Term Work	Practical	Oral	Total
02	01	50	--	--	50

Pre-requisite: Decent working knowledge of the English language (including Grammar) is a must, keeping in mind that most business/management transactions in India and internationally are conducted in the English language

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	To inculcate the essential skills that professionals need to distinguish themselves and make a positive impact on their work and social lives
2	To provide better understanding of corporate culture and to improve their etiquettes, interpersonal skills and professional image
3	To develop holistically and ensure comprehensive learning.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Develop interpersonal skills that help in communication, teamwork, leadership and decision-making.	Understand, Apply
CO2	Methodically study, formulate and interpret different facets of organizational behavior.	Analyze, Evaluate
CO3	Develop holistic leaders and technocrats helping in individual and organizational growth.	Create

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Soft-Skills Introduction:** What is Soft Skills? Significance of Soft Skills – Soft-Skills Vs. Hard Skills - Selling Soft- Skills – Components of Soft Skills – Identifying and Exhibiting Soft-Skills **Self-Learning Topics:** Types of Soft, Hard Skills	02	CO1	1, 2
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	04	CO1	1,3,4

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Practical (Role plays, case studies) **Self-Learning Topics:** Problems/Barriers in communication.			
3	**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, Memos, Circulars, Notice, Agenda, Minutes of Meetings) Impact of modern Technology on Business Communication the paperless office, use of modern devices **Self-Learning Topics:** Goodwill letters, Routine & Request letters, Status- enquiry, Credit and Sales letters etc	04	CO1, CO2	1,3,4
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. 1. 3.Attitude: Meaning, Components of Attitude, changing attitude and its impact on career growth 3. Perception and Values. 4. Motivation and Leadership: Concept, Importance. 5. Goal setting: SMART (Specific, Measurable, Attainable, Realistic, Timely) Goals, personal and professional goals 8. Time and Self-Management. 9. Learning in a group, Understanding Work Teams, Dynamics of Group Behavior, Techniques for effective participation 10. Etiquettes- General & Business Etiquette, Body language 11. Emotional intelligence of self and SWOC 12. Business and personal ethics 13. Do's and Don'ts of a presentation / meetings	08	CO2, CO3	5,6,7,8

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Online & offline.(presenter & members) **Self-Learning Topics :** Voice modulation, tone, pitch, knowledge and self confidence			
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-Learning Topics:** Preparation, Attire, Posture and Delivery techniques	02	CO1, CO2	3,8
6	**Group discussions:** Group Discussion Skills, Evaluation components, Do's and Don'ts. Practical (Group Discussions) **Self-Learning Topics:** Difference between a group discussion and debate	02	CO1, CO2	5,6
7	**Decision-making:** Types of decisions, Process and techniques of decision-making, essentials, Influence of technology on decision-making.	02	CO2	5,6
8	**Interview Techniques:** Pre-Interview Preparation, Conduct during interview, Verbal and non-verbal communication, common mistakes. Preparation of CV, Dressing and appearance. Practical (Role plays, mock interviews, Telephonic Interviews, Body Language, Facial Expression) **Self-Learning Topics:** Sample communications and exercises, audio-visual presentations	02	CO2, CO3	8,9

Assessment:
Term Work: Will be based on Continuous Assessment
- As per the suggested list of experiments/activities.
- It will be evaluated by the subject teacher and documented according to a rubric

Reference Books:

Reference No	Reference Name
1	Business Communication (Revised Edition), Rai & Rai, Himalaya Publishing House.
2	Soft skills: an integrated approach to maximize Personality, Chauhan & Sharma, Wiley India publications.
3	Business Communication: A practice-oriented approach, Kalia and Shailja Agarwal.
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

Course Code	Course Name				
MCAL22	**Artificial Intelligence and Machine Learning Lab**				
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
2	**1**	**50**	**30**	**20**	**100**

Pre-requisite: Basic knowledge of Mathematics, Statistics and Data Mining concepts

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand problem solving concepts of Artificial Intelligence.
2	Implement Artificial Neural Network algorithms
3	Understanding and implementing different feature extraction and selection techniques
4	Impart a thorough understanding of basic Machine Learning algorithms and its applications
5	Build model using appropriate Machine Learning algorithms for real world problems

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

Sr. No.	Course Outcome	Bloom Level
CO1	Apply the basic concepts of Artificial Intelligence and its applications using PROLOG.	Applying
CO2	Understand basics of Python Programming language and Implement Artificial Neural Network algorithms	Applying, Analyzing
CO3	Analyze data preprocessing techniques for feature extraction and selection.	Analyzing
CO4	Develop models using appropriate Machine Learning algorithms for real world problems.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Logic programming with Prolog:** To specify relationships among objects and properties of objects, problem solving. **Self Learning Topic:** Define rules defining implicit relationships between objects.	2	CO1	3
2	**Introduction to Python Programming:** Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn. **Self Learning Topic:** Basics of Python programming	4	CO2	1,2, 6,7

3	**Artificial Neural Network:** Implementation of Perceptron and ADALINE algorithm, Gradient Descent Algorithm **Self Learning Topic:** ANN, Activation functions	4	CO2	3
4	**Feature Selection:** Features Extraction, Feature Selection, Normalization, Transformation, Principal Components Analysis-visualizations of complex datasets. **Self Learning Topic:** LDA (Linear Discriminant Analysis).	4	CO3	4,5
5	**Supervised Learning:** Logistic regression, the cost function for logistic regression, and the application of logistic regression, SVM-RBF kernels. **Unsupervised Learning:** Choosing number of Clusters using Elbow method **Self Learning Topic:** Linear Regression	6	CO4	4,5
6	**Bagging Algorithm:** Different ensemble techniques like bagging, boosting, stacking and voting, Random Forest- bagging, Attribute bagging and voting for class selection. **Self Learning Topic:** Decision Tree	4	CO4	4,5
7	**Boosting Algorithms:** AdaBoost, Stochastic Gradient Boosting, Voting Ensemble. **Self Learning Topic:** AdaBoost as a Forward Stage wise Additive Model.	2	CO4	4,5

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with a minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - o Experiments 40 marks
  - o Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on the suggested practical list and entire syllabus.

Reference Books:

Refer ence No	Reference Name
1	Aurelian Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition.
2	Paul J. Deitel, Python Fundamentals
3	Stuart Russell, Peter Norvig ,Artificial Intelligence – A Modern Approach, Pearson Education / Prentice Hall of India, 3rd Edition, 2009
4	EthemAlpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6

5	Peter Harrington, Machine Learning in Action. Manning Publications, April 2012ISBN 9781617290183
6	Introduction to Computer Programming using Python, John V Guttag
7	Core Python Programming, R. Nageswara Rao

Web References:

Reference No	Reference Name
1	https://talentsprint.com/pages/artificial-intelligence-machine-learning-iiit-hprogram/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_intelli gence
5	https://scikit-learn.org/0.16/modules/generated/sklearn.lda. LDA.html
6	https://machinelearningmastery.com/ensemble-machine-learning-algorithmspython-scikit-learn/
7	https://data-flair.training/blogs/python-ml-data-preprocessing/

Suggested list of experiments:

Practical No	Problem Statement
1	Implementation of Logic programming using PROLOG DFS for water jug problem
2	Implementation of Logic programming using PROLOG BFS for tic-tac-toe problem
3	Implementation of Logic programming using PROLOG Hill-climbing to solve 8- Puzzle Problem.
4	Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.
5	Implement Perceptron algorithm for OR operation
6	Improve the prediction accuracy by estimating the weight values for the training data using stochastic gradient descent.(Perceptron)
7	Implement Adaline algorithm for AND operation
8	Implementation of Features Extraction and Selection, Normalization, Transformation, Principal Components Analysis.
9	Implementation of Logistic regression
10	Implementation of Classifying data using Support Vector Machine (SVM).
11	Implement Elbow method for K means Clustering
12	Implementation of Bagging Algorithm: Random Forest
13	Implementation of Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble

Note : At least 12 programs

Course Code	Course Name			
MCAL23	**Devops Lab**			
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**		
		Term Work	**Practical**	**Oral**	**Total**
2	**1**	**50**	**30**	**20**	**100**

Pre-requisite:
- Basic Understanding of Linux/Unix
- Basics of Programming Language
- Knowledge of Networking concepts
- Understanding the SDLC software development model, Agile development

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	To Learn what DevOps is, including its principles and the benefits it offers to organizations.
2	To obtain knowledge of Version Control Systems to effectively track changes with Git, GitHub and understand their best practices in team environments
3	To learn what containers are, using Docker, and the benefits they offer in terms of consistency, scalability, and efficiency.
4	Understand the concept of CI and how Jenkins automates the process of integrating code changes from multiple contributors.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Recall and explain the key principles and benefits of DevOps	Understand
CO2	Demonstrate the use of Git and GitHub to manage version control in projects and compare different workflows.	Analyse
CO3	Implement and evaluate containerized applications using	Apply
CO4	Configure Jenkins for automated build and deployment and assess its effectiveness in CI/CD workflows	Evaluate

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**DevOps Introduction:** What is DevOps, Key Principles and practices, Benefits of Implementing DevOps, Basic Git Setup **Self Learning** : SDLC, Agile Programming	2	CO1	1,2
2	**Development:** Exploring Git and GitHub Commands, Familiarize students with essential Git concepts and commands, Basic Git commands - init, clone, add, commit, push, pull, GitHub operations using Git-forks, pull requests, merging, Git for version control **Self Learning** : Use of Git in modern DevOps	4	CO2	3

129

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
3	**GitLab Essentials:** Using GitLab web IDE, Git commands to interact with GitHub, Overview of CI/CD Workflow, CI/CD capabilities of GitLab **Self Learning**: Security and Compliance issues in using GitLab	4	CO2	4
4	**Continuous Integration -** Jenkins Jenkins Installation – setup, Setting up a CI/CD pipeline for a web development, Build and deploy a web application to a local HTTP server, Integrating Jenkins with GitHub **Self Learning** : Case studies of Jenkins in large-scale environments	6	CO3	5,6
5	**Continuous Deployment:** Docker for Containerization, Basics of Docker Architecture, components, What is Containerization, Understanding images and containers, Docker commands: build, run, images, containers, Build, deploy and manage web/software application on Docker Engine, Docker Management **Self Learning** : Best practices for securing Docker images and containers	6	CO3	5
6	**Configuration Management**: Ansible Introduction to Software Configuration management, Ansible Playbooks using YAML, Push/Pull Models **Self Learning**: Best practices for writing maintainable and scalable playbooks	4	CO4	7

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments.
  The experiments should be completed in the allotted time duration.
  - Experiments 40 marks
  - Attendance   10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
  Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", Wiley Publication
2	DevOps Bootcamp, Sybgen Learning
3	Prem Kumar Ponuthorai, Jon Loeliger, Version Control with Git, 3rd Edition,O'Reilly Media.
4	Mastering Jenkins by Jonathan McAllister,Packt Publishing

5	Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
6	John Ferguson Smart,"Jenkins, The Definitive Guide", O'Reilly Publication.
7	Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication
8	Httermann, Michael, "DevOps for Developers", Apress Publication.

Web References:

Reference No	Reference Name
1	https://www.javatpoint.com/devops
2	https://docs.gitbook.com/
3	https://git-scm.com/docs/gittutorial
4	https://www.jenkins.io/doc/book/installing/
5	https://saucelabs.com/resources/blog/a-getting-started-guide-to-setting-up-jenkins
6	https://faun.pub/jenkins-pipeline-script-to-build-deploy-application-on-web-server-af55daf70c5a
7	https://www.whizlabs.com/blog/integrate-jenkins-with-github
8	https://www.jenkins.io/solutions/github/
9	https://www.jenkins.io/doc/tutorials/
10	https://docs.docker.com/get-started/
11	https://docs.ansible.com/ansible/latest/getting_started/index.html

Suggested list of experiments:

Practical No	Problem Statement
1	Basic Git commands
2	Create and fork repositories in GitHub. Apply branch, merge, rebase concepts.
3	Using Git for Collaboration
4	Collaborating and Cloning using GitHub
5	Using GitLab Web IDE
6	Performing merge requests using GitLab
7	Workflow management in GitLab
8	Demonstrate Continuous Integration and development using Jenkins
9	Explore docker commands for content management
10	Develop a simple containerized application using Docker
11	Ad-hoc Ansible commands
12	Using Ansible playbooks

Course Code	Course Name				
MCALE241	**Internet of Things Lab**				
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
2	**1**	**50**	**30**	**20**	**100**

Pre-requisite: 1. Knowledge of C and C++
                 2. Basics of Cloud computing and Web Technology

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Get familiarize with basic electronic components and Arduino microcontroller, software and Arduino simulator.
2	Interface various I/O devices and sensors with Arduino.
3	Interface sensors with Arduino and send data to cloud.
4	Design and develop real-life IoT based projects.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Identify basic electronic components and interface them with Arduino, programmed for applications using Arduino	Applying
CO2	Experiment with various electronic I/O devices and sensors with Arduino.	Applying
CO3	Demonstrate IoT application using Cloud.	Understanding
CO4	Build IoT based projects using Arduino	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.

1	**Introduction to Basic Components**: LEDs, Switches, resistors, Push buttons, Buzzers
	▪ Familiarization with Arduino
	▪ Breadboard Basics
	▪ Programming the Arduino
	  o Arduino, basic components, and code
	  o interfacing LED's,RGB's, Slider Switches, push buttons, Speakers and Buzzers
	Self Learning Topics: Basics of Arduino programming
		4	01	Book 1 Web 1

2	**Complex components : LCD,SSD** ▪ Interfacing LCD and 7 Segment Display with Arduino **Self Learning Topics:** Other output components	4	01	Book 2
3	**Analog I/O** ▪ Interfacing LED's, Potentiometer, Photoresistor with Arduino ▪ PWM pins of Arduino ▪ Serial Monitor of Arduino	4	02	Book 1

132

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self Learning Topics: Basic of Analog values, PWM concepts			
4	**Sensors** ▪ temperature sensor ▪ soil moisture sensor ▪ photoresistor / LDR ▪ gas sensor ▪ PIR sensor ▪ Ultrasonic Sensor ▪ interface IR remote with Arduino to control fan/light ▪ Demonstrate 4x4 keypad with Arduino **Self Learning Topics: Understanding sensors**	6	02	Book 1
5	**Motors:** ▪ interfacing LED's, Servo Motor, DC Motor, Potentiometer with Arduino **Self Learning Topics:** Basics of servo motors, potentiometer	**2**	02	Book 1
6	**Module: IoT in Cloud:** Interfacing IoT device with Cloud **Self Learning Topics:** Computer Network and Cloud Concepts,	**2**	03	Web 5,6
7	Mini Project using Arduino Mini projects such as Home automation, Robots, Wearable projects, art projects etc. **Self Learning Topics:** Real life problem statement	4	04	Book 1 Web 1,2,3,4

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - Experiments 20 marks
  - Mini project   20 marks
  - Attendance   10 marks
- Mini project has to be done in groups of 2 or 3 using Arduino hardware, sensors etc. It will be evaluated by subject teacher
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Make: Learn electronics with Arduino, Jodi Culkin and Eric Hagan, Maker Media

2	Programming Arduino: Getting started with sketches, Simon Monk , TMH
3	Getting Started with Arduino: A Beginners Guide, Brad Kendal,
4	Make: Getting Started with Arduino, Massimo Banzi, Michael Shiloh, Makermedia
5	Make: Getting Started with Sensors, KimmoKarvinen, TeroKarvinen, Makermedia
6	Learn Electronics wit Arduino, Don Wilcher, Apress
7	The Internet of Things in the Cloud:A Middleware Perspectiv,By Honbo Zhou
8	Rethinking the Internet of Things A Scalable Approach to Connecting Everything, Francis daCosta, Apress

Web References:

Reference No	Reference Name
1	https://www.javatpoint.com/arduino-coding-basics
2	http://www.tinkercad.com
3	https://www.arduino.cc/
4	https://www.makerspaces.com/15-simple-arduino-uno-breadboard-projects/
5	https://thingspeak.com/
6	https://www.instructables.com/

Suggested list of experiments:

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 and slide switch with Arduino and write a program to turn ON LED when push button is pressed.
4	To interface Push button, Speaker/buzzer with Arduino and write a program to turn ON LED and generate a note or tone when push button is pressed.
5	To interface 2 Push buttons, a Speaker with Arduino and write a program to turn ON LED and generate a 2 different notes on two button keyboard.
6	To interface Seven Segment Display (SSD) with Arduino and write a program to print numbers and alphabets on SSD.
7	To interface LCD, push button, potentiometer with Arduino and write a program to display message on LCD when push button is pressed.
8	To interface LCD, push button, potentiometer with Arduino and write a program to display the no. of times (count) the push button is pressed on LCD.
9	To interface LED's, potentiometer with Arduino and write a program to turn on or off more of the LEDs by turning the potentiometer knob.
10	To interface LED, Photo resistor (LDR) with Arduino and write a program to increase and decrease the brightness of the LED based on the amount of light present.

11	To interface LED's with Arduino and write a program to show the fading effect on LED's.
12	To interface TMP 36 sensor with Arduino and write a program to display temperature data on serial monitor.
13	To interface PIR/ Ultrasonic sensor with Arduino and write a program to turn on and off LED depending on motion detection/sound detection.
14	To interface IR Remote with Arduino and write a program to start fan/bulb using IR remote
15	To interface Soil Moisture sensor Gas Sensor with Arduino
16	To demonstrate keypad using Arduino
17	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.
18	To interface Temperature sensor with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification.
19	To interface LDR sensor with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification
20	To build a mini project based on interfacing any combination of sensors with Arduino and cloud.

Note : At least 12-14 programs

Course Code	Course Name				
MCALE242	**Robotic Process Automation Lab**				
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
02	**01**	**50**	**30**	**20**	**100**

Pre-requisite:
1. Knowledge of C and C++ Programming
2. Software Engineering (UML)

Lab Course Objectives: Course aims to

Sr. No.	Course Objective
1	Identification of Use Cases for creating BOTs.
2	Build, Edit and Run BOTs.
3	Describe how Automation Anywhere's RPA tool can be used for creating software robots.
4	Develop and apply IQ BOTs.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Define the key concepts of Robotic Process Automation and evolution.	Remember
CO2	Demonstrate development of BOT with specific tools.	Understanding
CO3	Apply RPA commands to automate tasks.	Applying
CO4	Summarize this tool as a summation of Robotic Process Automation, Cognitive Analytics, and Workforce Analytics.	Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Introduction to GUI of Tool:** Demonstrate good understanding of Recorders, Editor, and various Basic Commands to build simple tasks / Bots for automating simple processes, Develop simple BOT, Control Room Features: Control Room Issues & Login, create Creator & Runner in Control Room, run Bot from Control Room, Schedule Bot from Control Room, working with credential managers, credentials vaults in control room. **Self Learning Topics:** Use of Web Control Room of AAE. Control Room, demonstrate client, Audit Log in Control Room.	2	1	1
2	**Automation anywhere Basic Commands:** MESSAGE BOX, Comment & Variables Type, Clipboard, Delay & Wait, Log To File, Launch	4	2	2,3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Website, - Open Program / File, Read From CSV / Text File, Object Cloning with Insert Keystroke, Variable Operation with Loop, Window Actions, String operation (Before After - Compare - Find), String operation (Join - Length - Lower Case), String Operation (Replace - Reverse - Split), String Operation (Sub String - Trim - Upper Case), error handling. **Self Learning Topics:** Play Sound & System			
3	**Automation anywhere Advanced Commands:** FTP / SFTP, Excel Automation, PDF Integration, Send Email, Email Automation, REST Web Service, Database, PGP (Pretty Good Privacy), Manage Windows Control, OCR (Optical Character Recognition) of Analog values. **Self Learning Topics:** PWM concepts, schedulers and triggers.	4	3	2,3
4	**RPA for Excel Commands:** Automation of excel commands for different real-world business use cases using A2019 Excel Commands and Generation of reports for data analysis, decision making, and other business process automation requirements. **Self Learning Topics:** Automation of excel commands.	4	3	2,3
5	**Working with PDF Documents:** **Self Learning Topics:** Real life problem statement.	6	3	2,3
6	**Advanced RPA Techniques:** Manipulating web-based components like textbox, IQBotDahsboard, IQBot Commands, Build resiliency within a bot. **Self Learning Topics:** Manipulating web-based component such as drop down.	4	4	2,3
7	**Use of UI Path Tool:** UIPath Orientation, UI Path Structure, Control Flow, Error Handling. **Self Learning Topics:** UI Control Flow	3	2,3	2,3
8	Automation of RPA Case study	3	2,3,4	1,2,3

Assessment:

Term Work: Will be based on Continuous Assessment(CA)

- Laboratory work will be based on the syllabus with minimum 10 experiments.
  The experiments should be completed in the allotted time duration.
    - o Experiments: 40 marks
    - o Attendance: 10 marks
- Practical will be evaluated by the subject teacher and documented according to rubrics.

137

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems By Tom Taulli
2	Value-Driven Robotic Process Automation Enabling Effective Digital Transformation by Mathias Kirchmer, Peter Franz and Danny Bathmaker
3	Learning Robotic Process Automation- Alok Mani Tripathi, Packt Publishing

Web References:

Reference No	Reference Name
1	https://www.udemy.com/course/robotic-process-automation/
2	https://www.udemy.com/course/learn-automation-anywhere/
3	https://university.automationanywhere.com/rpa-learning-trails/automationanywhere-university-essential-level-prep-courses-mba-students/
4	https://www.udemy.com/course/learn-advanced-rpa-automation-anywhere-withiqbot-and-wlm/
5	https://www.edureka.co/blog/automation-anywhere-examples
6	https://docs.automationanywhere.com/bundle/enterprisev11.3/page/enterprise/topics/aae-client/bot-creator/commands/commands.html
7	https://robot.uipath.com/
8	https://activities.uipath.com
9	http://studio.uipath.com

All Programs are designed for RPA tool: Automation Anywhere, UI Path

Suggested list of experiments:

Practical No.	Problem Statement
1	Use of recorder, editors and basic commands to build simple tasks.
2	Run Bot from Control Room and Schedule Bot from Control Room.
3	Automate action of getting the title of active window.
4	Automate action of closing a notepad window.
5	Automate task of replacing few characters from a string
6	Automate task of copying files from a source folder to destination folder.
7	Extract a table from webpage.
8	Automate task of extracting a text from a window and display text.
9	Automate task of writing text into Notepad file.
10	Extract data from JSON file and display output in message box.
11	To automate the task of extracting the data from an Excel File according to some condition and storing the extracted data in another File.
12	To automate the task of extracting the data from multiple PDF documents and storing the data into a CSV file.

Practical No.	Problem Statement
13	Manipulate web-based components like textbox, drop down.
14	Extract data from website and store it in excel or database.
15	Bot that implements Error handling.
16	Demonstrate Scheduler and trigger.
17	Design IQ BOT and resilience BOT.
18	Apply UIPath tool for some examples.

Course Code	Course Name		
MCALE243	Natural Language Processing Lab		
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)		

Contact Hours (Per Week)	Credits Assigned	Term Work	Practical	Oral	Total
2	1	50	30	20	100

Pre-requisite:
- Programming Skills (Python)
- Basics of Machine Learning

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	To understand the key concepts of NLP.
2	To learn various phases of NLP.
3	To design and implement various language models and POS tagging techniques.
4	To understand various NLP Algorithms
5	To design and implement applications based on natural language processing

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand the information retrieval techniques using NLP	Understanding
CO2	Apply mathematical techniques to model linguistic phenomena with formal grammar.	Applying
CO3	Analyze various NLP algorithms and text mining NLP applications	Analyze
CO4	Creating real world NLP applications such as machine translation, text categorization, text summarization, information extraction by applying NLP techniques.	Create

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Tokenization, Stemming and Lemmatization, Stop word removal **Self learning topics:** Python libraries for NLP (NLTK, spaCy)	4	CO1, CO2	1,2,3
2	Multiple tags & words, Unknown words. Named Entity Recognition (NER) **Self learning topics:** Text preprocessing	4	CO2	4,6
3	Bag of Words (BoW), Term Frequency-Inverse Document Frequency (TF-IDF) **Self learning topics:** Text representations	4	CO2, CO3	1,4

4	Word embeddings (Word2Vec, GloVe),Robust Word Sense Disambiguation (WSD), Dictionary based approach **Self learning topics:**Word2Vec Model	4	CO3	2,4
5	Sentiment Analysis introduction, Sentiment Analysis - Affective lexicons, Sentiment analysis techniques, Aspect based sentiment analysis **Self learning topics:** Chatbots	5	CO4	1,6
6	Text classification, Text summarization **Self learning topics:** Algorithms for summarization and classification	5	CO4	1,6

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - Experiments 40 marks
  - Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
2	Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
3	Daniel Jurafsky and James Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Prentice Hall, Second Edition, 2009.
4	Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing , MIT Press, 1999.
5	Alexander Clark, Chris Fox, Shalom Lappin ― The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
6	Introduction to Natural Language Processing by Jacob Eisenstein, MIT Press
7	Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009

Web References:

Reference No	Reference Name
1	http://www.cse.iitb.ac.in/~cs626-449
2	http://cse24-iiith.virtual-labs.ac.in/#

3	https://nptel.ac.in/courses/106105158
4	https://www.coursera.org/learn/language-processing
5	https://www.udemy.com/course/natural-language-processing/?trk=profile_certification_title&utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA

Suggested list of experiments:

Practical No	Problem Statement
1	To implement Tokenization of text.
2	To implement Stop word removal.
3	To implement Stemming of text
4	To implement Lemmatization
5	To implement N-gram model.
6	To implement POS tagging.
7	Building a custom NER system
8	Creating and comparing different text representations
9	Training and using word embeddings
10	Implementing a text classifier
11	Building a sentiment analysis system
12	Creating a text summarization tool

Course Code	Course Name				
MCALE244	Design and Analysis of Algorithm Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
02	01	50	30	20	100

Pre-requisite: Data Structure and Core Java / C++
Lab Course Objectives: The course aims to

Sr. No.	Course Objective
1	Implement and analyze recursive and non-recursive Algorithms.
2	Apply Algorithms to Real-World Problems using the divide-and-conquer approach.
3	Apply greedy techniques to solve real-world problems.
4	Analyze and implement the optimal control problem for dynamic programming solutions.
5	Implement backtracking and branch and bound techniques for optimization problems.
6	Design and Implement different Pattern Matching Algorithms.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Implement and analyze recursive and nonrecursive Algorithms	Analyze
CO2	Apply and compare Algorithms using the divide and conquer approach.	Analyze
CO3	Implement and apply Algorithms to Real-World Problems using greedy techniques.	Apply
CO4	Demonstrate dynamic programming solutions for complex problems.	Understand
CO5	Develop backtracking and branch and bound techniques for problem-solving.	Create
CO6	Understand, apply, and compare different string-matching algorithms.	Apply

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction:** Implementing and analyzing fundamental algorithms of Recursive and Non-recursive problems **Self-Learning Topics:** Basic array programs	4	1	1,2,3,8,9
2	**Divide And Conquer:** Binary Search, Merge sort, Quick sort, Heap Sort, and compare their performances, Multiplication of Large Integers **Self-Learning Topics:** Closest- Pair and Convex-Hull Problems	6	2	1,2,3,5,8

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
3	**Greedy Technique:** Knapsack, Minimum cost spanning tree (Kruskal, Prims) Minimum cost spanning tree, Single source shortest path (Dijkstra's algorithm) **Self-Learning Topics:** Huffman Coding	4	3	1,2,3,4,5,6
4	**Dynamic Programming:** Knapsack (0/1), Matrix chain multiplication, All pair shortest path (Floyd Warshall) **Self-Learning Topics:** DFS, BFS, and Partition Problem	4	4	1,2,3,4,5,6,7
5	**Backtracking And Branch And Bound:** n-Queen problem, Graph colouring problem, Hamiltonian cycle. Travelling Salesman Problem. **Self-Learning Topics:** Subset Sum Problem	4	5	1,2,3,5,6
6	**String Matching:** Brute force string matching, Knutt-Morris-Pratt algorithm, Rabin-Karp algorithm, Naïve string matching, Boyer Moore algorithm **Self-Learning Topics:** Finite automata, Approximation Algorithms	4	6	1,2

Assessment:

Term Work: Will be based on Continuous Assessment

- Laboratory work will be based on the syllabus with minimum 10 experiments.
  The experiments should be completed in the allotted time duration.
  - o Experiments 40 marks
  - o Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on the suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, ―Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012 ISBN 978-0-262-03384-8
2	Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012 ISBN 978 0 13 231681
3	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran - Computer Algorithms/ C++
4	S. Sridhar ―Design of Algorithms and Analysis, Oxford university press, 2014.
5	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, Reprint 2006
6	Harsh Bhasin, ―Algorithms Design and Analysis, Oxford university press, 2016.

7	Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Edition, 2008, ISBN: 8177585959, Pearson Education.
8	Data Structures and algorithms in Java by Goodrich, Michael T.
9	Data Structures with Java second edition by John R.Hubbard

Web References:

Reference No	Reference Name
1	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
2	https://www.javatpoint.com/daa-tutorial
3	https://onlinecourses.nptel.ac.in/noc19_cs47/preview
4	https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
5	https://www.guru99.com/design-analysis-algorithms-tutorial.html

Suggested list of experiments:

Practical No	Problem Statement
1	Write a program to print the Fibonacci series. (Recursive and Non-recursive)
2	Write a program Maximum and minimum number from an array. (Recursive and Non-recursive)
3	Write a program to find the factorial of a number. (Recursive and Non-recursive)
4	Write a program to find the Sum of the First N Odd & Even Numbers. (Recursive and Non-recursive)
5	Write a program to add, multiply, and transpose of two matrices. (Recursive and Non-recursive)
6	Given an array of integers, find an element from it using Binary Search.
7	Given an array of integers, sort it using the merge sort technique using the Divide and Conquer Approach.
8	Given an array of integers, sort it by using Quick Sort using Divide and Conquer Approach.
9	Sort an array of integers by building a max or min heap using the Divide and Conquer Approach.
10	Write a program to implement the Multiplication of Large Integers using Divide and Conquer Approach.
11	Write a program to implement the Knapsack problem using the greedy method
12	By applying Greedy Technique, write a program to implement a Minimum cost-spanning tree using Prims and Kruskal.
13	Write a program to implement a Single source shortest path (Dijkstra's algorithm) using the greedy method
14	Write a program to implement Knapsack (0/1) using Dynamic Programming.
15	Write a program to implement Matrix chain multiplication using Dynamic Programming.
16	Write a program to implement all pair shortest paths (Floyd Warshall) using Dynamic Programming.
17	Write a program to implement Graph coloring problems using Backtracking

18	Write a program to implement the Hamiltonian cycle using Backtracking
19	Write a program to implement Travelling Salesman using branch and bound.
20	Given a text txt [0...n-1] and a pattern pat [0...m-1], prints all occurrences of pat [ ] in txt [ ] by using the Brute force string matching approach. You may assume that n > m.
21	Given a text txt [0...n-1] and a pattern pat [0...m-1], prints all occurrences of pat [ ]in txt [ ] by using the KMP approach. You may assume that n > m.
22	Given a text txt [0...n-1] and a pattern pat [0...m-1], prints all occurrences of pat [ ] in txt [ ] by using the Rabin Krap approach. You may assume that n > m.
23	Given a text txt [0...n-1] and a pattern pat [0...m-1], prints all occurrences of pat [ ] in txt [ ] by using the Naïve string matching approach. You may assume that n > m.
24	Given a text txt [0...n-1] and a pattern pat [0...m-1], prints all occurrences of pat [ ] in txt [ ] by using the Boyer Moore algorithm. You may assume that n > m.
25	Group project (2 to 3 members) to be given to work on one application to a real-world problem like: Analyze and compare different algorithms concerning space and time. (Examples sorting algorithms, string matching algorithms, different approaches)

Note: At least 12-14 programs

Course Code	Course Name			
MCAL25	**Advanced Web Technologies(AWT) Lab**			
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
4	**2**	**50**	**30**	**20**	**100**

Pre-requisite:
1) Understanding of Object Oriented Programming concepts
2) Basic knowledge of web technologies

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	To understand advanced web development techniques using dot NET
2	To Use Microsoft ADO.NET to access data in web Application
3	To impart understanding of Web Techniques and Design Web Services
4	To learn advanced web framework MVC with razor

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

Sr. No.	Course Outcome	Bloom Level
CO1	Develop Web applications using various controls and programming techniques.	Apply
CO2	Implement Data Binding applications using ADO.NET	Analyze
CO3	Solve identity management problems in web Applications using session management and AJAX concepts.	Evaluate
CO4	Create modern web applications using Web Services and Core MVC	Create

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to ASP.NET:** Design Simple web pages (Data types, variables, operators, ASP.net Objects), Basic Server side controls, Working with Cross Page, Postback and Autopostback. **Self-Learning Topics**: Event handling in ASP.NET	6	CO1	1,2,3 ,4 5
2	**Creating a User Interface (Controls and Master Page):** Advanced Web server controls (validation, Calendar, AdRotator, Navigation, File upload). Websites using Master Pages (creating master and content pages) **Self-Learning Topics**: Themes and skins	8	CO1	1,2,3 , 4, 5
3	**Database Programming in ASP.NET:** Connected and disconnected Architecture of ADO.NET, Commands, Datasets, Data Readers, Data Adapters. Data bound controls (DataList, DetailsView, FormView, GridView, ListView, Repeater). Working with Stored Procedures (Simple and Parameterise)	12	CO2	2,3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	LINQ with ASP.NET: LINQ Introduction, Mapping data model to an Object model, Introducing query syntax, Entity Framework **Self-Learning Topics**: Charts and Data Pagers			
4	**State Management and AJAX:** Client Side State Management - View State, Query String, Cookie, Hidden Fields. Server Side State Management- Session State, Application State, cache. **ASP.NET Applications with AJAX**: AJAX Controls, Testing an ASP.NET Ajax application, Global.asax and Web Config **Self-Learning Topics**: Web Parts	8	CO3	3,4
5	**Web Services and WCF:** Creating and Consuming a XML Web Service-Simple and Database. Creating and Consuming a WCF service – Simple and Database **Self-Learning Topics**: Caching Web service responses	6	CO4	3,4
6	**ASP.NET Core MVC Framework:** **Models-**Creating models**,** Data annotations and validation **Views-**Razor syntax, Layouts, partial views, and view components, Tag Helpers and HTML Helpers **Controllers-**Creating controllers, Action methods and routing ViewBag, ViewData, and TempData **Routing in MVC-** Defining routes, Route parameters **Using Entity Framework with MVC-** Code-First and Database-First approaches **Performing CRUD operations in MVC** **Self-Learning Topics**: Creating RESTful API	12	CO4	6,7,8,9

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with a minimum 15 experiments. The experiments should be completed in the allotted time duration.
    - Experiments 40 marks
    - Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on the suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Mathew MacDonald, Beginning ASP.NET 4.5 in C#, 2012, Apress, ISBN: 978-8132210054

2	Imar Spaanjaars, Beginning ASP.NET 4.5.1 in C# and VB, 2014, Wrox, ISBN: 978-1-118-84677-3
3	Jayson N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, Professional ASP.NET 4.5 in C# and VB, 2013, Wrox, ISBN: 978-1-118-31182-0
4	Bill Evjen , Scott Hanselman, Devin Rader, Professional ASP.NET 4 in C# and VB, 2010, ISBN: 978-0-470-50220-4
5	Walther, Stephen. ASP. Net 4.5 Unleashed. Pearson Education India, 2012. ISBN: 067233688X
6	Pro ASP.NET.Core 6.9 Edition by Adam
7	Programming ASP.NET Core by Dino Esposito
8	ASP.NET Core in Action by Andrew Lock
9	Pro ASP.NET MVC 5, ISBN 978-1-4302-6529-055999, APRESS

Web References:

Reference No	Reference Name
1	https://learn.microsoft.com/en-us/aspnet/tutorials
2	ttps://docs.microsoft.com/en-us/aspnet/mvc/overview/getting-started/introduction/getting-started
3	https://docs.microsoft.com/en-us/aspnet/core/?view=aspnetcore-3.1
4	https://www.w3schools.com/asp/default.ASP
5	en.wikipedia.org › wiki › Web_service
6	https://dotnettutorials.net/lesson/introduction-asp-net-core-mvc/
7	https://docs.microsoft.com/en-us/aspnet/core/mvc/views/razor?view=aspnetcore-3.1

Suggested list of experiments:

Practical No	Problem Statement
1	Design a Web Application for an Organization with Registration forms and advanced controls
2	Create a website using the master page concept.
3	Design a webpage to demonstrate a connection oriented architecture.
4	Design a webpage to demonstrate a disconnected architecture.
5	Create a webpage that demonstrates the use of data bound controls of ASP.NET.
6	Design a webpage to demonstrate the working of a simple stored procedure.
7	Design a webpage to demonstrate the working of parameterized stored procedures.
8	Design a webpage to display the use of LINQ.
9	Build websites to demonstrate the working of entity frameworks in dot net.
10	Design Web Applications using Client Side Session Management
11	Design Web Applications using Server Side Session Management Techniques
12	Build a web page using AJAX Controls.

13	Design Web Application to produce and Consume a web Service
14	Design web application using MVC framework
15	Design MVC application using entity framework
16	Design MVC Application to perform CRUD operation.

Course Code	Course Name				
MCAL26	**User Interface Lab**				
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
02	**01**	**50**	**30**	**20**	**100**

Pre-requisite: Basic knowledge of Web Technologies and Software Engineering

Lab Course Objectives: Course 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 Evaluating User Experience.
4	Apply the concept of Good UI and User Experience (UX).

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

Sr. No.	Course Outcome	Bloom Level
CO1	Interpret user needs and context of User Interface design Specification and describe the process and importance of user research	Understanding
CO2	Demonstrate the tools and techniques for designing in forming models	Applying
CO3	Develop high fidelity prototype for end-to-end solution.	Applying
CO4	Apply best practices for evaluating user experience.	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**The UI lifecycle:** Introduction to UI lifecycle and UI tools. **Self-Learning Topics:** phases and importance of UI lifecycle	2	CO1	2, 6
2	**Requirement gathering:** Include the business purpose and user needs. **Self-Learning Topics:** Understand the user, types of users, requirement gathering techniques, contextual enquiry.	4	CO2	6
3	**Analysis:** User analysis, Task analysis, Domain analysis, Social modeling **Self-Learning Topics:** Identifying the types of tasks, design objects model, contextual analysis.	4	CO1	6
4	**Design:** Scenario, Storyboard designs. **Self-Learning Topics:** Principles of good design, Mental model	4	CO2	3, 6
5	**Build and test the low fidelity prototype:**	4	CO3	6

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Build a prototype. Paper prototype, Wireframe Prepare a briefing for test users. (test the prototype) **Self Learning Topics:** Types of prototypes			
6	**Implementation and Testing:** Working implementation of the chosen project. Light weight page loading, Evaluate interface with a small user test and write a final reflection **Self-Learning Topics:** Implementation tool, user friendly design, Testing Techniques.	8	CO4	2

Assessment:

Term Work: Will be based on Continuous Assessment

- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - Experiments 40 marks
  - Attendance 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Norman, Donald ,*The Design of Everyday Things,* Basic ISBN978-0-465-06710-7
2	Steve Krug, Don't Make Me Think, Revisited: A Common Sense, New Riders, ISBN, Thirdedition,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	TheoMandel, The Elements of User Interface Design, Wiley, FirstEdition, 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/
4	Material Design Guidelines, Apple Human Interface Guidelines, WebAIM
5	https://martinsolent.github.io/figma/

Suggested list of experiments:

Practical No	Problem Statement
1	Study of UI life cycle
2	Study of open source UX Tools
3	Prepare Project Proposal and Requirement Gathering (Choose the project) The project should be a web, desktop, or mobile interface. If the chosen project is a mobile application, note that it must at least be possible to simulate the project, since one of the prototypes will be such a simulation that can be evaluated.
4	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 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.
5	Create Social model of the chosen Project.
6	Identify the Users and Design a User persona.
7	Design Creation of Scenario Write a scenario that involves all three of the tasks identified for the chosen project. Output: • Explain the Scenario • Sketch the scenario (use any tool or hand sketches)
8	Draw a mental model for the above drawn scenario.
9	Create High-Fidelity prototype (Wire Frame) using Figma tool.
10	Create Prototype for Chosen Project.
11	Design Customer Journey map.
12	Perform UX Evaluation of Chosen Project. Testing of User Interface from Third Party (Test scripts).

Course Code	Course Name			
MCAL27	Networking with Linux Lab			
Contact Hours (Per Week)	**Credits Assigned**	**Examination Scheme (Marks)**			
		Term Work	**Practical**	**Oral**	**Total**
2	1	50	30	20	100

Pre-requisite: Basic commands in Linux, Basics of Computer Networks, Basic Programming Skill.

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Install and configure the network simulation Tool
2	Have a hands-on experience of computer network simulation and modeling techniques using NS-3 simulation software
3	Design various network topologies and implementation of various network protocols
4	Analyze network traffic using network sniffing software
5	Evaluate the performance of the protocols and analyze the metrics

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

Sr. No.	Course Outcome	Bloom Level
CO1	Install and configure the network simulation tool and basic Linux networking commands.	Understanding
CO2	Construct various network topologies and Network Protocols	Applying
CO3	Analyze the network traffic using network sniffing software	Analyzing
CO4	Evaluate the network performance using various metrics	Evaluating
CO5	Design and develop solutions to complex network problems using Network Simulator and Network	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Network Simulator and Sniffing Tool** - Introduction to ns-3 architecture, history, models. - Installation of ns3 tool on linux platform - Installation of netanim Animator - Installation of pyviz Visualizer - Installation of Wireshark - Installation of tcpdump - Basic networking commands in Linux:	4	1	1,2,3, 5,6

154

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self-learning: Advanced Linux network commands			
2	**Network Topology** • Point to Point Topology • Bus topology • Star Topology • Mesh topology • Hybrid topology **Self-learning:** Complex topology	8	2,3	2,3
3	**Basic Network Protocol Models** • Client server model • Simulating TCP and UDP protocols • Simulating FTP protocol • Implementing DHCP server and Clients **Self-learning:** Other network Protocols	8	2,3	2,3,9 ,10
4	**Monitoring and Analyzing the Network Traffic** • Analysis of Protocols using Wireshark • HTTP, HTTPS, DNS • TCP, UDP • IP, ICMP • ARP • DHCP **Self-learning:** NAT, SMTP	2	3	7, 8, 17, 18
5	**Network Performance Evaluation** • Evaluate the performance of the network using flow monitor. **Self-learning:** Other evaluation tools, animation Tools	2	4	4
6	**Real time Network Problem solving** • Creating complex network • Congestion Control Problems **Self-learning:** Explore network simulation tools OMNeT++, QualNet, NetSim, OPNET	2	3,4, 5	16

Assessment:
Term Work: Will be based on Continuous Assessment
- Laboratory work will be based on the syllabus with minimum 10 experiments. The experiments should be completed in the allotted time duration.
  - o Experiments 40 marks
  - o Attendance   10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:
Practical and oral examination will be based on suggested practical list and entire syllabus.

Reference Books:

Reference No	Reference Name
1	Riley, G.F., Henderson, T.R. (2010). The ns-3 Network Simulator. In: Wehrle, K., Güneş, M., Gross, J. (eds) Modeling and Tools for Network Simulation. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-12331-3_2
2	Lisa Bock, Learn Wireshark - Second Edition: A definitive guide to expertly analyzing protocols and troubleshooting networks using Wireshark 2nd ed. Edition, Packt Publishing
3	Vinit Jain, Wireshark Fundamentals: A Network Engineer's Handbook to Analyzing Network Traffic 1st ed. Edition, APress
4	Lewis Van Winkle, Hands-On Network Programming with C: Learn socket programming in C and write secure and optimized network code, Packt Publishing

Web References:

Reference No	Reference Name
1	https://www.nsnam.org/docs/tutorial/ns-3-tutorial.pdf
2	https://www.nsnam.org/docs/release/3.32/installation/ns-3-installation.pdf
3	https://www.nsnam.org/docs/release/3.32/models/ns-3-model-library.pdf
4	https://www.nsnam.org/docs/models/html/flow-monitor.html
5	https://www.redhat.com/sysadmin/7-great-network-commands
6	https://www.geeksforgeeks.org/linux-network-commands-cheat-sheet/
7	https://www.wireshark.org/docs/wsug_html/
8	https://www.wireshark.org/docs/
9	https://www.nsnam.org/docs/release/3.27/doxygen/dhcp-example_8cc.html
10	https://www.nsnam.org/docs/models/html/tcp.html
11	https://www.youtube.com/watch?v=9rkN3FtOkaQ
12	https://www.youtube.com/watch?v=I8jn4vKm5QA
13	https://www.youtube.com/watch?v=WbpUKpbyc7I
14	https://www.youtube.com/watch?v=VJBNnJ__ubM
15	https://www.youtube.com/watch?v=GmodKfVBLcU
16	https://www.nsnam.org/docs/release/3.27/doxygen/group__congestion_ops.html
17	https://wiki.wireshark.org/SampleCaptures
18	https://gaia.cs.umass.edu/kurose_ross/wireshark.php

Suggested list of experiments:

Practical No	Problem Statement
1	Installation: ns3 in Linux, NetAnim, Wireshark, PyViz, tcpdump
2	Linux Network Commands – ifconfig, ip, ping, netstat, traceroute, nslookup, route, hostname.
	ns3 Programs – Simulate, Visualize, Animate the Network, Trace and Analyze the Captured Packets.

3	Program to simulate Point to Point topology
4	Program to simulate Bus topology
5	Program to simulate Start topology
6	Program to simulate Mesh topology
7	Program to simulate Hybrid topology
8	Program to simulate UDP Client Server
9	Program to simulate DHCP server and Clients
10	Program to simulate FTP using TCP
11	Exercises for analyzing the network protocols using Wireshark • Capture the packets while browsing the any web site • Analyze the header fields of various protocols
12	Evaluate the network performance using metrics: throughput, delay, response time, packet loss, dropped packets etc. (Any Topology)
13	Projects (Group of 3 to 4 students) – Complex Networks, Congestion Control Algorithms, MAC Protocols,

Course Code	Course Name	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
MCAP21	Mini Project 1B	02	01	25	-	25	50

Pre-requisite: NIL

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquaint with the process of applying basic computer applications and provide solutions to the problems in various application domains.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate the ability to produce a technical document.	Understanding
CO2	Apply software project management skills during project work.	Applying
CO3	Build small groups to work effectively in team on medium scale computing projects.	Creating
CO4	Design and evaluate solutions for complex problems.	Creating

Guidelines for Mini Project:
1. Students shall form a group of 2 to 3 students.
2. Students should do survey and identify needs, which shall be converted into problems in consultation with the faculty Supervisor / Guide / HOD / Internal Committee of faculties. The project contact hours shall be allotted in the time table and 2 hours workload shall be considered for the guide / supervisor.
3. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A log book to be prepared by each group, wherein the group can record weekly work progress, Guide/Supervisor can verify and record notes/comments.
5. Faculty may give inputs during mini project activity; however, focus shall be on self-learning.
6. Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with Guide / Supervisor.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and project report to be compiled in standard format of University of Mumbai.

<u>**Assessment of Mini Project:**</u>
I) Term work (25 Marks):

- The progress of the mini project to be evaluated on a continuous basis.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Termwork marks shall be as below;

Marks awarded by guide / supervisor based on log book	10 Marks
Self contribution and use of skillset in project	10 Marks
Quality of Project report	05 Marks

II) Mini Project Examination (Oral 25 Marks):

- Mini project evaluation will be done at Institute level by alumni or industry experts
- Report should be prepared as per the guidelines issued by the University of Mumbai.
- The students shall present a seminar on Mini project and demonstrate their understanding of need / problem.
- Mini Project shall be evaluated through a presentation and demonstration of working model by the student project group to a panel of examiner at Institute level.
- Mini Project shall be assessed based on following points:
    - Quality of survey / need identification.
    - Clarity of Problem definition based on need.
    - Innovativeness in solutions.
    - Feasibility of proposed problem solutions and selection of best solution.
    - Cost effectiveness.
    - Societal impact.
    - Full functioning of working model as per stated requirements.
    - Effective use of skill sets.
    - Contribution of an individual as a member or leader.
    - Clarity in written and oral communication.

Bridge Course

Program Structure for
BRIDGE COURSE - Master of Computer Application (MCA)

UNIVERSITY OF MUMBAI

(With effect from 2024-2025)

Course Code	Course Name	Group	Theory	Pract	Tut.	Theory	Pract	Tut	Total
			Teaching Scheme (Contact Hours)			Credits Assigned			
MCABR1	Java Programming	Major	3	--	--	--	--	--	--
MCABR2	Data Structures	Major	3	--	--	--	--	--	--
MCABR3	Operating Systems	Major	3	--	--	--	--	--	--
MCABR4	Computer Networks	Major	3	--	--	--	--	--	--
MCABR5	Discrete Mathematics	Major	3	--	--	--	--	--	--
	Total		**15**			**-**	**-**	**-**	**-**

Course Code	Course Name	Group	CA	Test	Total	End Sem	Exam. Duration In Hrs	Pract	Oral	Total
			Examination Scheme							
			Theory					Practical		
			Internal Assessment			End Sem	Exam. Duration	Pract	Oral	Total
MCABR1	Java Programming	Major	25	25	50	50	2	--	--	100
MCABR2	Data Structures	Major	25	25	50	50	2	--	--	100
MCABR3	Operating Systems	Major	25	25	50	50	2	--	--	100
MCABR4	Computer Networks	Major	25	25	50	50	2	--	--	100
MCABR5	Discrete Mathematics	Major	25	25	50	50	2	--	--	100
	Total									**500**

Course Code			Course Name				
MCABR1			Java Programming				
Teaching Scheme Contact Hours			Credits Assigned				
Theory	Practical	Tut	Theory	Practical	Tut.	Total	
03	--	--	--	--	--	--	
Examination Scheme							
Theory			End Sem. Exam.	Term Work	Practical	Oral	Total
CA	Test	Total					
25	25	50	50	--	--	--	100

Pre-requisite: Nil
Course Outcomes:

Sr. No.	Course Outcomes	Bloom Level
CO1	To understand fundamental java programming constructs such as data types, Control statements and loops	Understanding
CO2	To comprehend Object oriented programming concepts	Understanding
CO3	To analyze and implement object-oriented programs in Java	Applying
CO4	To design and develop GUI based Java applications	Creating

Module	Detailed Contents	Hrs
01	**Introduction to Java:** **Introduction:** History of Java, Features of Java, JDK, JRE, and JVM, Setting up the Java Development Environment, Java Source File Structure, Compilation, Executions. **Java Basics:** Data Types and Variables, Operators and Expressions, Control Flow Statements (if-else, switch-case) Looping Statements (for, while, do-while), Arrays	06
02	**Object-Oriented Programming (OOP) Concepts and Strings:** **OOPS Concepts:** **Classes &Objects:** Class Fundamentals, Object & Object reference, Object Life time & Garbage Collection, Constructors, Access Control, Modifiers, Inner Class & Anonymous Classes **Methods:** Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members Inheritance, Method Overriding, Polymorphism, Encapsulation, Abstraction, Interfaces, Abstract& Static Classes **Java Strings:** String Class, StringBuffer and StringBuilder String Methods	12

03	**Exception Handling, Packages and Thread:** **Exception Handling**: Introduction, Exceptions & Errors, Types of Exception, Control Flow In Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exception examples **Packages**: Importing packages Access modifiers: private, protected, public, default, Threads & Multithreading in Java	08
04	**GUI Programming:** Basics of Components, Using Containers, Layout Managers Introduction to AWT **Swing Components**: Introduction, Components Layouts, Individual components Label, Button, CheckBox, Radio Button, Choice, List, Menu, Text Field, Text Area **Event-Delegation-Model, Listeners:** Mouse Listeners ,Key Listeners & Text Listener	10

Reference Books:

Reference No	Reference Name
1	E. Balagurusamy, Programming with Java, Tata McGraw-Hill Education India, 2014
2	Herbert Schildt, Java The Complete Reference, Ninth Edition, McGraw-Hill Education, 2014
3	Yashavant P. Kanetkar, Let us Java- 5th edition Paperback , 2019
4	Head First Java: A Brain-Friendly Guide, 3rd Edition
5	Core Java for Beginners: A Simplified Approach (Covers Java SE 13) (Paperback, Sharanam Shah, Vaishali Shah)

Web References:

Reference No.	Reference Name
1	https://www.geeksforgeeks.org/java/
2	www. javatpoint.com

Course Code			Course Name				
MCABR2			Data Structures				
Teaching Scheme			Credits Assigned				
Contact Hours							
Theory	Practical	Tut	Theory	Practical	Tut.	Total	
03	--	--	--	--	--	--	
Examination Scheme							
Theory			End Sem. Exam.	Term Work	Practical	Oral	Total
CA	Test	Total					
25	25	50	50	--	--	--	100

Pre-requisite: Nil
Course Outcomes:

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

Module	Detailed Contents	Hrs
01	**Introduction to Data Structures & Algorithms:** • Introduction of Data structures, Abstract Data Types, • Performance Analysis: Space Complexity, Time Complexity, • Asymptotic Notations (Big O, Omega, Theta), Performance • measurement, Divide and Conquer, Back Tracking Method, • Dynamic programming	06
02	**Sorting and searching algorithms:** • Bubble sort, Insertion sort, Radix Sort, Selection sort, shell Sort, • Linear Search, Sequential search, Binary search	05
03	**Hashing:** • Different Hashing Techniques, Address calculation Techniques, • Common hashing functions, • Collision resolution techniques: Linear probe, Quadratic probe, Key offset. • Rehashing, Doublehashing, Linklist addressing.	05
04	Linear Data Structures: • Stack Definition, Operations, Implementation of Stacks (Array and Linkedlist) • Queue: Definition, Operations, Implementation of simple queue (Array and Linkedlist) • Types of queues: Circular • Types of Linked List: Singly, Doubly and Circular Linked list Definition, Operations (Insert, delete, traverse, count, search)	10

164

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

Reference Books

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

Course Code			Course Name			
MCABR3			Operating System			
Teaching Scheme Contact Hours			Credits Assigned			
Theory	Practical	Tut	Theory	Practical	Tut.	Total
03	--	--	--	--	--	--
Examination Scheme						
Theory			End Sem. Exam.	Term Work	Practical	Oral	Total
CA	Test	Total				
25	25	50	50	--	--	--	100

Pre-requisite: Nil
Course Outcomes:

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

Module	Detailed Contents	Hrs
01	Introduction Operating System &Process and Thread Management: • Introduction to System Software & operating System • Overview of all system softwares: Compiler, Assembler, Linker, Loader, Operating system, OS services and Components, Types of OS-Batch, multiprocessing, multitasking, timesharing, Distributed OS, Realtime OS, virtual machines, • System Calls, types of System calls, Buffering, Spooling • Process and Thread Management: Concept of process and threads, Process states, Process management, Context switching, Interaction between processes and OS, • Multithreading, CPU scheduling algorithms, multiprocessor scheduling algorithms, • Realtime scheduling algorithms	08
02	Concurrency Control: • Concurrency and Race Conditions, • Mutual exclusion requirements, Software and hardware solutions, • Semaphores, Monitors, Classical IPC problems and solutions, Deadlock, Characterization, Detection, Recovery, Avoidance and Prevention	10
03	Memory Management: • Memory Management: Memory partitioning, Swapping, • Paging, Segmentation, Virtual memory, Overlays, Demand paging, Performance of Demand paging, • Virtual memory concepts, • Page replacement algorithms, Allocation algorithms	04
04	Mass Storage Structure & File systems: • Mass Storage Structure: Secondary-Storage Structure, Disk structure, Disk scheduling, Disk management, • Swap-space management, Disk reliability, Stable storage implementation,	08

	• Introduction to clock, Clock hardware, Clock software • File concept, File support, Access methods, • Allocation methods, Directory systems, File protection, • Free space management	
05	Protection & Security: • Protection-Goals of protection, • Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights • Security- The security problem, Authentication, One-Time passwords, Threats	06

Reference Books:

Reference No	Reference Name
1	Operating System Concepts (9th Ed) by Silberschatz and Galvin,Wiley,2000.
2	Operating Systems (5th Ed) –Internals and Design Principles by William Stallings, Prentice Hall, 2000.
3	Modern Operating Systems by Andrew S. Tanenbaum, Prentice Hall India,1992.
4	Operating Systems (3rd ed) by Gary Nutt, Nabendu Chaki, Sarmishtha Neogy, Pearson

Course Code			Course Name				
MCABR4			**Computer Networks**				
Teaching Scheme			**Credits Assigned**				
Contact Hours							
Theory	**Practical**	**Tut**	**Theory**	**Practical**	**Tut.**	**Total**	
03	**--**	**--**	**--**	**--**	**--**	**--**	
Examination Scheme							
Theory			**End Sem. Exam.**	**Term Work**	**Practical**	**Oral**	**Total**
CA	**Test**	**Total**					
25	**25**	**50**	**50**	**--**	**--**	**--**	**100**

Pre-requisite: Nil
Course Outcomes:

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

Module	Detailed Contents	Hrs
1	**Basics of Digital Communication:** • Introduction to digital communication, • Signal propagation, Signal types, Signal parameters, Switching & forwarding, Transmission impairments, Attenuation, • Delay distortion, Noise, Effects of limited bandwidth, • Data rate limits-Nyquist's theorem and Shannon's theorem **Network Organization and Models:** • Basics of computer Network, topology & types of topologies, types of networks (LAN, MAN, WAN), • Concept of Intranet & Extranet, Ad-Hoc Networks, types of communications (Asynchronous and synchronous), modes of communications (simplex, half duplex, full duplex), Protocols, • Networking models, ISO-OSI Reference Model, Design issues of the layer, Internet Model (TCP/IP), • Comparison of ISO-OSI & TCP/IP Model	6
2	**Networking Devices:** • Connectivity Devices: Passive & Active Hubs, Repeaters, Switches (2-LayerSwitch,3-Layer switch(Router), • Bridges (Transparent Bridges, Spanning Tree, Bridges, Source Routing Bridges), Brouters, Gateways Application, **Presentation & Session Layer:** • Principles of Application Layer Protocols, The Web and HTTP, FTP, Telnet, Electronic Mail in the Internet • (SMTP, MIME, POP3, IMAP), DNS, Introduction to SNMP.	6

3	**Transport layer:** • Transport-Layer Services, port addressing, • Multiplexing and Demultiplexing, • Principles of Reliable Data Transfer, • Congestion Control, TCP's Congestion Control. • Quality of Service: Introduction, Queue Analysis, QoS Mechanisms, Queue management Algorithms, Feedback, • Resource, Reservation.	6
4	**Network layer:** • Network Service Model, Data gram &Virtual Circuit, • Routing Principles, The Internet Protocol,(ipv4 & ipv6), • IP addressing and subnetting, Routing Algorithms. • Hierarchical Routing, Routing in the Internet: Intra and inter-domain routing; Unicast Routing Protocols RIP, • OSPF, BGP, Multicast Routing Protocols: MOSPF, DVMRP. • ATM Networks: Need for ATM, ATM Layers, ATM adaptation Layers, IP over ATM, Multiprotocol Label switching (MPLS), Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes	9
5	**Data Link Layer:** • Data Link Layer, Error Detection and Correction Techniques, • Multiple Access Protocols, LAN Addresses and ARP & RARP, PPP: The Point-to-Point Protocol, • Ethernet standards – IEEE 802.3, 802.5, FDDI, 802.6. Physical layer: • Physical Layer, Types of media wired and wireless media	9

Reference Books:

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

Course Code			Course Name				
MCABR5			Discrete Mathematics				
Teaching Scheme Contact Hours			Credits Assigned				
Theory	Practical	Tut	Theory	Practical	Tut.	Total	
03	--	--	--	--	--	--	
Examination Scheme							
Theory			End Sem. Exam.	Term Work	Practical	Oral	Total
CA	Test	Total					
25	25	50	50	--	--	--	100

Pre-requisite: Nil

Course Outcomes:

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

Module	Detailed Contents	Hrs
01	**Mathematical logic:** • Propositions and logical operations, Conditional Statements, • Methods of Proof, Mathematical Induction, • Mathematical Statements, • Logic and Problem-Solving, Normal Forms Sets and Relations: • Set operations and functions, Product sets and partitions, • Relations and digraphs, • Paths in Relations and Digraphs, • Properties of Relations, Equivalence Relations, Operations on Relations, • Partially Orders Sets, Hasse diagram	16
02	**Graphs:** • Graph, Representation of Graph, Adjacency matrix, • Adjacency list, Euler paths and Circuits, Hamiltonian Paths and Circuits	10
03	**Modeling using difference equation:** • Recurrence relation – Fibonacci series, Tower of Hanoi • Lines in a plane Homogenous linear equations with constant coefficients, • Particular Solution, Total Solution, Divide and conquer Recurrence Relations	10

Reference Books:

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

Letter Grades and Grade Points:

Semester GPA/Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result
9.00-10.00	90.0-100	O (Outstanding)
8.00-<9.00	80.0-<90.0	A+ (Excellent)
7.00-<8.00	70.0-<80.0	A (Very Good)
6.00-<7.00	60.0-<70.0	B+ (Good)
5.50-<6.00	55.0-<60.0	B (Above Average)
5.00-<5.50	50.0-<55.0	C (Average)
4.00-<5.00	40.0-<50.0	P (Pass)
Below 4.00	Below 40.0	F (Fail)
Ab (Absent)	-	Absent

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