University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

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8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
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AC – 20/5/2025
Item No. – 6.71 (N)

As Per NEP 2020

University of Mumbai

Title of the program

Master of Computer Application (MCA)

Syllabus for

Semester – Sem.- III & IV

As per AICTE Guidelines & Curricular Framework of NEP 2020 for MCA Program

(With effect from the academic year 2025-26)

Under

THE FACULTY OF SCIENCE & TECHNOLOGY

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O: _____**	**Master of Computer Application (MCA)**
5	**Scheme of Examination** **R: _____**	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. TPM – 5C** **R. TPM – 5D**	Attached herewith
8	**Semesters**	Sem. III & IV
9	**Program Academic Level**	6.5
10	**Pattern**	Semester
11	**Status**	New
12	**To be implemented from Academic Year**	2025-26

Dr. Murlidhar Dhanawade
Chairman
Board of Studies (MCA)
University of Mumbai

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology
University of Mumbai

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology
University of Mumbai

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. III & IV):

Sem III R. TPM – 5C Sem IV R. TPM -5D

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**	

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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)	--	2#	--	--	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

Contact hours: 2 hours in campus and 6 hours self-research by student outside campus in a week

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			
			Internal Assessment		University Assessment	Total Marks
			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 - III

Syllabus
MCA, Sem. III

Course Code	Course Name				
MCA31	Big Data Analytics and Visualization				
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:
Some prior knowledge about SQL, DBMS would be beneficial.

Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate the key issues in big data management and its associated application for business decision	Understanding
CO2	Develop problem solving and critical thinking skills in fundamental enabling technique using Map Reduce.	Applying
CO3	Build problem-solving and critical thinking abilities through fundamental enabling technologies like NoSQL and the Hadoop ecosystem.	Creating
CO4	Use of RDD and Data Frame to create Application in Spark.	Applying
CO5	Evaluate the suitability of various visualization methods in exploratory data analysis	Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Big Data:** Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data, Big Data Applications. **Hadoop:** Hadoop architecture, Hadoop Ecosystem. **HDFS:** HDFS architecture, Features of HDFS, Rack Awareness, HDFS Federation. **YARN architecture.** **Self-Learning Topics:** Google Cloud Dataproc, Azure HDInsight.	6	CO1	1,2,3, 4
2	**Map Reduce**: The Map Task, The Reduce Task, Grouping by Key, Partitioner and Combiners, Detail of Map Reduce Execution. **Algorithm Using Map Reduce:** Matrix and Vector Multiplication by Map Reduce Computing Selection and Projection by Map Reduce Computing Grouping and Aggregation by Map Reduce **Self-Learning Topics: Concept of Sorting and Natural Joins**	6	CO2	1,2,3, 4
3	**NoSQL:** Introduction to NoSQL, No SQL Business drivers NoSQL Data architecture patterns: key value stores, Column family Stores, Graph Stores, Document Stores. NoSQL to manage big data: Analyzing big data with shared nothing architecture, choosing distribution master slave vs. peer to peer. HBASE overview, HBASE data model, Read Write architecture. **Self-Learning Topics: Cassandra Case Study**	5	CO3	9
4	**Hadoop Ecosystem: HIVE and PIG** HIVE: background, architecture, warehouse directory and meta-store, HIVE query language, loading data into table, HIVE built-in functions, joins in HIVE, Partitioning. **HiveQL:** querying data, sorting and aggregation. **PIG:** background, architecture, PIG Latin Basics, PIG execution modes, PIG processing – loading and transforming data, PIG built-in functions, filtering, grouping, sorting data, PIG Latin commands. **Self-Learning Topics: Cloudera IMPALA**	6	CO3	10,11
5	**Apache Kafka:** Kafka Fundamentals, Kafka architecture, Case Study: Streaming real time data (Read Twitter Feeds and Extract the Hashtags)	9	CO4	5,6,7

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Apache Spark: Spark Basics, working with RDDs in Spark, Spark Framework, aggregating Data with Pair RDDs, Writing and Deploying Spark Applications, Spark SQL and Data Frames. **Self-Learning Topics: pyspark, Apache Flink**			
6	**Data Visualization:** Explanation of data visualization, Challenges of big data visualization, Approaches to big data visualization, D3 and big data, Getting started with D3, Another twist on bar chart visualizations. **Self-Learning Topics: PowerBI**	8	CO5	8

Reference Books:

Reference No	Reference Name
1	Tom White, "HADOOP: The definitive Guide" O Reilly 2012, Third Edition, ISBN: 978-1-449-31152-0
2	Chuck Lam, "Hadoop in Action", Dreamtech Press 2016, First Edition ,ISBN:13 9788177228137
3	Shiva Achari," Hadoop Essential " PACKT Publications, ISBN 978-1-78439-668-8
4	RadhaShankarmani and M. Vijayalakshmi ,"Big Data Analytics "Wiley Textbook Series, Second Edition, ISBN 9788126565757
5	Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide" O'Reilly, 2017, ISBN: 978-1-491-93516-0.
6	Jeffrey Aven,"Apache Spark in 24 Hours" Sam's Publication, First Edition, ISBN: 0672338513
7	Bill Chambers and MateiZaharia,"Spark: The Definitive Guide: Big Data Processing Made Simple "O'Reilly Media; First edition, ISBN-10:1491912219
8	James D. Miller," Big Data Visualization" PACKT Publications.ISBN-10: 1785281941
9	Shashank Tiwari,"Professional NoSQL" Wrox, 2011, ISBN:978-0-470-94224-6.
10	Alan Gates, "Programming Pig" O'Reilly, 2011, ISBN: 978-1-449-30523-9.
11	Dean Wampler, Jason Rutherglen, Edward Capriolo, "Programming Hive" O'Reilly, 2012, ISBN: 978-1-449-32248-9.

Web References:

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

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Course Code	Course Name				
MCAE321	Computer Vision				
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 Understanding of Computer Graphics and Image Processing

Course Objectives: Course aim to

Sr. No.	Course Objective
1	To learn basic concepts and applications of computer vision.
2	To learn image processing techniques
3	To use and implement feature detection mechanism
4	To understand advanced concepts leading to object and scene categorization from images.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Explain fundamental concepts, techniques, and applications of Computer Vision.	Understanding
CO2	Implement image processing techniques such as geometric transformations, filtering, and feature extraction.	Applying
CO3	Analyze and evaluate object recognition, motion estimation, and 3D reconstruction techniques.	Analyzing
CO4	Develop real-world Computer Vision applications using state-of-the-art frameworks and machine learning models.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Computer Vision** • Definition and scope of Computer Vision • Distinction between easy and hard problems in the field • Components and architecture of a Computer Vision system • Applications across various industries • Image acquisition sources and devices • Understanding image structure and pixel representation • Overview of frameworks and libraries used in Computer Vision • Concepts of connectedness, object labeling and counting, size-based filtering, distance functions, skeletonization, and thinning. Advanced techniques include deformable shape analysis, boundary tracking methods, active contours, shape modeling, and shape recognition. **Self-Learning Topic**: Exploration of Computer Vision applications in finance	07	CO1	1,3,4
2	**Image Processing Fundamentals** • Geometric primitives and transformations • Image plotting techniques, including points and lines • Analysis of image contours and histograms • Histogram equalization methods • Interactive image annotation • Gray-level transformations • Image filtering and transformation techniques • Introduction to image derivatives • Thresholding methods, edge detection techniques, corner and interest point detection, mathematical morphology, and texture analysis. **Self-Learning Topic:** Techniques for image denoising	08	CO2	1,2,3,
3	**Feature Detection and Image Mapping** • Line detection using Hough Transforms • Harris corner detection method • Edge detection techniques • Scale-Invariant Feature Transform (SIFT) • Matching geotagged images • Understanding homographies and image warping • Creating panoramas • Camera models and principles of augmented reality • Effects of lighting in image capture **Self-Learning Topic**: Techniques for drawing and overlaying on images	08	CO3	1,3,4,5,6

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
4	**3D Reconstruction and Motion Analysis** • Refinement techniques for 3D reconstruction • Visualization of 3D point clouds • Object recognition methodologies • Introduction to Bag-of-Words models in vision • Image Segmentation • Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection. • YOLO **Self-Learning Topic**: Approaches to object classification	7	CO3	5,6,7
5	**Object Detection and Recognition** • Face and pedestrian detection techniques • Face recognition algorithms • Eigenfaces method for facial recognition • Viola-Jones object detection framework • Haar-like features and their applications • Integral image concept • Training classifiers for detection tasks • Adaptive Boosting (AdaBoost) algorithm **Self-Learning Topic**: Methods for measuring and analyzing image features	5	CO4	5,6,7
6	**Deep Learning in Computer Vision** • Advantages of Convolutional Neural Networks (CNNs) • Architecture and layers of CNNs • Training methodologies for CNNs • Designing and building custom CNN models • Applications of CNNs in Computer Vision **Self-Learning Topic**: Case study on image classification, e.g., distinguishing between dogs and cats	5	CO4	8

Reference Books:

Reference No	Reference Name
1	Szeliski, Richard. Computer vision: algorithms and applications. Springer Science & Business Media, 2010. ISBN:1848829345
2	Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods
3	Solem, Jan Erik. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012. ISBN: 144934193
4	Demaagd, Kurt. Practical Computer Vision with SimpleCV: Making Computers See in Python. 2012. ISBN: 9781449337865
5	Jähne, Bernd, Horst Haussecker, and Peter Geissler, eds. Handbook of computer vision and applications. Vol. 2. San Diego: Academic press, 1999. ISBN: 0123797713

6	Jähne, Bernd, and Horst Haußecker. "Computer vision and applications." A Guide for Students and Practitioners (2000). ISBN:7302269157
7	Baggio, Daniel Lélis. Mastering OpenCV with practical computer vision projects. Packt Publishing Ltd, 2012. ISBN: 1849517827
8	Khan, Salman, et al. "A guide to convolutional neural networks for computer vision." Synthesis Lectures on Computer Vision 8.1 (2018). ISBN: 1681730219

Web References:

Reference No	Reference Name
1	http://groups.csail.mit.edu/vision/
2	https://medium.com/readers-writers-digest/beginners-guide-to-computer-vision-23606224b720
3	https://vision.in.tum.de/research
4	Deeplearning.ai

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				
MCAE322	Deep 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:
Basic knowledge of mathematical and machine learning concepts.

Course Objectives: Course aim to

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

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

Sr.No.	Course Outcome	Bloom Level
CO1	Demonstrate concepts, architectures and algorithms of Neural Networks to solve real world problems	Understanding
CO2	Identify deep feed-forward networks and different regularization techniques used in Deep Learning. Applying	Applying
CO3	Identify challenges in Neural Network optimization and different optimization algorithms used in Deep learning models	Applying
CO4	Analyze deep learning algorithms which are more appropriate for various types of learning tasks in various domains	Analyzing

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**ANN Algorithms :** Supervised Learning Network- McCulloch–Pitts Unit and Thresholding logic, Linear Separability, Multi-layer Perceptron Networks, Back-Propagation Network, factors affecting Backpropagation Training, Unsupervised Learning Networks- MaxNet. **Self learning Topic:** -Mexican Hat Net.	6	CO1	1,2
2	**Deep Feed-forward Networks**: Introduction to Deep Learning, Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Other Architectural Considerations. **Self learning Topic: -** Applications of Deep neural networks.	6	CO2	3and 4
3	**Regularization**: Regularization for Deep Learning - Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout. **Self learning Topic:**-Regularized Linear Regression.	7	CO2	3 and 4
4	**Optimization for Training Deep Models:** Need for Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, and Algorithms with Adaptive Learning Rates- AdaGrad, RMSProp, and Approximate Second-Order Methods-Newton's Method. **Self learning Topic:**-Conjugate Gradients Method.	6	CO3	3 and 4
5	**Convolutional Networks**: Motivation, Pooling, Convolutional layers, Additional layers, Residual Nets **Self learning Topic:**-Application of CNN	7	CO4	3 and 4
6	**Recurrent and Recursive Nets:** Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, LSTM Architecture, Deep Recurrent Networks, Recursive Neural Networks. **Self learning Topic:**-Application of RNN	8	CO4	3 and 4

Reference Books:

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

6	Simon Haykin, Neural Networks and Learning Machines, 3rd Edition Prentice Hall of India, ISBN-10: 0-13-147139-2.
7	Anandita Das., Artificial Intelligence and Soft Computing for Beginners, Shroff Publication. ISBN 9789351106159.
8	Raul Rojas, Neural Networks: A Systematic Introduction, 1996 ISBN 978-3-540-60505
9	Deep Learning Tutorial Release 0.1, LISA lab, University of Montreal
10	Deep Learning 1 st Edition Ian Goodfellow, YoshuaBengio, Aaron Courvile An MIT Press book2016

Web References:

Reference No	Reference Name
1	https://olympus.greatlearning.in/courses/10905/pages/courseoutline?module_item_id = 445065 2
2	https://www.analyticsvidhya.com/blog/2020/02/learn-image-classification-cnn-convolutional-neural-networks-3-datasets/
3	https://www.analyticsvidhya.com/blog/2021/07/in-depth-explanation-of-recurrent-neural-network
4	https://www.tutorialspoint.com/python_deep_learning/index.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					
MCAE323	Distributed System and Cloud Computing					
Teaching Scheme: Contact Hours (Per Week)			Credits Assigned			
Theory	Tutorial	Total	Theory	Tutorial	Total	
3	-----	3	3	-----	3	
Examination Scheme (Marks)						
Internal Assessment (IA)						
Continuous Assessment CA)	Test	Total (IA) (CA + Test)	End Sem. Examination		Term Work	Total (Marks)
25	25	50	50		----	100

Pre-requisite: Computer Networks, Operating Systems.

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the concepts of Distributed Operating System, design issues, IPC, RPC and RMI.
2	Understand the concepts of clock synchronization.
3	Understand the Distributed Shared Memory, issues in designing and implementing DSM systems.
4	Understand various algorithms in Distributed System Management, File management and process management.
5	Analyse the principles and paradigm of Cloud Computing.
6	Understand the various design issues and challenges in cloud computing.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Illustrate principles and communication protocols of Distributed Systems, Design issues, Inter Process Communication, Remote Process Communication and Remote Method Invocation	Understanding
CO2	Analyse clock synchronization and various algorithms.	Analysing
CO3	Analyze Distributed shared Memory, issues in designing and implementing DSM systems.	Analysing
CO4	Analyse various algorithms in Distributed System Management, File management and process management.	Analysing
CO5	Analyse Cloud computing and cloud models	Analysing
CO6	Analyse design issues and challenges in cloud computing	Analysing

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Introduction to Distributed Computing Concepts:** Basic concepts of distributed systems, distributed computing models, issues in designing distributed systems **Inter Process Communication** Fundamental concepts related to inter process communication including message passing mechanism, Concepts of group communication **Remote Communication** Remote Procedural Call (RPC), Remote Method Invocation (RMI) **Self-Learning Topics:** Case study on Java RMI	9	1	1,2,3
2	**Module: Clock synchronization:** Introduction of clock synchronization, Global state, Mutual Exclusion Algorithms, Election algorithms. **Self-Learning Topics:** Synchronization in Wireless Networks	4	2	1,2,3
3	**Module: Module: Distributed Shared Memory:** Fundamental concepts of DSM, types of DSM, various hardware DSM systems, Consistency models, issues in designing and implementing DSM systems. **Self-Learning Topics:** MemNet Architecture	5	3	1,2,3
4	**Module: Module: Distributed System Management:** **Resource Management** Scheduling Algorithms, Task Assignment, Load balancing approach, Load sharing approach **Process Management** Process Migration Mechanism, Thread models **Distributed File System** Concepts of a Distributed File System (DFS), file models **Self-Learning Topics:** Case Study of anyone distributed system	7	4	1,2,3
5	**Module: Introduction to Cloud Computing:** Cloud Computing Introduction and evolution, benefits of cloud computing. **Cloud Computing Architecture** Cloud Architecture model, Types of Clouds: Public Private & Hybrid Clouds, Cloud based services: Platform as a service (PaaS), Software as a service (SaaS), Infrastructure as a service (IaaS) **Self-Learning Topics:** Cluster computing, Grid computing, Fog computing**,** Edge Computing, micro services	6	5	4,5,6 ,7
6	**Module: Classification of Cloud Implementations:** Amazon Web Services, Microsoft Azure & Google Cloud—Compute Services, Storage Services, Network Services, Database services, Additional Services. Google AppEngine (GAE), Aneka, Comparative study of various Cloud Computing Platforms. **Cloud Issues and Challenges** Cloud computing issues and challenges like Security, Elasticity, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Identity and Access Management **Self-Learning Topics:** Kubernetes, Docker	9	6	6,7,8

Reference Books:

Reference No	Reference Name
1	Pradeep K. Sinha, Distributed Operating Systems concepts and design, PHI, ISBN No. 978-81-203-1380-4
2	Herbert Schildt, The Complete Reference JAVA, Tata McGraw-Hill,7th Edition, ISBN No. 978-0-07-163177-8
3	Dr. Sunita Mahajan, Seema Shah, Distributed Computing, Oxford University Press, Second Edition, ISBN No. 978-01-980-9348-0
4	James Broberg and Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms Wiley, First edition, ISBN No. 978-04-708-8799-8
5	Dr. Kumar Saurabh, Cloud Computing insights into new-era infrastructure, Willey ISBN No.10:8126528834
6	Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing Principles and Paradigms, Willey Publication, ISBN No. 9780470887998
7	Gautam Shroff, Enterprise Cloud Computing Technology, Architecture, Applications, Cambridge University Press, ISBN No. 978-0-521-13735-5
8	Cloud Computing and Virtualization by Dac-Nhuong Le , Raghvendra Kumar, Gia Nhu Nguyen , Jyotir Moy Chatterjee

Web References:

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

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				
MCAE331	Software Testing Quality Assurance				
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: Networking concepts, Structured Query Language, encryption algorithms
Course Objectives: Course aims to

Sr. No.	Course Objective
1	Define key terminologies in software testing.
2	Understand and apply various testing strategies and techniques.
3	Understand the process of regression testing and designing test cases for regression in Object-Oriented (OO) systems.
4	Develop the skills and knowledge to achieve quality throughout the product lifecycle.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand the fundamental concepts and terms related to software testing.	Remembering
CO2	Analyze test scenarios and choose the most appropriate techniques thorough software testing strategies.	Analyzing
CO3	Design test cases for effective regression testing strategy for various software systems.	Applying
CO4	Assess the effectiveness of quality by maintaining quality standards throughout the product lifecycle.	Evaluating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to software testing and test process** Errors, Faults, Failures, How to test, Testing Activities over entire Life Cycle of Software Development, Verification versus Validation, V Model, Test data versus Test cases, Test	7	CO1	1

	cases and Test Suites, Testing Team, Test Plan, Incident Management – Test Log, Incident Reporting, Classification, Test Summary Report **Self-learning Topics:** Structured group Examinations - Reviews, Static Testing.			
2	**Testing Strategy** – Unit Testing, Approaches to Design of Unit Test Cases – Black-box approach, White-box approach Black box testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision table-based Testing, Cause Effect Graph, State Transition Test White box testing -Statement coverage, Branch coverage, , Condition/decision coverage, Control flow graph, Path coverage, Cyclomatic complexity **Self-learning Topics:** Grey-box approach, Data flow based testing	9	CO2	1
3	**Integration Testing and System testing** Integration testing - Big bang approach, top-down approach, bottom-up approach, System testing – Alpha Testing, Beta Testing, acceptance Testing, Performance Tests, Stress Testing, Load Testing, Volume testing, Configuration Testing, Compatibility testing, Recovery Testing, Maintenance Testing, Documentation Tests, Usability testing **Self-learning Topics:** mixed approach for integration testing, Environmental system test	8	CO2	1
4	**Regression Testing** Need and importance for Regression Testing, Automated Regression Testing, Software Regression process, Regression Testing Tasks, Testing OO systems, Test case design for Regression Testing **Self-learning Topics:** Test Automation-Design and Architecture for Automation.	4	CO3	2
5	**Introduction to Software Quality** Definition of Quality, Concept of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Achieving and Maintaining Quality, Quality Control Stakeholders and their Expectations, Quality Assurance, Quality Audit, Quality Survey **Self-learning Topics:** Cost of quality, six sigma	8	CO4	3,6
6	**Quality Management Standards**	4	CO4	4, 7

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	What is ISO 9000?, Necessity of Management Standard, Components of ISO 9000, Benefits of ISO 9000, Requirements of ISO 9000-9004, Documentation for ISO 9000 QMS, Implementation of ISO 9000 QMS **Self-learning Topics:** ISO 9126 QMS, e-business and ISO			

Reference Books:

Reference No	Reference Name
1	Spillner, Andreas, Tilo Linz, and Hans Schaefer. *Software Testing Foundations*. 4th ed., Rocky Nook, 2014.
2	Desikan, Srinivasan, and Gopalaswamy Ramesh. *Software Testing: Principles and Practice*. Pearson Education India, 2006
3	Defeo, Joseph A., and J. M. Juran. *Juran's Quality Handbook: The Complete Guide to Performance Excellence*. 6th ed. McGraw Hill Professional, 2010
4	Hoyle, David. *ISO 9000 Quality Systems Handbook: Using the Standards as a Framework for Business Improvement*. Routledge, 2017.
5	Stephan H.Kan, "Metric and Model in Software Quality Engineering", Addison Wesley, 1995.
6	Software Testing & Quality Assurance Theory & Practice" By Kshirasagar Naik & Priyadarshi Tripathi, Wiley Student Edition.
7	"Software Quality Assurance Principles & Practice", by Nina S. Godbole, Narosa.
8	Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition ,McGraw Hill, 2001

Web References:

Reference No	Reference Name
1	Software Testing - Course
2	Quality Engineering & Management - Course
3	Total Quality Management - I - Course

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				
MCAE332	Ethical Hacking				
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: Networking concepts, Structured Query Language, encryption algorithms
Course Objectives: Course aims to

Sr. No.	Course Objective
1	Teach students to think like an ethical hacker. Follow the code of professional ethics and the Indian cyber laws.
2	Learn phases of hacking such as foot printing, scanning, enumeration and sniffing.
3	Make oneself aware of the cyber-attacks that are taking place in the real world.
4	Learn about how web servers and web applications can be hacked. Understand session hijacking and SQL injection techniques and their counter measures.
5	Learn about wireless hacking, cloud computing, cryptography and PEN testing.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Remember ethical hacking concepts like types of hacking, advantages and disadvantages of hacking , types of hackers, code of ethics , IT act 2000 , Amendment IT act(2008) and phases of hacking.	Remembering
CO2	Understanding foot printing and reconnaissance, scanning networks, enumeration and sniffing phase.	Understanding
CO3	Identify and apply different types of cyber-attacks.	Applying
CO4	Identify and apply session hijacking and SQL injection techniques on web based applications and servers	Applying
CO5	Identify what is Pen testing and classify types of wireless architecture, encryption techniques, cryptographic techniques.	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Introduction to ethical Hacking:** What is ethical hacking? Types of hacking, advantages, disadvantages and purpose of hacking, Types of hackers, Code of ethics, Types of attacks, IT act 2000, Amendments to the Indian IT Act (2008), Phases of hacking. **Self-Learning Topics:** ethical hacking tools	4	CO1	Ref 1-Chapter 1, Ref 2-Chapter 6, Ref-3,5,6, W_1
2	**Module:Footprinting and Reconnaissance.** What is footprinting? Active and passive footprinting, purpose of footprinting, objectives of footprinting, footprinting threats, Types of footprinting, footprinting, countermeasures. **Self-Learning Topics:** footprinting tools	5	CO2	Ref 1-Chapter 2, Ref 2-Chapter 2
3	**Module: Scanning networks, Enumeration and sniffing:** **Scanning networks:** Network scanning and its types, objectives of network scanning, scanning live systems, scanning techniques-TCP Connect / Full Open Scan, Types of Stealth scans,port scanning countermeasures, IDS evasion techniques, Banner grabbing and its tools, vulnerability scanning, proxy servers, anonymizers, IP spoofing and its countermeasures. **Enumeration and Sniffing:** What is Enumeration? Enumeration techniques, Enumeration types, Enumeration countermeasures, what is sniffing? Wiretrapping and its types, packet sniffing, sniffing threats, how sniffers work?, sniffing methods-ARP spoofing and MAC flooding, active and passive sniffing, types of sniffing attacks, sniffing countermeasures, sniffing detection techniques. **Self-Learning Topics:** Scanning, enumeration and sniffing tools.	8	CO2	Ref 1-Chapter 3 and 4
4	**Module: Trojans and other Attacks:** Worms, viruses, Trojans, Types of worms, viruses and worms, Preventing malware attacks, types of attacks**:** (DoS /DDoS), Waterhole attack, brute force, phishing, ARP poisoning, Identity Theft, BOTs and BOTNETs, Steganography - text, image and audio and video, Social Engineering. **Self-Learning Topics: buffer overflow, case studies, malware tools and steganographic tools.**	8	CO3	Ref 1-Chapter 9,11 Ref 2-Chapter3,4,5, W_2, W_3
5	**Module: Hacking web servers, web applications and sql injection: Session hijacking:** What is session hijacking? , why session hijacking successful? Session hijacking techniques, session hijacking process, Types of session hijacking, **Hacking web servers and web applications:** Causes of webservers being compromised, web server attacks, stages of web server attacks, defending against web server attacks, web application components, its working, architecture,	8	CO5	Ref 1-Chapter 6, Ref 2-Chapter 4

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	web server attack vectors, web application threats and counter measures. **SQL Injection:** What is SQL injection, SQL injection threats, SQL injection attacks, SQL injection detection, Types of SQL injection, SQL injection methodology, SQL injection prevention and countermeasures. **Self-Learning Topics:** tools of session hijacking, web servers and applications and SQL injection.			
6	**Module: Wireless hacking, cloud computing, cryptography and PEN testing:** Types of wireless Architecture, wireless encryption techniques-WEP and WPA, breaking WEP/WPA and defending WPA encryption, Characteristics, types of cloud computing services, models and benefits, threats and attacks, cryptography and its objectives, cryptography types, cryptography attacks, what is Pen Testing, need for pen testing, types and techniques of pen testing, phases of pen testing. **Self-Learning Topics:** Tools of WEP/WPA, cloud computing, cryptography, Pen testing.	7	CO5	Ref 1-Chapter 7,8,10, 12 and Ref 4

Reference Books:

Reference No	Reference Name
1	Matt Walker, All-In-One-CEH-Certified-Ethical-Hacker-Exam-Guide.
2	SunitBelapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.
3	Manthan Desai Basics of ethical hacking for beginners.
4	Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson.
5	Alana Maurushat, Ethical Hacking.
6	TutorialsPoint Professionals, Ethical Hacking by TutorialsPoint.

Web References:

Reference No	Reference Name
1	Code of ethics link https://cert.eccouncil.org/code-of-ethics.html
2	https://www.edureka.co/blog/steganography-tutorial
3	https://www.guru99.com/how-to-hack-using-social-enginering.html

Internal 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.

End Semester Theory Examination:

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

Course Code	Course Name				
MCAE333	Blockchain				
Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
03	--	03	03	--	03
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

Prerequisite:

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

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the fundamental structure, mechanisms, and cryptographic primitives of Blockchain technology.
2	Understand the structure and underlying mechanisms of permissionless and permissioned blockchain.
3	Understanding smart contracts, solidity basics and tokens.
4	Understand the Hyperledger case studies in Blockchain.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Explain Blockchain technologies, their components, and the importance of cryptographic primitives in ensuring security and functionality.	Understanding
CO2	Explain the structure and underlying mechanisms of permissionless and permissioned blockchain.	Understanding
CO3	Develop the ethereum smart contract and token in ethereum	Applying
CO4	Analyze the use of Blockchain technology in various domains.	Analyzing

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Cryptographic Primitives:** Cryptographic hash functions collision free, hiding, puzzle friendly (properties), Hash Chain, Hash tree- Merkle Tree, Public Key cryptography, Digital signatures. Use of hash functions and digital signatures in blockchain **Self-learning Topics:** Basics of data structure (Linked lists), Hash Functions	06	CO1	1,6
2	**Introduction:** Basics of blockchain, History, Uses of Blockchain, Structure of a block, Transactions, Public Ledger, Distributed Consensus and its objective. Peer to peer systems, centralized and decentralized systems, Types of blockchain **Self-learning Topics:** Basics of cryptography (Symmetric and Asymmetric) RSA algorithm	04	CO1	3,5,6 ,12
3	**Bitcoin:** Basics (Structure of block, creation of coins), Double Spending, Bitcoin Script (FORTH), Mining Process,Block Propagation, Sybil Attack, Consensus in Bitcoin - Proof of Work, Proof of Elapsed Time, Proof of Stake, Proof of Burn **Self-learning Topics:** Other Cryptocurrencies	08	CO2	3,5,6
4	**Ethereum:** History, Architecture, Ethereum Virtual Machine, Accounts, Account Types , Ether, Gas, Transactions, Structure (Blocks, Transactions), Ethereum Mining process, Smart Contracts, Introduction to Solidity, Non Fungible Tokens **Self-learning Topics:** Bitcoin Vs Ethereum	08	CO2	7,8, Web ref 7,8
5	**Permissioned Blockchain:** Distributed Consensus, Faults in Distributed Consensus, Algorithms Paxos, RAFT, Byzantine Fault Tolerance, Practical Byzantine Fault Tolerance **Hyperledger Fabric**: Features of hyperledger, Architecture, ordering service, Transaction Flow, Membership and Identity Management, Gossip Protocol **Self-learning Topics:** Distributed algorithms, Ethereum Vs HyperLedger	10	CO3	10, Web ref 5,6
6	**Case Study**: Blockchain in Government (Digital Identity, Tax Payments, Land Registration, Audit and Compliances), Supply Chain Management, Financial Services, Health Services **Self-learning Topics:** other case studies	04	CO4	Web ref 3

Reference Books:

Reference No	Reference Name
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press
2	Don Tapscott,AlexTapscott, Blockchain Revolution, ISBN No. 9781101980132
3	Mark Gates, Blockchain ultimate Guide to understanding Blockchain, Bitcoin,Cryptocurrencies, Smart Contracts and Future of money, Wise Fox Publishing
4	VikramDhillon, David Metcalf, Max Hooper, Blockchain Enabled Applications, Apress, ISBN No.13:978-1-4842-3081-7
5	Sharad Mangrulkar, R., Vijay Chavan, P., Blockchain Essentials. Apress, Berkeley, CA,ISBN No.978-1-4842-9974-6
6	Andreas M. Antonopoulous, Masterin Bitcoin Programming the Open Blockchain, 2nd Edition, O'Reily Publication, ISBN: 978-95-5213-574-5
7	Mayukh Mukhopadhyay, Ethereum Smart Contract Development, Packt publishing, First Edition, ISBN No.978-1-78847-304-0
8	Chris Dannen, Introducing Ethereum and Solidity, Apress, ISBN No.978-1-4842-2535-6
9	Martin Quest, Cryptocurrency Master Bundle
10	Nitin Gaur, Luc Desrosiers, Petr Novotny, Venkatraman Ramkrishna, Anthony O'Dowd, Salman A. Baset, Hands-On Blockchain with Hyperledger, Packt
11	Andreas Antonopoulos & Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reily Publications,
12	Imran Bashir, Mastering Blockchain,4th Edition, Packt Publishing, ISBN-10 : 1803241063, ISBN-13: 978-1803241067

Web References:

Reference No	Reference Name
1	https://www.blockchain.com/explorer
2	https://en.wikipedia.org/wiki/Digital_signature
3	https://nptel.ac.in/courses/106/105/106105184/?authuser=0
4	https://github.com/ethereum/wiki/wiki/White-Paper
5	https://hyperledger-fabric.readthedocs.io/en/latest/key_concepts.html
6	https://hyperledger-fabric.readthedocs.io/en/release-1.3/arch-deep-dive.html
7	https://www.investopedia.com/non-fungible-tokens-nft-5115211
8	https://www.forbes.com/advisor/investing/cryptocurrency/nft-non-fungible-token/

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				
MCAE341	Design Thinking & Innovation Skills				
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: Software Project Management

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the Design Thinking and its role in fostering creativity, innovation, and problem-solving.
2	Identify user needs and generate innovative solutions.
3	Develop prototypes and test ideas iteratively.
4	Apply design thinking tools to solve real-world problems.
5	Integrate innovation skills in technology projects and product development.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Define the principles of Innovation, Creativity, Design Thinking and its applications.	Remembering
CO2	Apply empathy-driven research methods to identify and articulate user needs.	Applying
CO3	Analyze user insights and generate innovative solutions using ideation techniques.	Analyzing
CO4	Design and test prototypes through iterative processes, incorporating user feedback to improve solution effectiveness.	Creating
CO5	Integrate design thinking principles into technology projects to develop innovative, sustainable, and user-centric solutions.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Design Thinking:** - Meaning , Definition and Importance of Design Thinking -Origins of Design Thinking	05	CO1	1, 2, 3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	-Features of Design Thinking -Principles of Design Thinking -Stages of Design Thinking - Benefits of Design Thinking **Self-Learning Topic:** Main goal of Design Thinking			
2	**Creativity & Innovation**: Meaning & Definition, of creativity & innovation, Theories of Innovation and Levels , Types of Innovation, Fundamentals of innovation and its role in technology. **Building an innovative mindset:** Creativity and adaptability. Design thinking in software development **Tools for innovation:** Business Model Canvas, Value Proposition Canvas. Creative Industries & Potential for Growth. **Self-Learning Topic:** How does Design Thinking help businesses innovate?	06	CO1	4
3	**Design Thinking Process:** **Emphatize:** Understanding users and their needs. **Observation:** Conducting interviews, surveys, and observations. **Define:** Framing problems through user insights. **Creating maps:** Affinity diagram, mind map, journey map, combining ideas into complex innovation concepts. **Ideate:** Brainstorming and divergent thinking techniques. **Tools:** SCAMPER, mind mapping, and six thinking hats. **Self-Learning Topic:** Why is empathy important in the Design Thinking Process?	09	CO2	3, 5
4	**Wireframe and Prototyping** **Wireframe:** Definition, Types, Usage and guidelines **Creating Story Board:** Definition, Usage, guidelines, scenario planning. **Prototyping:** Definition, Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Types: Low Fidelity and High Fidelity, Usage, Guidelines. Lean Start-up Method for Prototype Development **Tools for Prototyping:** Paper Prototyping, Figma, Adobe XD, or similar software **Self-Learning Topic:** Observe a real-life problem in your surroundings and define it using the Design Thinking approach, Brainstorm possible solutions and create a simple prototype using sketches or models.	10	CO3, CO4	1, 6
5	**Prototype Testing:** Heuristic testing, it's Principles and reporting, Kano Model for testing. **Different types of Testing:** First Click method, 5 second test case, Navigation Test, Preference Test, Design Test, Prototype test, Questionaire test (Quantitative evaluation and Qualitative Evaluation).	06	CO4	3, 7

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Self-Learning Topic: Why is prototype testing crucial in product development? How does user feedback influence the final product design?			
6	**Implementation in Real World Application** Design thinking for startups and entrepreneurship. Scaling innovation: From prototypes to final products. Ethics and sustainability in design thinking. Design Thinking in Organizations Case studies of successful design thinking applications. **Self-Learning Topic:** Identify a real-world product or service and analyze its implementation process. Analyze E-commerce Platforms (Amazon, Flipkart etc.)	04	CO5	4, 8

Reference Books:

Reference No	Reference Name
1	Johny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
2	Roger Martin, "The Design of Business:Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3	The UX Book: Process and Guidelines for Ensuring a Quality User Experience , by Rex Hartson, Pardha S. Pyla , MK publication, 2012.
4	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by TimBrown, HarperCollins e-books; 1st edition (16 September 2009).
5	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand-Improve–Apply". Springer, 2011.
6	Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and TimOgilvie. ,Columbia Business School publishing, 2011.
7	Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests, 2nd Edition Jeffrey Rubin, Dana Chisnell, Jared Spool, Wiley Publication.
8	Design thinking success stories from IDEO, Google, and IBM.
9	Six Thinking Hats: An Essential Approach to Business Management-Edward De Bono
10	Christian Mueller-Roterberg, Handbook of Design Thinking – Tips & Tools for howto designthinking, Nov.2018, paperback.
11	Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and TimOgilvie. ,Columbia Business School publishing, 2011.

Web References:

Reference No	Reference Name
1	https://venturewell.org/class-exercises
2	https://www.goodreads.com/shelf/show/design-thinking
3	https://www.nngroup.com/articles/ten-usability-heuristics/
4	https://www.lyssna.com/

Tutorials:

Sr. No	Topic	Hrs.
1	Case study analysis on real-world applications of design thinking (e.g., Apple, Google, IDEO). Create a Summary of key insights from the case study.	**1**
2	Brainstorming session using SCAMPER technique: A list of creative solutions to a given problem like: How can we redesign an ATM to make it more user-friendly for the elderly?	**1**
3	How can we create a profitable and sustainable **smart water-saving device** for households? Develop a Business Model Canvas for the product.	**1**
4	How can we improve online learning platforms for students with disabilities? Conduct a role-play interview to understand challenges faced by such students.	**1**
5	How can we make food delivery services more efficient during peak hours? Organize user feedback using an Affinity Diagram and create a Journey Map. A visual representation of a customer's experience and problem areas.	**1**
6	Conduct a brainstorming session using Six Thinking Hats. How can we redesign an ATM to make it more user-friendly for the elderly?	**1**
7	How can we design a **mobile app for mental health support** targeted at teenagers? Create a paper prototype of the app's core functionalities.	**1**
8	How accessible and user-friendly is the **Indian Railway ticket booking website (IRCTC)?** Design an interactive prototype in Figma or Adobe XD.	**1**
9	Evaluate the IRCTC website made above using Nielsen's usability heuristics.	**1**
10	How did **Zomato use design thinking** to improve its user engagement? Research Zomato's key innovations and discuss in groups.	**1**
11	What challenges did **Tesla** face in scaling electric cars, and how did they overcome them? Analyze Tesla's journey from prototype to mass adoption.	**1**
12	What challenges did **Tesla** face in scaling electric cars, and how did they overcome them? Analyze Tesla's journey from prototype to mass adoption.	**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				
MCAE342	Digital Forensics				
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, Computer Network , Cyber security

Course Objectives: Course aim to

Sr. No.	Course Objective
1	Understand the fundamental concepts, types, and impact of cybercrime, Learn the principles and the role of digital evidence in of digital forensics investigations.
2	Learn methodologies for identifying, containing, and mitigating cyber incidents and Understand the legal, ethical, and procedural aspects of digital forensic investigations
3	Learn forensic data acquisition techniques and duplication methods
4	Investigate and interpret forensic artifacts in Windows operating systems. Explore volatile and non-volatile memory sources in forensic investigations
5	Understand techniques for investigating network-based attacks and intrusions Learn Mobile Forensic Techniques
6	To explore the techniques used in Email Forensic and Internet Artifacts analysis.

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

Sr.No.	Course Outcome	Bloom Level
CO1	Define cybercrime and its categories, Identify the key concepts of digital forensics, List various types of digital evidence	Remembering
CO2	Describe the phases of an incident response plan and Explain legal frameworks and compliance standards	Understanding
CO3	Identify different forensic data acquisition methods	Remembering
CO4	Correlate Windows artifacts with user activity	Analyzing
CO5	Explain network protocols and forensic methodologies.	Understanding
CO6	Explain email header analysis and explain different types of internet artifacts (cookies, cache, history).	Understanding

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Cybercrime:** Cyber Crime Attack mode, How are Computers used in Cyber Crimes? Types of Cyber Crime, Cybercrime Statistics in India Prevention of Cybercrime **Introduction to Digital Forensics:** Introduction to Digital Forensics Objective and need of Digital Forensic Types of Digital Forensics Digital Forensic Investigations Process Locard's Exchange Principle, Daubert's Rule **Digital Evidences:** Type , Role of Digital evidence and Rules , sources of Digital Evidences, **Self-Learning topics:** Standards, Guidelines and Best Practices Handling the Digital Crime Scene.	**8**	**CO1**	1,3,7
2	**Incidence Response Process :** Introduction, People Involved in Incident Response Process, Incident Response Process, Incident Response Methodology, Activities in Initial Response, Phases after Detection of an Incident Pre-investigation considerations: The forensic workstation, The response kit, Forensic software, Forensic investigator training, Understanding case information and legal issues, Understanding data acquisition, Chain of custody, Understanding the analysis process, Dates and time zones Hash analysis , File signature analysis, Reporting your findings, Details to include in your report, Document facts and circumstances, The report conclusion. **Self-Learning topics:** CERT	**6**	**CO2**	1,2,5
3	**Data Acquiring and duplication:** Exploring evidence**,** Understanding the forensic examination environment**,** Tool validation**,** Creating sterile media**,** Understanding write blocking**,** Hardware write blocker**,** Software write blocker**,** Rules of Forensic duplication, Defining forensic imaging: DD image, Encase evidence file, SSD device. Imaging tools: FTK Imager, PALADIN **Self-Learning topics:** ENCASE AND FTK Imager	**5**	**CO3**	1,2
4	**Windows Artifact Analysis:** Understanding user profiles, Understanding Windows Registry, Determining account usage, Last login/last password change, **Determining file knowledge**: Exploring the thumb cache, Exploring Microsoft browsers, Determining most recently used/recently used, Looking into the Recycle Bin, Understanding shortcut (LNK) files, Deciphering Jump Lists, Opening shellbags, Understanding prefetch	**8**	**CO4**	2

	Identifying physical locations: Determining time zones, Exploring network history**,** Understanding the WLAN event log**,** Exploring program execution, Determining User Assist**,** Exploring the Shimcache **RAM Memory Forensic Analysis:** Identifying sources of memory, Capturing RAM, Preparing the capturing device, Exploring RAM capture tools, Exploring RAM analyzing tools, Using Bulk Extractor. **Self-Learning topics:** DumpIt, FTK Imager			
5	**Introduction to Network Forensic:** Understanding Password Cracking, Understanding Technical Exploits**,** Analyzing Network Traffic**,** Collecting Network-Based Evidence**,** Evidence Handling**,** Investigating Routers**,** Handling Router Table Manipulation Incidents**,** Using Routers as Response Tools **Mobile Forensics :** Definition, Information available in Mobile Phones, identification, isolation of mobile devices, search and seizure of mobile devices, acquisition methods (physical, logical, file system, JTAG, Chip off), Analysis of mobile images, understanding a mobile forensic report **Self-Learning topics:** Intrusion Detection System its types and Attacks Security features of Mobile Operating System	**8**	**CO5**	1,4 ,10
6	**Email Forensics** – Investigation Techniques, Understanding web-based email, Decoding email, Understanding the email message format, Email attachments, Understanding client-based email analysis, Exploring Microsoft Outlook/Outlook Express, Exploring Microsoft Windows Live Mail, Mozilla Thunderbird Understanding Web Mail analysis, E-mail Investigations Challenge **Internet Artifacts:** Understanding browsers, Exploring Internet Explorer/Microsoft Edge (Old Version),Exploring Firefox, Social media,P2P file sharing, Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report **Self-Learning topics:** Understanding SMTP – Simple Mail Transfer Protocol, Understanding the Post Office Protocol, IMAP – Internet Message Access Protocol	**5**	**CO6**	2

Reference No	Reference Name
1	Digital Forensic by Dr. Nilkashi Jain & Dr. Dhananjay Kalbande
2	Learn Computer Forensic: A beginner's guide to searching, analyzing, and securing digital evidence, William Oettinger Packt Publisher
3	Digital Forensics Basics A Practical Forensic Basic used by Nihad A. Hassan
4	Practical Mobile Forensics, Satish Bommisetty, Rohit Tamma, Heather Mahalik, Packt Publishing Ltd., 2014,ISBN 978-1-78328-831-1
5	Digital Forensics and Incident Response, Gerard Johansen, Packt Publishing
6	Practical Cyber Forensics An Incident-Based Approach to Forensic Investigations Niranjan Reddy, A Press publication
7	Practical Digital Forensics. Forensic Lab Setup, Evidence Analysis, and Structured Investigation Across Windows, Mobile, Browser, HDD and Memory ,A. Bhardwaj, K. Kaushik BPB Publication
8	Practical Windows forensic Packt publisher
9	Practical_Digital_Forensics_Richard_Boddington
10	CHFI Computer Hacking Forensic Investigator The Ultimate Study Guide to Ace the Exam

Web References:

Reference No	Reference Name
1	https://www.rohasnagpal.com/docs/ASCL_Cyber_Crime_Investigation_Manual.pdf
2	https://doi.org/10.6028/NIST.SP.800-86
3	https://onlinecourses.swayam2.ac.in/cec20_lb06/preview

Tutorials:

Sr. No	Topic	Hrs.
1	AI Powered Cyber Crime	1
2	Chain of Custody	1
3	FTK imager and ENCase Imager	1
4	Hashing Tool (md5sum, sha256sum)	1
5	Case Study: Autopsy Tool	1
6	Case Study: To recover deleted files form windows system using Recuva Tool	1
7	Study of SluethKit tool	1
8	Investigation of information of captured packets by using 'Wireshark' tool.	1
9	Extraction of data from an Android device by using the ADB	1
10	Web Browser Forensic using DB Browser for SQLite	1
11	Study of Email Investigation tool	1
12	Guidelines for Writing a Report	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				
MCAE343	Entrepreneurship Management				
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	Understand fundamental entrepreneurship concepts of entrepreneurial development.
2	Develop entrepreneurial skills and mindset of students to overcome entrepreneurial challenges.
3	Guide students in creating comprehensive business plans covering all critical aspects.
4	Students will get an overview of institutions and policies supporting entrepreneurship.
5	Encourage the development of intrapreneurial activities and a positive entrepreneurial environment within organizations.
6	Emphasize the importance of social responsibility and ethical practices in entrepreneurship to students.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Define key concepts related to entrepreneurship, including the roles and characteristics of entrepreneurs, and the phases of entrepreneurship development.	Remembering
CO2	Explain the entrepreneurial mindset and the factors affecting entrepreneurial growth, including the barriers and challenges faced by entrepreneurs.	Understanding
CO3	Develop a comprehensive business plan, incorporating marketing, production, organization, and financial strategies for a new venture.	Applying
CO4	Examine the role of small-scale industries and institutions supporting entrepreneurship, and analyze the impact of these institutions on entrepreneurial growth.	Analyzing
CO5	Assess the significance of rural and social entrepreneurship and the ethical considerations in corporate entrepreneurship, including the social responsibilities of entrepreneurs.	Evaluating
CO6	Design strategies to foster an entrepreneurial culture and promote intrapreneurship within organizations.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Entrepreneurship:** • Introduction and concept of entrepreneur • Entrepreneurship and enterprise • Definition of entrepreneurship • Objectives of entrepreneurship development • Phases of entrepreneurship development • Role of entrepreneurship • The entrepreneurial mindset • Characteristics of entrepreneurship • Introduction to entrepreneurship skills	5	1,2	1,2,4,7,8,9,10,11,12
2	**Entrepreneurship Development & Environment:** • Entrepreneur personality and mindset • Entrepreneurial functions and career • Myths, problems, and challenges of entrepreneurship • Limitations of entrepreneurship • Concept, evolution, and stages of entrepreneurial development • Entrepreneurial environment and factors affecting growth • Barriers to entrepreneurship • Developing an entrepreneurial culture • Role of entrepreneurs in the Indian economy • Case studies of successful entrepreneurs: Dhirubhai Ambani, Aditya Birla, Elon Musk, Bill Gates • Women entrepreneurs in India	7	2	1,2,4,7,8,9,10,11,12
3	**Meaning of Business Plan** • Business plan process • Advantages of business planning • Marketing plan • Production plan • Organization plan • Financial plan • Final project report • Preparing a model project report for starting a new venture	6	3	2,3,4,8,10,11,12,13
4	**Women and Rural Entrepreneurship** **Women Entrepreneurship:** • Meaning, need, and scope • Growth of women entrepreneurship • Problems faced by women entrepreneurs • Special schemes for women entrepreneurs	6	2,5	7,8,9,11,13

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	• Role of Self-Help Groups (SHGs) in women entrepreneurship development **Rural Entrepreneurship:** • Meaning, need, and scope • Problems faced by rural entrepreneurs • Entrepreneurship development in rural areas • Special schemes for rural entrepreneurs			
5	**Institutional Support to Entrepreneurs:** **Importance, incentives, and facilities** • Key institutions: EDI, NSIC, SIDO, NIESBUD • Overview of financial institutions: SIDBI, NABARD, IDBI, SIDCO • National Policy on Skill Development and Entrepreneurship **Entrepreneurship Development Programs (EDPs):** • Need and role of EDPs • Incentives, subsidies, and grants • Promotion of export-oriented units • Role of District Industries Centre (DIC) in entrepreneurship development **Other Funding Sources:** • Non-traditional funding options: angel investors, venture capital, crowdfunding, grants, peer-to-peer lending **Private Institutions:** • Support from Tata, Infosys, Wipro, Reliance, Mahindra, Aditya Birla, and Godrej through mentorship, funding, and resources.	10	4	4,6,7,8,10,11,12,13
6	**Evolving Concepts in Entrepreneurship:** **Social Entrepreneurship:** • Meaning • Social responsibility of an entrepreneur **Barriers to Entrepreneurship:** • Environmental, economic, non-economic, personal, and entrepreneurial barriers **Intrapreneurship:** • Meaning and characteristics • Intrapreneurial activities • Types of corporate entrepreneurs	6	5,6	2,6,8,10,11,13

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	• Corporate vs. intrapreneurial culture • Climate and fostering intrapreneurial culture • Promoting intrapreneurship • Formal venture teams • Establishing intrapreneurial ventures **Ethics and Entrepreneurship:** • Defining ethics • Approaches to managerial ethics • Ethical practices and code of conduct • Ethical considerations in corporate entrepreneurship			

Reference Books:

Reference No.	Reference Name
1	Strategic Entrepreneurship "A Decision-making approach to new venture creation and management" Philip A. Wickham, Pearson Education Society.
2	Entrepreneurship by Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sixth Edition International Edition.
3	Creating a Business Plan (Pocket Mentor) by Harvard Business Press.
4	**"*Entrepreneurship: Successfully Learning New Ventures*"**, by Barringer, Ireland, Pearson.
5	***"Entrepreneurship"***, Hisrich, Peters, Shepherd, Mc Graw Hill, Sixth Edition.
6	Enterprise Planning and Development: Small Business Start-up, Survival and Development.
7	Entrepreneurship and Small Business Management by Dr. C. L. Bansal, Haranand Publications Pvt. Ltd.
8	Entrepreneurship by Lall, Madhurima. Sahai, Shikha. Excel Books, New Delhi, 2008, 2nd Edition.
9	Small Business Management - Entrepreneurship and Beyond by Timoth S. Hatten, Publisher - Houghton Mifflin College, 2nd Edition.
10	The Dynamics of Entrepreneurial Development and Management, by Vasant Desai, 2015, Himalaya Publishing House.
11	Entrepreneurship Development- Small Business Enterprise, by Poornima Charantimath, Pearson.
12	Entrepreneurship Development, Dr. T.N. Chhabra, Sun India Publications, New Delhi.
13	Small and Medium Enterprises in Global Perspective, Dr. C.N. Prasad, New century Publications, New Delhi.

Web References:

Reference No	Reference Name
1	http://niesbud.nic.in/
2	http://msme.gov.in/
3	http://ssi.nic.in/
4	www.womenentrepreneursindia.com
5	https://mygov.in
6	https://www.makeinindia.com

7	https://www.startupindia.gov.in
8	www.msmetraining.gov.in
9	www.dcmesme.gov.in
10	www.nsic.co.in

EM: Tutorials

Sr. No.	Detail Contents	Hrs.
1	Entrepreneurial Tasks.	01
2	Entrepreneurship Development in rural areas (Agriculture/Allied Business)	01
3	Women Entrepreneurship Development. (Case Study)	01
4	Team Building Activities (Board of Members/ Employees)	01
5	Entrepreneurship in the Service Sector.	01
6	Preparing Business Plan	01
7	Scenarios for fundraising in Entrepreneurship	01
8	E-Business Brainstorming Activities	01
9	Case Studies of Successful SSIs (small-scale industries) in a Liberalized Economy.	01
10	Successful Intrapreneurship (Case Study)	01
11	Social Development through Entrepreneurship.	01
12	Private Institutions support start-up (case study).	01

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				
MCAL31	Big Data Analytics and Visualization Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
02	01	50	30	20	100

Pre-requisite:
Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate HDFS Commands in Hadoop	Understanding
CO2	Apply Map Reduce Programming Paradigm to solve the algorithmic problems	Applying
CO3	Build No SQL Database and Query it Using Mongo DB	Applying
CO4	Analyze the Data Using Hadoop Ecosystem Projects: Hive and Pig	Analyzing
CO5	Explain RDD and Data Frame Creation in Apache Spark	Evaluating
CO6	Create various Visualizations using Tableau.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	Set up and Configuration Hadoop Using Cloudera / in Linux environment Creating a HDFS System with minimum 1 Name Node and 1 Data Nodes HDFS Commands **Self-Learning Topics**: Creating a HDFS System with minimum 1 Name Node and multiple Data Nodes	2	1	1,2
2	Map Reduce Programming Examples Word Count. Union, Intersection Matrix Multiplication **Self-Learning Topics**: Natural Join Programming Example	4	2	1,3
3	Mongo DB: Installation and Creation of database and Collection CRUD Document: Insert, Query, Update and Delete Document. **Self-Learning Topics:** HBASE Commands	4	3	4

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
4	Hive: Introduction Creation of Database and Table, Hive Partition, Hive Built in Function and Operators, Hive View and, HiveQL – where, order by, group by, join **Self-Learning Topics**: Configure Hive Metastore to MySQL	4	4	5,6
5	Pig: Pig Latin Basic Pig Shell, Pig Data Types, Creating a Pig Data Model, Reading and Storing Data, Pig Operations **Self-Learning Topics:** Writing UDF (user-defined functions) in Apache Pig	4	4	5,6
6	Spark: RDD, Actions and Transformation on RDD , Ways to Create -file, data in memory, other RDD. Lazy Execution, Persisting RDD **Self-Learning Topics:** Machine Learning Algorithms using pySpark	4	5	5,7,8
7	Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Tableau **Self-Learning Topics:** Forecasting and trend analysis using Tableau	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.
    - 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	Tom White, "HADOOP: The definitive Guide" O Reilly 2012, Third Edition, ISBN: 978-1-449-31152-0
2.	Rohit Menon, "Cloudera Administration Handbook" Released July 2014 Publisher(s): Packt Publishing, ISBN: 9781783558964
3	Chuck Lam, "Hadoop in Action", Dreamtech Press 2016, First Edition ,ISBN:13 9788177228137
4	Kyle Banker, "MongoDB in Action" December 2011 ISBN 9781935182870
5	Shiva Achari," Hadoop Essential " PACKT Publications, ISBN 978-1-78439-668-8
6	RadhaShankarmani and M. Vijayalakshmi ,"Big Data Analytics "Wiley Textbook Series, Second Edition, ISBN 9788126565757
7	Jeffrey Aven,"Apache Spark in 24 Hours" Sam's Publication, First Edition, ISBN: **0672338513**
8	Bill Chambers and Matei**Z**aharia,"Spark: The Definitive Guide: Big Data Processing Made Simple "O'Reilly Media; First edition, ISBN-10: 1491912219;
9	James D. Miller," Big Data Visualization" PACKT Publications. ISBN-10: 1785281941

Web References:

Reference No	Reference Name
1	https://hadoop.apache.org/docs/stable3/hadoop-project-dist/hadoop-hdfs/HdfsUserGuide.html
2	https://shorturl.at/4ij9O
3	https://www.mongodb.com/try/download/community
4	https://www.mongodb.com/docs/manual/crud
5	https://hive.apache.org/
6	https://pig.apache.org/
7	https://spark.apache.org/documentation.html
8	https://help.tableau.com/current/pro/desktop/en-us/default.htm

Suggested list of experiments:

Practical No	Problem Statement
1	**HDFS:** List of Commands (ls, mkdir, touchz, copy from local/put, copy to local/get, move from local, viewing file content(cat, head, tail),cp, rmr, du, dus, stat)
2	**Map Reduce:** **1.** Write a program in Map Reduce for WordCount operation. **2.** Write a program in Map Reduce for Union operation. **3.** Write a program in Map Reduce for Intersection operation. **4.** Write a program in Map Reduce for Matrix Multiplication
3	**MongoDB :** 1. Installation 2. Sample Database Creation 3. Query the Sample Database using MongoDB querying commands 4. Create Collection 5. Insert Document 6. Query Document 7. Delete Document 8. Indexing
4	**Hive:** 1. Hive Data Types 2. Create Database & Table in Hive 3. Hive Partitioning 4. Hive Built-In Operators 5. Hive Built-In Functions 6. Hive Views **7.** HiveQL : Select Where, Select OrderBy, Select GroupBy, Select Joins
5	**Pig:** 1. Pig Latin Basic 2. Pig Data Types, 3. Download the data 4. Create your Script 5. Save and Execute the Script 6. Pig Operations : Diagnostic Operators, Grouping and Joining, Combining & Splitting, Filtering, Sorting
6	**Spark**: 1. Downloading Data Set and Processing it Spark 2. Word Count in Apache Spark.
7	**Visualization using Tableau:** Tableau: Tool Overview, Importing Data, Analyzing with Charts, Creating Dashboards, Working with maps, Telling Stories with tableau.

Course Code	Course Name				
MCALE321	Computer Vision Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
2	1	50	30	20	100

Pre-requisite: Fundamental Knowledge of Computer Graphics and Image Processing

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	To Learn basic Image Processing techniques used in Computer Vision
2	To Illustrate various components used in Computer Vision
3	To Implement Motion Tracking and Face Detection
4	To Understand applications of CNN in Computer Vision

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

Sr. No.	Course Outcome	Bloom Level
CO1	Understand Open CV Framework	Understanding
CO2	Develop applications using basic image processing techniques used in Computer Vision	Applying
CO3	Design Applications to Detect Motion and Face in an image	Creating
CO4	Create a Applications using CNN	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Overview of Computer Vision and its Applications** Fundamental of Image Processing, Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation, Applications of Computer Vision **Open CV and Python** Running Python Programs, Frameworks for CV, Understanding OpenCV, Programs using OpenCV	04	CO1 CO2	1,2,4
2	**Module: Basic Image Handling using python** Reading, Writing and Displaying Images, Plotting images, points and lines, Image contours and histograms, Histogram equalization, Interactive annotation, Gray level transforms, Image Transformations, Image Derivatives Self Learning Topics: Image Denoising	05	CO2	1,2,4

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
3	**Module: Image Transformations** Program based on: Line Detection-Hough Transforms, Harris corner detector, Edge Detection, SIFT - Scale-Invariant Feature Transform, Matching Geotagged Images, Homographies, Warping images, Creating Panoramas :Camera Models and Augmented reality, Light effects Self Learning Topics: Drawing on Images	**05**	CO2	2
4	**Module: Exploring Structure from Motion** Motion Detector Using OpenCV, Motion Detection using Video, Plotting the motion Direction Graph Self Learning Topics: Object Classification	**04**	CO3	3,4
5	**Module: Face Detection and Tracking** Face detection, Pedestrian detection, Face recognition, Eigenfaces, Viola-Jones Algorithm, Haar-like Features, Integral Image, Training Classifiers Self Learning Topics: Measuring features	**04**	CO3	3,4
6	**Module: Convolutional Neural Networks for CV** Object Detection and Identification using CNN, Building a CNN, Project Self Learning Topics: Dogs and cats case study	**04**	CO4	3

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	Digital Image Processing by Rafael C. Gonzalez, PEARSON Education
2	Solem, Jan Erik. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012. ISBN: 144934193
3	Computer Vision: Algorithms and Applications, by Richard Szeliski
4	Demaagd, Kurt. Practical Computer Vision with SimpleCV: Making Computers See in Python. 2012. ISBN: 9781449337865
5	Jähne, Bernd, Horst Haussecker, and Peter Geissler, eds. Handbook of computer vision and applications. Vol. 2. San Diego: Academic press, 1999. ISBN: 0123797713
6	Baggio, Daniel Lélis. Mastering OpenCV with practical computer vision projects. Packt Publishing Ltd, 2012. ISBN: 1849517827
7	Introductory Techniques for 3D Computer Vision, Emanuele Trucco and Alessandro Verri, Prentice Hall.
8	Khan, Salman, et al. "A guide to convolutional neural networks for computer vision." Synthesis Lectures on Computer Vision 8.1 (2018).ISBN: 1681730219

Web References:

Reference No	Reference Name
1	http://groups.csail.mit.edu/vision/
2	https://medium.com/readers-writers-digest/beginners-guide-to-computer-vision-23606224b720
3	https://vision.in.tum.de/research
4	Deeplearning.ai
5	http://www.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html
6	http://groups.csail.mit.edu/vision/

Suggested list of experiments:

Practical No	Problem Statement
1	Implementing various basic image processing operations in python/open-CV: Reading image, writing image, conversion of images, and complement of an image.
2	Program for Changing Color Spaces
3	Program to resize Images
4	Program to Rotate Images
5	Programs using Histogram Equalization
6	Programs for Edge detection
7	Programs for Line Detection
8	Programs using Scale Invariant Feature Transform (SIFT)
9	Implementing Harris corner detection algorithm. Using OpenCV functions to extract SIFT, SURF, and ORB features
10	Programs for Motion Detection
11	Programs for Face Detection
12	Programs to differentiate objects

Course Code	Course Name				
MCALE322	Deep Learning Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
02	01	50	30	20	100

Pre-requisite: Basic understanding of machine learning concepts

Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Demonstrate Tensor flow/Keras deep-learning workstations.	Understanding
CO2	Choose appropriate data preprocessing techniques to build neural network models.	Applying
CO3	Analyze different regularization and optimization techniques used in deep learning.	Analyzing
CO4	Build neural network models using deep learning algorithms-CNN, RNN and LSTM to solve real world problems.	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Tensor flow/Keras** -Installation, Importing Libraries and Modules. **Self Learning Topic**:-Setting up a deep-learning workstation.	2	1	1,2
2	**Working with Dataset** -Loading the dataset, splitting dataset into training and testing data sets. **Self Learning Topic**:-Data representations for neural networks	2	2	4
3	**Data Preprocessing Techniques**- Numerical Data, Feature Scaling, Handling Missing Values, Categorical Data and String Data Types, Encoding, Data Splitting. **Self Learning Topic**: - Outliers detection.	2	2	4
4	**Artificial Neural Networks**- McCulloch-Pitts neuron, Back propagation network. **Self Learning Topic**:- MaxNet	6	2	5

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
5	**Regularization Techniques**- Dataset Augmentation, Early Stopping, Dropout. **Self Learning Topic**:- Optimization techniques	2	3	2,3
6	**Deep Neural Network Algorithm**: Convolutional Neural Network(CNN)- Introduction to convnets, adding a classifier, Training the convnet on given data set, the convolution operation, the max-pooling operation, Evaluating the model, analysing and visualizing results. **Self Learning Topic**: - Pre-trained Convnet.	6	4	1,2,3 ,4
7	**Deep Neural Network Algorithm**-Recurrent Neural Network (RNN) - Training the model with RNN layers, Evaluating the model, analyzing and visualizing results. Training model with LSTM. **Self Learning Topic**: - Pre-trained RNN.	6	4	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 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	François Chollet, Deep Learning with Python, 2018 by Manning Publications Co. ISBN 9781617294433.
2	Deep Learning Tutorial Release 0.1, LISA lab, University of Montreal
3	Sebastian Raschka, Vahid Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python,3rd Edititon, Packet Publishing.
4	Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots and Face, Object, and Speech Recognition With TensorFlow and Keras , Apress,2018.
5	Dr. S. N. Sivanandam and Dr. S. N. Deepa, ”Principles of Soft Computing“, 3rd Edition, John Wiley

Web References:

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

Suggested list of experiments:

Practical No	Problem Statement
1	Introduction to Tensor flow /Keras -Importing Libraries and Modules.
2	Loading the dataset, splitting dataset into training and testing data sets.
3	Implementation of Data preprocessing techniques.
4	Implementation of Artificial Neural Networks – McCulloch-Pitts neuron with ANDNOT function, Back propagation Network for XOR function with Binary Input and Output.
5	Implementation of Regularization Techniques- Dataset Augmentation, Early Stopping, Dropout.
6	Implementation and analysis of Deep Neural network algorithm: Convolutional neural network (CNN) – • Object identification and classification, • Image recognition.
7	Implementation and analysis of Deep Neural network algorithm: Recurrent neural network (RNN) - Character recognition and web traffic Image classification.
8	LSTM Network: Sentiment analysis using LSTM

Course Code	Course Name				
MCALE323	Distributed System and Cloud Computing Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
2	1	50	30	20	100

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

Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Develop Remote Procedure Call and Remote Method Invocation concepts.	Applying
CO2	Develop a Remote Object Communication Program.	Creating
CO3	Develop mutual exclusion concept using Token ring algorithm and develop any one of Election Algorithm	Creating
CO4	Implementation of Cloud Computing Services.	Applying
CO5	Implementation of Identity Management using Cloud Computing concept.	Applying
CO6	Implementation of Virtual Machine using Cloud Computing Concepts	Creating

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Remote Procedure Call:** A remote procedure call is an inter process communication technique that is used for client-server-based applications. A client has a request message that the RPC translates and sends to the server. This request may be a procedure or a function call to a remote server. When the server receives the request, it sends the required response back to the client. The client is blocked while the server is processing the call and only resumed execution after the server is finished. **Self-Learning Topics:** Other types of call semantics	4	1	1
2	**Module: Remote Method Invocation:** The Remote Method Invocation is an API that provides a mechanism to create distributed application in java. The client invokes methods via an interface. These methods are implemented on the server side. **Self-Learning Topics:** Concept of client and server applications, remote interface, RMI registry tool	4	1	1,2
3	**Module: Remote Object Communication:** Pass remote objects from the server to the client. The client will receive the stub object (through remote interfaces) and saves it in an object variable with the same type as the remote interface. Then the client can access the actual object on the server through the variable. **Self-Learning Topics: Concept of JDBC**	4	2	1,2,3
4	**Module: Election & Mutual Exclusion** Token ring algorithm solves the mutual exclusion existing in the process communication, Election Algorithm Choose a Coordinator among Processes Self-Learning Topics: Other algorithms of Mutual Exclusion	4	3	1,2,3
5	**Module: Implementation of Cloud Computing Services:** Cloud Computing provides different services such as SaaS, PaaS, IaaS, Storage as service and many more. Storage as a Service is a business model in which a large company rents space in their storage infrastructure to a smaller company or individual. **Self-Learning Topics:** Other types of Cloud Services	2	4	5
6	**Module: Implementation of Identity Management using Cloud Computing concept** The main goal of identity management is to ensure that only authenticated users are granted access to the specific applications, systems or IT environments for which they are authorized. **Self-Learning Topics**: Other tools to implement the technique	2	5	5,6
7	**Module 7: Implementation of Virtual Machine using Cloud Computing Concepts**	4	6	7, 8

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	The main goal of Virtualization is to create and develop applications by using Virtual machine on your System systems or IT environments. Creating a Virtual Machine using GUI (AWS Console/ Azure Portal/ GCP Console) **Self-Learning Topics:** Types of Virtualizations Desktop Virtualization, Network Virtualization, Storage Virtualization, Application Virtualization,			
8	**Module: Project** Make use of various tools and techniques to develop efficient, dynamic applications using cloud computing.	2	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 30 marks
    - Attendance 10 marks
    - Project 10 marks
- Practical will be evaluated by the subject teacher and documented according to a rubric

End Semester Practical Examination:

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

Reference Books:

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

Web References:

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

Suggested list of experiments:

Practical No	Problem Statement
1	To implement a Server calculator using RPC concept. (Make use of datagram)
2	To implement a Date Time Server using RPC concept. (Make use of datagram)
3	To implement a Server calculator using RPC concept. (Make use of Server Socket)
4	To implement a Date Time Server using RPC concept. (Make use of Server Socket)
5	To retrieve day, time and date function from server to client. This program should display server day, time and date. (Use Concept of JDBC and RMI for accessing multiple data access objects)
6	To implement Equation solver using Datagram. The client should provide an equation to the Server through an interface. The server will solve the expression given by the client. (a-b)2 = a2 –2ab + b2; If a = 5 and b = 2 then return value = 52 – 2.5.2 + 22 = 9.
7	Using MySQL create Library database. Create table Book (Book_id, Book_name, Book_author) and retrieve the Book information from Library database using Remote Object Communication concept.
8	Using MySQL create the Elecrtic_Bill database. Create table Bill (consumer_name, bill_due_date, bill_amount) and retrieve the Bill information from the Elecrtic_Bill database using Remote Object Communication concept.
9	Implementation of mutual exclusion using Token ring algorithm.
10	Implementation of Election Algorithm.
11	Implementation of Storage as a Service using Google Docs
12	Implementation of Identity Management.
13	Create a virtual machine (VM) on any cloud provider (AWS/Azure/GCP) of your choice with the specifications: Operating System, VM Type, Disk Size, Public IP, Network Rules Once created, verify that the VM is running and submit a screenshot of the instance details and a brief description of the steps you followed.
14	Install Virtual Box/VMware/ Equivalent open-source cloud Workstation with different flavours of Linux or Windows OS on top of Windows 8 and above.
15	Group projects (2 to 3 members) are to be given the opportunity to work on any Cloud Concept.

Course Code	Course Name				
MCALE331	Software Testing Quality Assurance Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
2	1	50	30	20	100

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

Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Apply manual software testing techniques to test a software application and create a test cases.	Creating
CO2	Implement Selenium tool to perform automation testing.	Applying
CO3	Implement TestNg frameworks to test the application	Applying
CO4	Demonstrate validation checks and regression testing on the application	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Testing Basics:** Study of Test cases and Test Suits based on different manual software testing techniques to test a software application **Self-Learning Topics:** Software Requirement Specification (SRS), Requirement analysis and Traceability matrix , Level of Testing, Case Study	2	CO1	1
2	**Introduction to Selenium:** Introduction to automation Testing, Selenium latest version, Installation, Selenium WebDriver First Script. **Self-Learning Topics:** Record and run a test case in Selenium IDE	2	CO2	2,3
3	**Selenium Web Driver Commands:** Implementing Web Drivers on Multiple Browser (chrome, Firefox),handling multiple frames	8	CO2	2,3

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Browser command, navigation Commands and find element command with Example. Locator (id, css selector, Xpath), synchronization in selenium, Handling Alerts using selenium web driver, types of alerts. Action Classes in selenium, Handling Drop Down, List Boxes, Command Button, radio buttons & text boxes. Waits command in selenium. **Self-Learning Topics:** Implementation of web driver on any other browser			
4	**TestNg Framework:** What is testNg? Installing Testng, TestNg Test, writing test cases using testNg, testNg annotation, Testing .xml **Self-Learning Topics:** Parameters and dependencies from xml	8	CO3	4
5	**Automation Framework Basics:** Introduction to basic types, linear scripting, library architecture framework, data driven Framework. **Self-Learning Topics:** Keyword Driven Framework	4	CO3	4
6	**Quality Assurance:** Introduction to software quality assurance, Validation checks and Regression Testing **Self-Learning Topics:** Audits and its types	2	CO4	5

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	Software Testing Foundations, 4th Edition: A Study Guide for the Certified Tester Exam (Rocky Nook Computing) Fourth Edition,Andreas Spillner, Tilo Linz and Hans Schaefer.
2	Selenium WebDriver, Pearson, Rajeev Gupta, ISBN 9789332526297.
3	Selenium WebDriver Practical Guide - Automated Testing for Web Applications Kindle Edition ,SatyaAvasarala ,ISBN-13: 978-1782168850
4	Testng Beginner's Guide, Packt Publishing Ltd.VarunMenon, ISBN 1782166017, 9781782166016
5	Software Testing & Quality Assurance Theory & Practice" By Kshirasagar Naik & Priyadarshi Tripathi, Wiley Student Edition.

Web References:

Reference No	Reference Name
1	https://www.techlistic.com/p/selenium-tutorials.html
2	http://www.guru99.com/selenium-tutorial.html
3	http://www.techlistic.com/p/selenium-tutorials.html
4	https://www.geeksforgeeks.org/data-driven-testing/
5	https://www.browserstack.com/guide/dataprovider-in-selenium-testng
6	https://www.browserstack.com/guide/regression-testing#:~:text=Regression%20Testing%20is%20a%20type,the%20introduction%20of%20new%20changes

Suggested list of experiments:

Practical No	Problem Statement
1	Write a Test cases for any known software application using testing techniques.
2	Implement Web Drivers on Browsers (Eg. Chrome , Firefox , Microsoft Edge Browser)
3	Implement the find element /elements command thorough different locators (id, css selector, path).
4	Implement Browser command and navigation Commands.
5	Demonstrate handling multiple frames in selenium
6	Demonstrate synchronization in selenium using wait command.
7	Demonstrate different types of alerts
8	Demonstrate : Handling Drop Down, List Boxes
9	Demonstrate: Command Button, Radio buttons & text boxes.
10	Demonstrate action classes in Selenium
11	Installation of TestNg , running testNg and TestNg annotations
12	Implementation of Data Driven Framework
13	Demonstrate Validation testing

Course Code	Course Name				
MCALE332	Ethical Hacking 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 fundamentals of any programming language

Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Applying foot printing tools for information gathering	Applying
CO2	Applying tools for scanning networks, enumeration and sniffing	Applying
CO3	Creating malwares like virus, trojan and keyloggers and using tools to study malware attacks.	Creating
CO4	Creating applications and demonstrating attacks like sql injection and session hijacking.	Creating
CO5	Applying tools and algorithms related to cryptography.	Applying
CO6	Analyzing to find out vulnerabilities in a computer system using pen testing and analyzing case studies under IT act 2000 and IT Amendment Act 2008 of Indian cyberlaw. Generating report for the same.	Analyzing

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Indian Cyberlaw: IT Act 2000 and IT Amendment Act 2008:** Report writing of Cyberlaws section under IT act 2000 and IT act 2008 - 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. **Self-Learning Topics: Additional cases under above given sections.**	2	CO6	Ref 2-Chapter 11
2	**Foot printing and Reconnaissance:** Performing foot printing using Google Hacking, website information, information about an archived website, to fetch DNS information. **Self-Learning Topics:** Additional foot printing tools and commands	2	CO1	W_1, W_2, W_3, W_4
3	**Scanning networks, Enumeration and sniffing:** Use port scanning. network scanning tools, IDS tool, sniffing tool and generate reports. **Self-Learning Topics:** Additional scanning and sniffing tools	5	CO2	W_5, W_6, W_7, W_8
4	**Malware Threats: Worms, viruses, Trojans**: Use Password cracking, Dictionary attack., Encrypt and decrypt passwords, DoS attack, ARP poisoning in windows, Ipconfig, ping, netstat, traceroute, Steganography tools. **Self-Learning Topics:** Additional hacking tools.	5	CO3	Ref 5-Chapter 13 W_9
5	**Developing and implementing malwares:** Creating a simple keylogger in python, creating a virus, creating a trojan. **Self-Learning Topics:** Additional implementation of hacking tools.	4	CO3	W_10
6	**Hacking web servers, web applications, SQL injection and Session hijacking:** Installation of DVWA, Hacking a website by Remote File Inclusion. SQL injection for website hacking, session hijacking. **Self-Learning Topics:** Use DVWA for testing SQL injection commands and local file inclusion.	4	CO4	W_11
7	**Wireless network hacking, cloud computing security, cryptography:** Using Cryptool to encrypt and decrypt password, implement encryption and decryption using Ceaser Cipher. **Self-Learning Topics:** implementing additional encryption algorithms.	2	CO5	W_12
8	**Pen testing:** Penetration Testing report writing using Metasploit and metasploitable,	2	CO6	W_13

Assessment:

Term Work(50): Will be based on Continuous Assessment

- Laboratory work will be based on the syllabus.
- The experiments should be completed in the allotted time duration.
    - Experiments 40 marks
    - Attendance 10 marks
- Term work will be evaluated by the subject teacher and documented according to 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	Matt Walker, All-In-One-CEH-Certified-Ethical-Hacker-Exam-Guide.
2	Manthan Desai, Basics of ethical hacking for beginners
3	SunitBelapure& Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.
4	Alana Maurushat, Ethical hacking
5	TutorialsPoint professionals, Ethical Hacking.

Web References:

Ref No	**Reference Name**
1	https://www.googleguide.com/print/adv_op_ref.pdf https://www.oakton.edu/user/2/rjtaylor/CIS101/Google%20Hacking%20101.pdf
2	http://whois.domaintools.com
3	www.archive.org
4	https://ping.eu/
5	Nmap Tutorial for Beginners - 4 - More Port Scanning Options : https://www.youtube.com/watch?v=MoGxY3yCySk https://nmap.org/download.html https://nmap.org/npcap/dist/
6	How to Use Nmap: Commands and Tutorial Guide
7	https://ttcshelbyville.wordpress.com/2014/03/30/defending-your-network-with-snort-for-windows/ Snort 101 : https://www.youtube.com/watch?v=W1pb9DFCXLw Snort Install on Windows 7 : https://www.youtube.com/watch?v=X64-0ogjoP4
8	Learn Wireshark in 10 minutes - Wireshark Tutorial for Beginners https://www.youtube.com/watch?v=lb1Dw0elw0Q https://www.guru99.com/wireshark-passwords-sniffer.html
9	https://www.md5hashgenerator.com/ crackstation.net https://dnschecker.org/password-encryption-utility.php

	https://hashes.com/en/decrypt/hash Denial of Service Attacks_ The Ping of Death-3_D_1 https://www.youtube.com/watch?v=Y8k_UGCiA6Y Denial of Service Attacks (Part 3)_ TCP SYN Flooding-3_D_2 https://www.youtube.com/watch?v=sUrM7_G_y7A Denial of Service Attacks (Part 5)_ The Smurf Attack_(240p)-3_D_3 https://www.youtube.com/watch?v=xQL3n_REkiw ARP Poisoning with Cain & Able https://www.youtube.com/watch?v=sBpe6GAXJZE Steganography using S-Tools https://www.youtube.com/watch?v=B8uN3nlLdqE
10	Design a Keylogger in Python https://www.tutorialspoint.com/design-a-keylogger-in-python Create a Virus https://www.youtube.com/watch?v=-TSWzErSxC4
11	Building a Web Hacking Lab (w/ XAMPP and DVWA) https://www.youtube.com/watch?v=XCqSQJapP7M&t=310s Web Hacker Basics 04 (Local and Remote File Inclusion) https://www.youtube.com/watch?v=htTEfokaKsM SQL injection for website hacking https://www.youtube.com/watch?v=3Axp3VDnf0I DVWA | SQL Injection | Low Security | Solution https://www.youtube.com/watch?v=BjmhucA08_s Cookie Manipulation and Session Hijacking https://www.youtube.com/watch?v=fbZpsHMgNdk
12	Download cryptool 2 https://www.cryptool.org/en/ct2/downloads Caesar Cipher in Cryptography https://www.geeksforgeeks.org/caesar-cipher-in-cryptography/
13	Penetration Testing Tutorial | Penetration Testing using Metasploit https://www.youtube.com/watch?v=LUGkIvcQmGE

Suggested list of experiments:

Practical No.	Problem statement
1	**Indian Cyberlaw: IT Act 2000 and IT Amendment Act 2008:** Report writing of Cyberlaws section under IT act 2000 and IT act 2008 - 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.
2	**Footprinting and Reconnaissance:** Using the software tools/commands to perform the following , generate an analysis report : A. To perform footprinting using Google Hacking. B. To find out the information about a website C. To find the information about an archived website. D. To fetch DNS information.
2.	**Scanning networks, Enumeration and sniffing:** Using the software tools/commands to perform the following , generate an analysis report : A. Port scanning. B. Network scanning tools C. IDS tool **D.** Sniffing tool
3.	**Malware Threats : Worms, viruses, Trojans:** Using the software tools/commands to perform the following , generate an analysis report : A. Password cracking. B. Dictionary attack. C. Encrypt and decrypt passwords. D. DoS attack. E. ARP poisoning in windows. F. Ipconfig,ping,netstat, traceroute. G. Steganography tools.
4.	**Developing and implementing malwares :** A. Creating a simple keylogger in python. B. Creating a virus. C. Creating a trojan.
5.	**Hacking web servers, web applications:**: A. Hack a website by Remote File Inclusion B. Disguise as Google Bot to view Hidden Content of a Website C. How to use Kaspersky for Lifetime without Patch.
6.	**SQL injection and Session hijacking :** A. Installation of DVWA, B. Hacking a website by Remote File Inclusion. C. SQL injection for website hacking, **D.** session hijacking.
7.	**Wireless network hacking, cloud computing security, cryptography:** 1 .Using Cryptool to encrypt and decrypt password, 2. Implement encryption and decryption using Ceaser Cipher.
8.	**Pen testing** : Penetration Testing report writing using Metasploit and metasploitable,

Reference of Books and study material:

Module No.	Book	Chapter No/ Page No.
1	SunitBelapure& Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.	Chapter 11
2	Web Reference	W_1,W_2, W_3, W_4,
3	Web Reference	W_5, W_6, W_7, W_8
4	TutorialsPoint professionals, Ethical Hacking.	W_9 + Chapter 13
5	Web Reference	W_10
6	Web Reference	W_11
7	Web Reference	W_12
8	Web Reference	W_13

Course Code	Course Name				
MCALE333	Blockchain Lab				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Term Work	Practical	Oral	Total
2	1	50	30	20	100

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

Lab Course Objectives: Course aim to

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

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

Sr. No.	Course Outcome	Bloom Level
CO1	Implement encryption algorithms and hash functions	Applying
CO2	Implement a bitcoin blocks and validating	Applying
CO3	Demonstrate the role of Smart contract using Solidity	Analyzing
CO4	Develop and deploy Dapp in Ethereum	Applying

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Module: Cryptography:** Symmetric Encryption using Ceaser Cipher, Asymmetric Encryption using RSA, Hash Functions (SHA-256), Merkle Tree (Implementation in Python/Java Script/Java)	6	CO1	RF-1
2	**Module: Cryptocurrency:** Concept of Bitcoin, block, blockchain, Immutable ledger**,** Public and Private Blockchain. (Implementation in Python/Java Script/ Java)	6	CO2	RF-2
3	**Module: Solidity Programming:** Introducing Solidity, Sample Code, Layout of Source File, Structure of a Contract, State Variables, Functions Types, Reference Types, Units, Special	6	CO3	RF-3,RF-

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Variables and Functions, Expressions and Control Structures, Function Calls, Error Handling, Visibility for Functions and State Variable			4,WRF-1
4	**Module: Ethereum:** Ethereum Virtual Machine (EVM): Accounts, Transactions, Gas, Ether, Memory Dapp architecture: Developing a DApp, Compile and Deploy the Smart Contract, Publish the DApp, Connecting to DApp, Ganache Output for Transaction Migration	6	CO4	RF-4
5	**Module: Case Study:** Use cases based on Hyper Ledger	2	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	David H. Hoover, Kevin Solorio, and Randall Kanna, Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment, O'Reilly Publications, ISBN-13: 978-1492045267
2	Jimmy Song, Programming Bitcoin: Learn How to Program Bitcoin from Scratch, O'Reilly Publications, ISBN-13: 978-1492031499
3	Ritesh Modi, Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publications
4	Chris Dannen, Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners, Apress

Web References:

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

Suggested list of experiments:

Practical No	Problem Statement
1	Implementation of Ceaser Cipher (Symmetric Encryption)
2	Implementation of RSA Algorithm (Asymmetric Encryption)
3	Implementation of SHA-256
4	Implementation of Merkle Tree
5	Implement the creation of Bitcoin Block (Genesis Block)
6	Implement the creation of a Blockchain (Adding the blocks to the chain and validating)
7	Creating ERC20 token
8	Implement blockchain in Merkle Trees
9	Implement Mining using block chain
10	Implement peer-to-peer using block chain
11	Creating an account in Crypto-currency Wallet
12	Implement the creation of a public/private Blockchain
13	Simple Solidity Program using Arrays and Structure.
14	Simple Experiments using Solidity Program Constructs (if-then, while etc...)
15	Creation of smart contract in Ethereum
16	Creation of Dapp in Ethereum
17	Mini Project

Course Code	Course Name				
MCAL34	Mobile Computing 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 Java Programming and XML.

Lab Course Objectives: Course aim to

Sr. No.	Course Objective
1	Develop and design Android applications using various UI components and Intents.
2	Implement data persistence and perform CRUD operations using SQLite and Firebase.
3	Develop Android applications with animations, multimedia content, and location-based services.
4	Consume web services and handle JSON responses using RESTful API.
5	Build Flutter applications using Dart programming and various widgets
6	Manage local databases and perform network requests in Flutter applications.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Design and develop Android applications with user interfaces and UI controls.	Creating
CO2	Implement database connectivity using SQLite, Shared Preferences, and Firebase for data persistence.	Applying
CO3	Develop animation, multimedia, and location-based features within Android applications.	Creating
CO4	Integrate RESTful APIs in Android applications to consume web services and parse JSON responses.	Analyzing
CO5	Develop cross-platform mobile applications using Dart and Flutter, understanding widget-based UI design.	Creating
CO6	Manage data handling in Flutter and publish Android applications on the Google Play Store.	Appling

Course Contents:

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
1	**Introduction to Android Application Components and UI Controls:** Creating an Android application, Creating the activity, Design user interface with Views, different types of layouts and components. UI Controls: Text view, Edit Text, Radio button, Checkbox, Spinner, Progress Bar, AlertDialog, Switch and other controls, Working with Intents (Explicit and Implicit) **Self-Learning Topics:** The android platform, the layers of android, Four kinds of android components, understanding the androidManifest.xml file, Methods of all control class	**10**	CO1	1,2,3,4
2	**Database Connectivity:** Persistence data using the file system (external, internal, SD card), Working with Shared Preferences, Working with Content providers, CRUD operation using SQLite database connection, CRUD operation with Realtime database Firebase. **Self-Learning Topics:** Interface to Database	**8**	CO2	3,4
3	**Animation, Multimedia and Location Based Services:** Creating animations with android's graphics API, Playing audio & video. Getting Location Data. **Self-Learning Topics:** Capturing media and photos, SMS and E-Mail messaging, Geocoding and Reverse Geocoding	**6**	CO3	1,2,3,4
4	**REST API integration:** Consuming Web services using HTTP (htttpurlconnection), Working with OkHttp, Retrofit and Volley library, Dealing with Responses and JSON Parsing. **Self-Learning Topics:** publishing Android application on Google play store.	**8**	CO4	
5	**Introduction to Dart and Flutter:** Introduction to Structure of Dart Language, OOPS concept and classes & packages in Dart Programming, Introduction to Flutter, Flutter User Interface using Widgets, Types of Widgets and	**12**	CO5	8,5,6,7

Module No.	Detailed Contents	Hrs.	CO No.	Ref No.
	Working with Widgets, Flutter List, Navigation, Effects, Building Layout. **Self-Learning Topics:** Deployment of android application on the play store.			
6	Data Handling in Flutter: Working with Sqflite, Working with http package in Flutter, Handling Responses and JSON Parsing. **Self-Learning Topics: Swift Programming, iOS app development**	**8**	CO6	5,6,7

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	Wei-Meng Lee ,Beginning Android™ 4 Application Development , John Wiley & Sons Crosspoint Boulevard Indianapolis ,ISBN: 978-1-118-24067-0
2	Reto Meier, Professional Android™ Application Development, Wiley Publishing, ISBN: 978-0-470-56552-0
3	Zigurd Mednieks, Laird Dornin, G. Blake Meike, & Masumi Nakamura, Programming Android , Gravenstein Highway North, Sebastopol, CA 95472, ISBN :9781449316648.
4	W. Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, Android in Action, Third Edition, Dreamtech Press, ISBN 9781617290503
5	Alessandro Biessek Flutter for Beginners: An Introductory Guide to Building Cross-platform Mobile Applications with Flutter and Dart 2, Packt Publishing Ltd. ISBN. 9781788990523
6	Marco L. Napoli Beginning Flutter: A Hands On Guide to App Development John Wiley &Sons, ISBN:- 1119550823, 9781119550822
7	Rap Payne Beginning App Development with Flutter: Create Cross-Platform Mobile Apps Apress, ISBN 978-1-4842-5181-2
8	Gilad Bracha, The Dart Programming Language, Addison-Wesley Professional, ISBN: 9780133429961

Web References:

Reference No	Reference Name
1	https://developer.android.com/guide/components/activities/intro-activities
2	https://developer.android.com/guide/components/intents-filters
3	https://developer.android.com/training/data-storage/sqlite
4	https://developer.android.com/training/data-storage/shared-preferences
5	https://docs.flutter.dev/get-started/install/windows/mobile
6	https://docs.flutter.dev/get-started/fundamentals/layout
7	https://dart.dev/language
8	https://pub.dev/packages/sqflite
9	https://docs.flutter.dev/cookbook/networking/fetch-data
10	https://pub.dev/packages/http
11	https://developer.android.com/studio/write/firebase

Suggested list of experiments:

Practical No	Problem Statement
1	Android Program using various UI controls (Registration Form, Survey Form, etc..)
2	Android Program using Intents (Explicit and Implicit)
3	Android Program for Notification and Alert Box.
4	Android Program using Shared Preference
5	Android Program for File Storage (Internal and External)
6	Android Program to perform CRUD operations using SQlite
7	Android Program to perform CRUD operation using real time database Firebase
8	Android Program for Simple Animation
9	Android Program to work with Images, Audio and Video
10	Android Program to work with Locations.
11	Android Program to work with RestAPI (OkHttp, Volley, Retrofit)
12	Flutter Program based on Stateful and Stateless Widgets
13	Flutter Program using List
14	Flutter Program using TextField, Check Box, Buttons, Drop down, Switch etc.
15	Flutter Program for Navigation
16	Flutter Program to perform CRUD operations using sqflite.
17	Flutter Program using Rest API.

Course Code	Course Name			
MCARP31	Research Project (RP)			
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)		
		Term Work	Practical	Total
02#	04	75	75	150

Contact hours: 2 hours in campus and 6 hours self-research by student outside campus in a week

Pre-requisite:

1. Research Methodology Concepts
2. Data Analysis Concepts

Course Objectives: Course aims to

Sr. No.	Course Objective
1	Develop self-learning, research, problem solving and entrepreneurship attitude in students.
2	Develop communication, organizational skills and maturity through discussions, presentations etc.
3	Write the Research Project Proposal / Technical Report
4	Develop a conceptual framework to address the identified problem statement by applying the research methodology concepts and theories
5	Test and validate data to address the research questions/hypothesis

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

Sr. No.	Course Outcome	Bloom Level
CO1	Write the Research Project Proposal	Applying
CO2	Interpret others researcher's work critically while doing own research work	Applying
CO3	Develop a conceptual framework/ model to address the identified problem statement by applying the research methodology concepts and theories	Creating
CO4	Test and validate data to address the research questions/hypothesis	Evaluating
CO5	Understand professional, ethical, legal, industry practices and responsibilities.	Understanding

Course Contents:

- **Research Project is an opportunity to inculcate** self-learning, research, problem solving and entrepreneurship attitude in students.
- A research project focuses on conducting work on a research topic under the supervision of a faculty member. Students shall form a group of 2 to 3 students.
- This type of project typically requires developing a testable hypothesis, involves background reading, and requires systematic evaluation of a particular strategy or solution for a specific problem or topic applicable to the research area of interest. A research project provides a sensitization for a research topic and may result in collaborative publications with the project mentor. Students attempting this type of project are expected to apply the appropriate research methodologies and techniques necessary to support their project and clearly present them.
- 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.

- **Steps for Research Project:**
  - ✓ Keen observation of the surrounding/society and identification of a problem
  - ✓ Read existing Literature to understand and identify the research gaps
  - ✓ Analysis and formulation of the problem
  - ✓ Design the solution
  - ✓ Conducting experiments/ survey and draw conclusion
  - ✓ Perform testing by creating test cases
  - ✓ Prepare the documentation in each phases
  - ✓ Submit the final project report

Students can seek guidance from faculty mentors, other experts and make effective use of other sources of information available around them. Students must ensure that the problem is manageable in one semester.

Assessment:

Term work: 75 marks

Term work marks can be distributed as follows:

Sr. No.	Assessment Parameters	Marks
1	Research Project Proposal ▪ Formulation of problem statement ▪ Background study ▪ Hypothesis/ Research Questions	15
2	Literature Survey	10
3	Research Methodology, Data Collection, Data Analysis	15
4	Development of Model	20
4	Testing	15

Practical: 75 marks

Practical marks can be distributed as follows:

Sr. No.	Assessment Parameters	Marks
1	Presentation of Research Project	25
2	Evaluation of Research Project	30
3	Evaluation of Project Report	20

Rubrics have to be followed during project evaluation. It is advisable to use LaTex for technical report writing. Research project evaluation will be done at Institute level by preferably alumni or industry experts

Course Code	Course Name	Category	Contact Hours	Credit
MCAFP31	**Individual Social Responsibility (ISR)**	**Field Project (FP)**	**30 hours in the span of three semesters**	**1***

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

Course objective:

To inculcate social awareness and encourage students to engage in social services and foster ethical values.

Course Outcome:

Learners will be able to create awareness about institutional and individual social responsibilities, fostering societal development.

About Individual Social Responsibility (ISR):

Individual Social Responsibility (ISR) signifies an institution's ongoing commitment to ethical practices and its contribution to the broader socioeconomic development of society. Social responsibility is a moral duty that calls on individuals to uphold their civic obligations, ensuring their actions benefit society. It stresses the importance of balancing economic growth, social welfare, and environmental sustainability. This responsibility can be fulfilled in two ways: passively, by avoiding actions that negatively impact society, or actively, by participating in initiatives that promote social welfare. Learners can make meaningful contributions to society through social activities, either independently or in collaboration with institutions, social organizations, NGOs, or clubs. Social work instils empathy, responsibility and sensitization towards humanity in learners, which enable them to nation building through social welfare initiatives or community engagement

Guidelines for ISR Activity:

- A teacher can be given responsibility as ISR coordinator, relaxation of 1 hour per week load can be given to the teacher.
- ISR coordinator is responsible to maintain the records of ISR activities and the students participating in the activity.
- Students shall participate in Social work activities individually or in association/collaboration with Institute/ Social organizations/NGOs/Clubs etc. with prior permission of ISR coordinator

● A Student shall complete at least 30 hours social activities under the guidance of ISR coordinator/HOD/Principal/Director between MCA Semester 1 to Semester 3.

● Certificate of Participation given by concern Institute/NGO/Social organization/Private or Government organization/Club etc shall be verified by ISR coordinator.

● 1 credit will be awarded on the completion of 30 hours ISR work which is certified by ISR coordinator.

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

- Computer Literacy Programs for ZP School Students/ Villagers/ Farmers etc.
- Digital literacy/Functional Literacy programme.
- Awareness programme for Cybercrime.
- Donation of books/cloths.
- Blood Donation Camps.
- Public Awareness Programs for Health, Road Safety, Organ Donation, Global Warming, Plastic Eradication, etc.
- Aids/Cancer/Corona Awareness
- Programme for Mental Health awareness.
- Rain water harvesting and water saving awareness.
- Sanitization and hygiene awareness.
- River/Beach Cleanliness Drive.
- Voter Registration Drive.
- Tree Plantation Drives.
- Visits and Help to Orphanage/Old homage.
- Disaster Management Program.
- Swachha Bharat Abhiyan.
- E Waste Collection and Disposal.
- Anti-Addiction Program.
- Yoga, Meditation camp.
- Self Defence Programs for Children.
- Programs for Physically Challenged People.
- First Aid training programme.

Semester IV

Syllabus
MCA Semester IV

Course Code	Course Name				
MCAIP41	Internship Project				
Contact Hours (Per Week)	Credits Assigned	Examination Scheme (Marks)			
		Internal Assessment		University Assessment	Total
		Mid Term Presentation I	Mid Term Presentation II	Final Presentation	
40	12	**75**	**75**	**150**	**300**

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

Course Objectives: Course aim to

Sr. No.	Course Objective
1.	**Application of Knowledge:** Apply theoretical concepts from the MCA program to real-world projects, enhancing technical skills in programming, databases, and software development.
2.	**Hands-on Technical Experience:** Gain practical experience with coding, testing, debugging, and using current technologies
3.	**Industry Practices and Standards:** Learn about industry methodologies, project management tools and collaboration techniques in a professional setting.
4.	**Problem-Solving and Analytical Thinking:** Develop critical thinking and problem-solving skills by tackling real-world challenges with innovative solutions.
5.	**Professional Development:** Improve communication, teamwork, and ethical practices, preparing for a successful career in the tech industry.

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

Sr. No.	Course Outcome	Bloom Level
CO1	**Enhanced Technical Proficiency:** Students will demonstrate the ability to apply programming languages software development techniques and industry-specific tools to real-world projects.	Applying
CO2	**Practical Problem Solving:** Students will effectively analyze and solve complex technical problems using critical thinking algorithm design and appropriate technologies.	Analyzing
CO3	**Familiarity with Industry Standards:** Students will gain practical experience with project management tools version control systems and collaborative workflows commonly used in the software development industry.	Understanding
CO4	**Improved Communication and Teamwork:** Students will strengthen their ability to work effectively in teams communicate technical concepts clearly and collaborate on project development.	Evaluating

Sr. No.	Course Outcome	Bloom Level
CO5	**Professional and Ethical Practices:** Students will exhibit professionalism time management and ethical behavior in a work environment preparing them for future careers in the IT industry.	Creating

Assessment:

- **Internal Assessment Test: 150 marks**

  Internal Assessment consists of two presentations of 75 marks each. The final marks should be the sum of the two presentations.

- **End Semester Practical Examination: 150 marks**

  External Examination will be based on the project completed by the candidate during his / her internship project.

Guidelines

1. The internship must be conducted within any organization, including philanthropic entities, agricultural producers, governmental bodies, research and development institutions, laboratories, artisans, distinguished individuals or institutions, cooperatives, and corporate entities that offer students the opportunity to engage in an internship during their program.
2. The internship may take place during any stage of the software development life cycle, providing students with valuable practical experience in various phases of software development.
3. Duration of the Project: The internship project is required to span a minimum of 16 weeks.
4. Project Hours: Students are required to dedicate at least 40 hours per week to the project.
5. Project Requirements:
   a) Progress Reports: Students are obligated to submit two progress reports to both the internship supervisor and the academic advisor.
   b) Final Report: A comprehensive final report detailing the project outcomes, challenges encountered, and lessons learned must be submitted by the students.
   c) Presentation: Students are required to present their project findings and outcomes to the internship supervisor, academic advisor, and external examiner.

Rubrics have to be followed during project evaluation:

Mid Term Presentations I and II

To be conducted after completion of 6 weeks and 12 weeks respectively of the Internship.

The rubrics to be followed for the Mid Term Presentations are as follows

a) Progress Report (30 marks)

- *Content (10 marks)*:
    i. Clearly summarizes the project progress and achievements
    ii. Identifies any project issues or challenges
    iii. Outlines the project plans and goals for the next reporting period
    iv. Includes any relevant project metrics or data
- *Organization and Format (10 marks)*:
    i. Well-organized and easy to follow
    ii. Properly formatted and visually appealing
    iii. Includes all required elements
- *Timeliness and Frequency (10 marks)*:
    i. Reports are submitted on time and as scheduled
    ii. Reports are frequent and regular
    iii. Reports demonstrate consistent progress and achievement

b) Presentation (45 marks)

- *Content (20 marks)*:
    i. Clearly summarizes the project outcomes and achievements
    ii. Effectively communicates the project results and impact
    iii. Identifies any project lessons learned and best practices
- *Delivery and Presentation (15 marks)*:
    i. Confident and effective presentation style
    ii. Engaging and interactive presentation
    iii. Properly uses visual aids and supporting materials
- *Q&A and Discussion (10 marks)*:
    i. Effectively answers questions and addresses comments
    ii. Demonstrates knowledge and understanding of the project

Rubrics for Final Presentation/ Viva etc.:

a) Presentation (100 marks)

I. Introduction and Overview (10 marks)

- Clearly introduces the project and its objectives
- Provides a concise overview of the project scope and timeline
- Effectively sets the stage for the rest of the presentation

II. Technical Content (30 marks)

- Clearly explains the technical aspects of the project
- Effectively uses visual aids and supporting materials to illustrate key concepts
- Demonstrates a deep understanding of the project's technical requirements and challenges

III. Progress and Achievements (20 marks)

- Clearly summarizes the project's progress and achievements
- Effectively highlights the project's successes and accomplishments
- Identifies and discusses any challenges or obstacles overcome

IV. Conclusion and Recommendations (10 marks)

- Clearly summarizes the project's key findings and implications
- Effectively provides recommendations for future work or improvements
- Leaves the audience with a clear understanding of the project's significance and impact.

V. Presentation Style and Delivery (30 marks)

- Confident and effective presentation style
- Engaging and interactive presentation
- Properly uses visual aids and supporting materials
- Effectively answers questions and addresses comments

b) Project Report (50 marks)

- The Project Report is well-organized and easy to follow
- The Project Report effectively documents the project's progress and decisions
- The Project Report demonstrates a clear understanding of the project's technical and management aspects

MCA Semester IV Project Report Guidelines:

1. Students appearing for MCA Program (**Semester IV**) must submit their work [Project Report] done during the semester.
2. Report must be written in **English Language only**.
3. Project Report must be Black Colored Hard Bounded and Golden Embossed lettering.
4. Hard Copy Report must be submitted in the institute at least **one week prior** to the final presentation.
5. One copy should be submitted for University records which will be retained by the respective colleges **(College copy)**.
6. The student copy can be kept with the individual student with due signatures of the authorities. (If a group consists of 2 members then they need to submit total of 3 copies, one as University copy and two as individual copies).
7. The college copy will have names of all the students who are part of the team.
8. The Student copy will have name of the individual student.
9. Each student has to submit the **soft copy of final report** to coordinators.
10. No **water mark / Logo** are allowed in any page of the document.
11. Students must avoid plagiarism and properly cite all sources.
12. Printout should be taken on one-sided page.
13. The project report must be of **minimum of 75 pages** [excluding code].
14. Before taking the hard copy, the candidate is required to show the content to the respective faculty guide **well in advance for approval** since faculty may suggest modification in the document.
15. If the examiner finds that the project work is not done by the candidate then he/she can allot **zero marks** for **project**.
16. The Report book should have mat finishing as preference as compared to Glossy finishing.
17. **Performance Appraisal (given format)** form should be submitted separately **in sealed envelope by company / external guide** to the college / internal guide on the day of final evaluation. Student is not supposed to see this document.
18. If any doubts then be free to ask your internal guide as soon as possible.

Note:

- If the candidate feels that the content of the Index is not applicable in the project then give valid reason to the internal guide if she/he agrees then only you can go ahead with the same.
- Transparency sheet should be used before (inside cover page, Company and College letter heads and also at the end of the document inside)
- It is mandatory to give the Performance Appraisal / employer's Feedback form to on the day of final examination in the sealed envelope to the external examiner.

<Company Letter head>

<Date>

EXTERNAL GUIDE EVALUATION OF INTERN

Student Name:	
Internship Start Date:	**End Date:**
Project Name:	

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs Improvement	Satisfactory	Good	Excellent
Dependability and Responsibility: Performs reliably, accepts responsibility, and is punctual.				
Collaboration and Communication: Cooperates with others, communicates well, and accepts feedback.				
Work Quality and Initiative: Produces high-quality work, shows interest, and demonstrates initiative.				
Problem-Solving and Creativity: Analyzes problems effectively and shows creativity.				
Professionalism: Maintains a professional attitude, appearance, and uses time effectively.				
Overall Performance				

Additional comments, if any:

External Guide Name & Designation:
External Guide Contact No.:
External Guide Email Id:

External Guide Signature:

Course Code	Course Name	Assessment (University/ Institute)	Teaching Scheme (Contact Hours)	Credits Assigned	
			Presentation	Total	
			02	02	
MCARP 42	Research Paper / Product / Patent	Institute Level	Examination Scheme		
			Internal Assessment		Total
			Mid term Presentation I	Mid term Presentation II	
			50	50	100

Pre-requisite: Basics of Research Methodology

Course Objectives: The course is aimed to develop appropriate research and/or entrepreneurial skills among the students at post-graduate level.

Sr. No.	Course Objective
01	Understand analytic approach towards choosing a research topic or a business problem and acquiring skills to solve the same.
02	Collate and review relevant data and present new ideas related to area of research or development.
03	Adhere to ethical standard of research and development.
04	Understand what constitutes plagiarism or violation of any IP.

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

Sr. No.	Course Outcome	Bloom Level
CO1	Show data coherently, effectively and counter-hypothesis.	Understanding
CO2	Apply experience in preparation of research and development material for publication or presentation.	Applying
CO3	Identify and assess relevant published work to identify scope for new research and/or development.	Applying
CO4	Analyze data and synthesize research findings for formulation of new models / products / processes.	Analyzing
CO5	Evaluate the findings / product features with established procedures	Evaluate
CO6	Formulate the research paper / Patent Application / Product Literature and package.	Creating

Following guidelines should be followed for Research Paper / Patent / Product, MCA Sem.- IV:

RESEARCH PAPER:

- A Student shall do an in-depth study in a specialized area by following the basic principles of research viz, review of existing pool of literature related to the area of proposed research, collating data if required from primary or secondary sources, formulating a methodology for performing the proposed research study and design the experimental setup wherever required, presentation and discussion of the findings and concluding the same at the end.
- The publication of the research paper so formulated should be published anytime when the student is in the Second Year of the MCA pogramme. However, the necessary preparation and ground work on the research paper may start at an earlier stage as well.
- The research paper has to be guided / supervised by a full-time faculty of the college to which the learner belongs to.
- The research topic must be approved from the Institute. The institute should set up a committee/Supervisor/Research Guide to scrutinize the topics and finalize the same
- The research paper may be written in a group of maximum 2 students under the guidance of Supervisor/Research Guide.
- The research paper must be published/presented in a National /international conference (where the proceedings are published in an ISBN / ISSN compendium or is accepted by a indexed journal for publication) or national/ international journal indexed / listed in an appropriate database / platform.
- Papers published in Conferences organized by the same college can also be considered for award of credits provided the proceedings are published with minimum an ISBN number.
- Research paper written on the Research Project carried out on SEM IV may also be considered.

PATENT:

- Process / Product / Design patents will be considered. Trademarks / Copyrights will not be considered.
- Only Indian Process / Product / Design patents will be considered and should be verifiable post its publication / grant on the portal of the Indian registering authority.

- Patents published by a learner or a group of learners not more than four, along with the guide or mentor who is a full-time faculty of the institute in which the student is registered as a learner will be acceptable for award of credits.
- For award of credits under this category the time line for Publishing / Grant of the patent would be anywhere in between Semester II and Semester IV.
- Mere filling of an application for publication / grant will not suffice.
- Patents originating from the Research Project executed in Sem IV may also be considered.

PRODUCT:

- A marketable software product / service / platform needs to be developed by a learner or a group of learners (subject to a maximum of four learners in a group) under the guidance and mentoring of a full-time faculty of a college and/or an Industry mentor authorized by the college.
- The product so developed should be authenticated by either the IIC (Registered with the competent authority) or the E-Cell of the institute in which the learner is registered as a student.
- The authentication of the product so developed should be minuted in at least two of the meetings of the respective Cell/s held during the Second Year of the MCA programme (considering the fact that the development period might extend beyond six months the work may start from Sem III itself and should be minuted accordingly in the meetings of the respective Cell of the institute) and should be uploaded on the website of the college and the competent government authority wherever applicable.
- Mere presentation of a software / application programme / utility in front of an internal faculty committee will not suffice unless the above process is strictly followed in totality.

Reference:

1. Kothari C. R., Gaurav Garg (2019), "Research Methodology, Methods and techniques"(4th edition), New Delhi: New age International (p) Ltd.
2. James D. Lester , Writing Research Papers: A Complete Guide (10th Edition).
3. How to Write a Great Research Paper, Book Builders, Beverly Chin, July 2004, Jossey-Bass.

Web References:

1. https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf
2. https://ipindia.gov.in/writereaddata/images/pdf/oatent-office-procedures.pdf
3. http://www.fcsresearch.org/index.php?option=com_content&view=article&id=83&Itemi d=166
4. https://www.ece.ucsb.edu/~parhami/rsrch_paper_gdlns.htm
5. http://nob.cs.ucdavis.edu/classes/ecs015-2007-02/paper/citations.html

Assessment:

Internal Assessment: 100 marks

- Internal Assessment consists of two presentations of 50 marks each. The evaluation is to be done by a team of two examiners.
- The examiners may be Internal full-time or external examiner (full time faculty) drawn from other MCA colleges or an Industry professional (with minimum 3 years of experience in relevant domain).
- Appropriate documentation as described above should be maintained.

The marks distribution of two presentations is as given below:

Presentation I (Mid Term)	**Marks**	**Presentation II (Mid Term)**	**Marks**
Abstract, Introduction, Originality of the problem statement	10	Research Methodology, Provess / Models followed for development	10
Literature Review, Market Survey	15	Analysis, Findings & Conclusion / Adherence and completeness of the product specifications	20
Objectives/ Scope / Features	15	Publication • IEEE Transactions / Patent Grant : (10) • Patent Publication (07) • Scopus / WOS / IEEE Xplore (07) • Conference Proceedings in ISSN Journal traceable on the web and listed in any of the indexes mentioned above (07) • Conference proceedings with ISBN (05) • Marketed Product and/or hosted on e-store (10) • Product certified and authenticated by the Institute IIC / E-Cell with appropriate documentation available in public domain (10)	10
Presentation	10	Presentation	10
Total	**50**	**Total**	**50**

The above Rubric have to be followed during evaluation. Documentation at appropriate levels to be maintained at the institute level subject to inspection by appropriate University authorities as and when required.

Course Code	Course Name				
MCAMS43	Massive Open Online Course (MOOC)				
Teaching Scheme: Contact Hours (Per Week)			Credits Assigned		
Theory	Tutorial	Total	Theory	Tutorial	Total
6#	-	6	6	-	6!

Work load only for students
! Credits transferred from MOOC courses
MOOC may be taken in any of semesters 1-4 but accounted for in semester 4 only.

Course Objectives:

MOOC-based learning aligns with industry standards and contributes effectively to student academic progress.

Sr.No.	Course Objective
1	Students will be able to identify and explain key concepts, theories, and terminologies relevant to the MOOC course.
2	Students will apply acquired knowledge and techniques to solve practical problems, case studies, or hands-on projects related to the course content.
3	Students will design innovative solutions, propose research-based improvements, and develop comprehensive projects integrating course learnings.
4	Students will be able to critically analyze various concepts, compare different approaches, and assess their effectiveness in real-world applications.

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

Sr.No.	Course Outcome	Bloom Level
CO1	Understanding of fundamental concepts related to the subject area.	Understand
CO2	Apply theoretical knowledge to solve real-world problems or case studies.	Apply
CO3	Analyze information, compare different perspectives, and assess the validity of arguments in the subject domain.	Evaluate
CO4	Develop original ideas, propose innovative solutions, and design projects that integrate their acquired knowledge from the MOOC course.	Create

Course Contents:

MOOC-based courses from recognized platforms such as **SWAYAM-NPTEL, MKCL, NITTER, ISRO, NIELIT, or institutions with NIRF ranking within 100/Government Institutions etc**. The courses selected will contribute to the student's academic workload and will allow for **credit transfer** upon successful completion.

- Courses must be from **approved MOOC platforms** (SWAYAM-NPTEL, ISRO, etc.).
- Courses should be relevant to the student's academic discipline.
- Approval from the department/faculty is required before enrolment
- MOOC courses will be counted towards the total academic workload.
- Students must **complete weekly assignments and final exams** as required.
- A mentor/faculty guide will oversee the progress and guide students.
- **Institution will verify the certificate** before granting credits.
- A grading equivalency table will be used for credit conversion.
- A **MOOC Course Coordinator** will monitor student progress.
- Periodic review meetings will ensure quality and effectiveness.
- Students will submit a **completion report** to claim credits.
- AICTE Smart India Hackathon (SIH): Exemption in MOOC courses for 4 credits can be given in case a student / group of students have been selected for the Grand Finale of SIH either during their First Year or Second Year.

  Note: Respective MOOC Coordinator of Institute will evaluate performance of student, certificates of successfully completed MOOC courses and grant the credits for MOOC course/s.

QUESTION PAPER PATTERN

I. External/ End Term Examination (Theory):

MCA (NEP 2020 Scheme)

Course Code: < > **Course Name:** < >

Paper Code: < > **Total Marks: 50**

(2 Hours)

Note: • **Question number Q1 is compulsory** • **Attempt any two questions out of Q2 to Q5**			**Marks**	**Course Outcome**	**Bloom's Level**
				CO	**BL**
Q1	**Answer the following**				
	a.		**[05]**		
	b.		**[05]**		
	c.		**[05]**		
	d.		**[05]**		
Q2	**a.**		**[08]**		
	b.		**[07]**		
Q3	**a.**		**[08]**		
	b.		**[07]**		
Q4	**a.**		**[08]**		
	b.		**[07]**		
Q5	**a.**		**[08]**		
	b.		**[07]**		

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II. External/ End Term Examination (Practical):

UNIVERSITY OF MUMBAI
Practical Examination – <Month : Year>
M.C.A.(NEP 2020 Scheme) Semester – < >
LABORATORY <Course code>
[Name of Course]

Duration: 3 hours **Seat No: _____**
Marks: 30
General Instructions:

- *Viva will be taken at the time of practical as well as after the practical if required.*
- *The figures to the right indicate full marks.*
- *Create a folder with name of your seat Number in the folder "MCA_NEP_<Sem>_<Month>_<Year>_<Name of sub>" on the desktop.*
- *Answer to the questions, if any, should be written in the answer book. Use the last page for rough work.*
- *If you are using any additional information, state it clearly.*
- *Once you finish with the code show it to the examiner for testing.*
- *Attach the printout of the program and its output along with the answer book.*

Question No.	Question	**Marks**	**CO**
A)		**15**	
B)		**15**	

OR

Question No.	Question	**Marks**	**CO**
A)		**10**	
B)		**10**	
C)		**10**	

III. Internal Examination (Internal Assessment Test: IAT):

<College Logo> **<University Logo>**

<College Name>

<Department Name>

Internal Assessment Test (IAT)

Sem:____ Course Code:_____ Course Name: _____

Max. Marks:25 **Duration: 1 Hr**

Note: • All Questions are compulsory. • Figures indicate full marks.			**Marks (25)**	**Course Outcome**	**Bloom's Level**
				CO	**BL**
Q1	Each question of five marks (Solve any two)				
	a.		**[05]**		
	b.		**[05]**		
	c.		**[05]**		
Q2	Each question of eight marks (Attempt any one)				
	a.		**[08]**		
	b.		**[08]**		
Q3	Each question of seven marks (Attempt any one)				
	a.		**[07]**		
	b.		**[07]**		

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Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Dr. Murlidhar Dhanawade
Chairman
Board of Studies (MCA)
University of Mumbai

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology
University of Mumbai

Prof. Shivram S. Garje
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