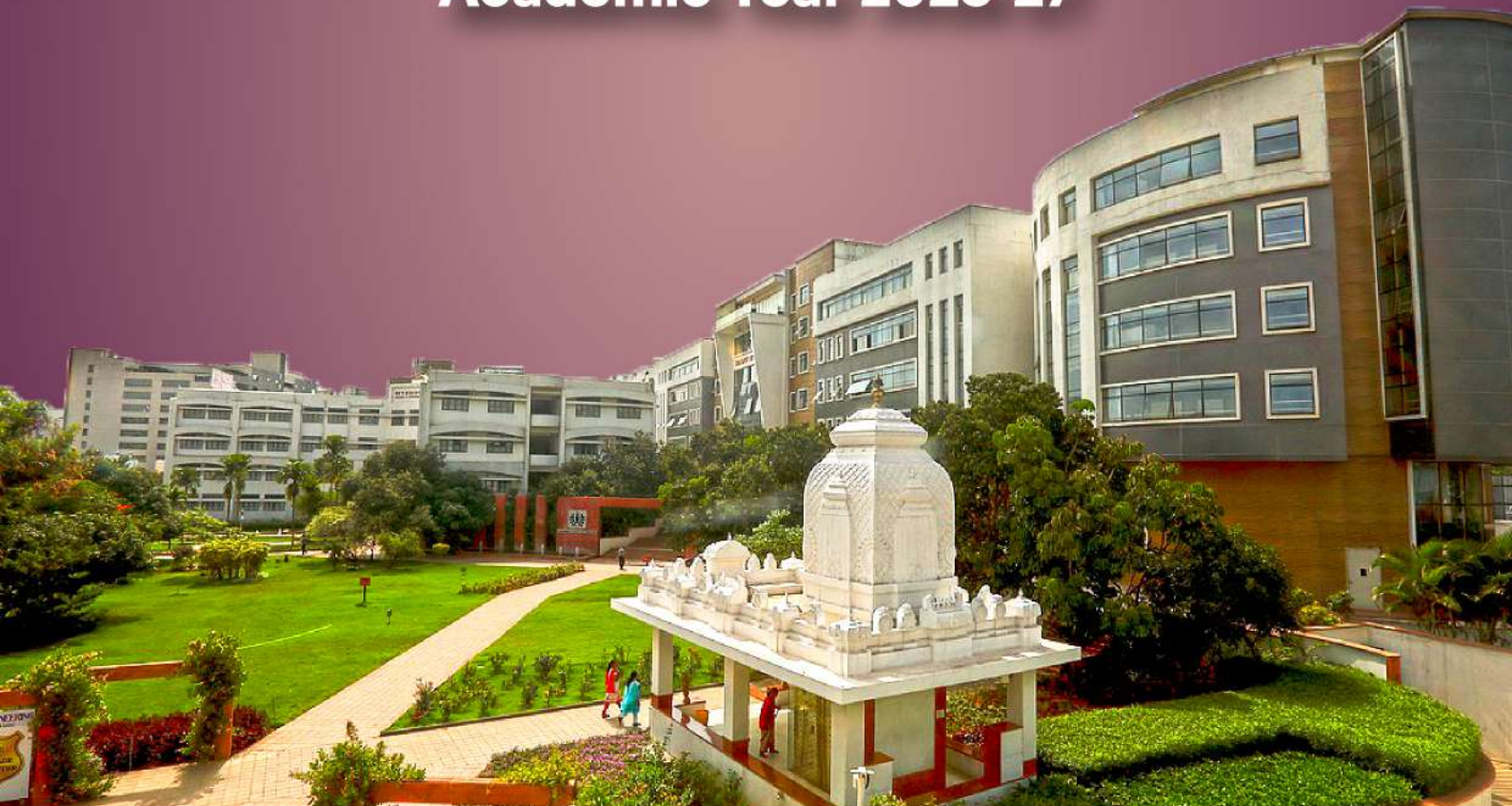




**Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA**

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

**Scheme 2024
Academic Year 2026-27**



MCA

**Third and Fourth Semester Scheme & Syllabus
BATCH 2024-26 Onwards
CREDITS:80**



Department of Master of Computer Applications

Scheme 2024

Academic Year 2026-27

**Third and Fourth Semester MCA
Scheme & Syllabus**

Batch: 2024-26 Onwards

Credits: 80

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NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.

To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

QUALITY POLICY

To provide educational services of the highest quality, both curricular and co-curricular, to enable students integrate skills and serve the industry and society equally well at global level.

VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

**DEPARTMENT OF
MASTER OF COMPUTER APPLICATIONS
VISION**

To emerge as a department of eminence in the field of Computer Applications in serving the Information Technology Industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

To strengthen the theoretical, practical and ethical aspects of the learning while inculcating a culture of research, innovation and practical applications amongst faculty and students.

To encourage long-term interactions between the department and the IT Industry through rich involvement of the Industry in the design of the curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO1** Excel in the field of Computer Applications and contribute to academia, industry and research.
- PEO2** Deliver software solutions that are socially relevant and adapt quickly to emerging technologies.
- PEO3** Demonstrate professional behavior by understanding ethical and communication skills to engage in lifelong learning.

PROGRAMME OUTCOMES (POs)

- P01 (Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
- P02 (Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.
- P03 (Development of Solutions):** Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.
- P04 (Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
- P05 (Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
- P06 (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.
- P07 (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.
- P08 (Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PS01

Apply knowledge of programming, database systems, operating systems, computer networks, software engineering, and data analytics to analyze, design, and implement computing solutions for real-world applications using modern software tools and technologies.

PS02

Design and develop innovative, secure, ethical and sustainable software solutions using data science, artificial intelligence, cloud computing, cyber security, and full-stack development to address industry requirements and societal needs.

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3
To strengthen the theoretical, practical and ethical aspects of the learning while inculcating a culture of research, innovation and practical applications amongst faculty and students.	3	3	2
To encourage long-term interactions between the department and the IT Industry through rich involvement of the Industry in the design of the curriculum and its hands-on implementation.	3	3	2
To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.	2	2	3

Correlation: 3- High, 2-Medium, 1-Low

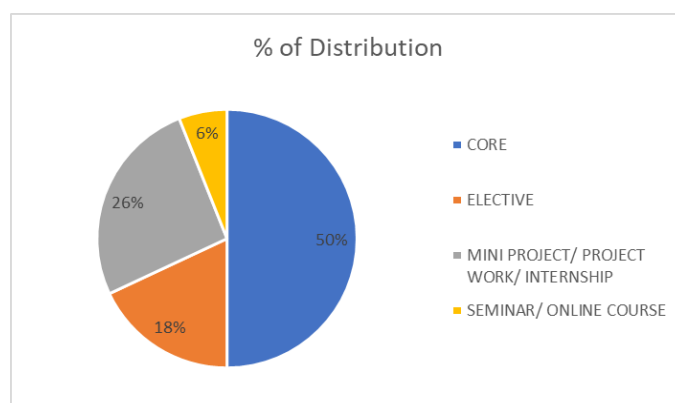
Mapping of POs to PEOs

PO's	P01	P02	P03	P04	P05	P06	P07	P08
PEO1	3	3	3	3	2	2	1	2
PEO2	1	3	3	3	2	2	2	3
PEO3	0	1	1	1	3	2	3	3



**DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
MCA DEGREE CURRICULUM – COURSE CREDIT STRUCTURE
BATCH 2024-26 Onwards: SEMESTER I TO IV**

SEMESTER	CORE	ELECTIVE	MINI PROJECT/ PROJECT WORK/ INTERNSHIP	SEMINAR / ONLINE COURSE	TOTAL CREDITS
I	20	0	0	0	20
II	12	6	2	0	20
III	8	3	9	0	20
IV	0	5	10	5	20
TOTAL	40	14	21	5	80
% of Distribution	50%	18%	26%	6%	100%



DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
SCHEME OF THIRD SEMESTER MCA PROGRAM
Scheme 2024 - AY 2026-27

SL NO	BOARD/ COURSE	COURSE CODE	COURSE	B O S	CREDIT DISTRIBUTION				OVERALL CREDITS	TLP CONTACT HOURS / SEM	TW & SL / SEM	TOTAL HOURS /SEM	EXAM HRS	MARKS		
					L	T	P	S						CIE	SEE	TOTAL
1	MCA/IPCC	24MCA31	MACHINE LEARNING	MCA	3	0	1	0	4	75	45	120	3	50	50	100
2	MCA/IPCC	24MCA32	WEB DEVELOPMENT USING FULL STACK	MCA	3	0	1	0	4	75	45	120	3	50	50	100
3	MCA/PEC	24MCA33X	PROFESSIONAL ELECTIVES - 2	MCA	3	0	0	0	3	45	45	90	3	50	50	100
4	MCA/PROJ	24MCA34	PROJECT WORK	MCA	0	0	9	0	9	135	135	270	3	50	50	100
TOTAL					9	0	11	0	20	330	270	600	12	200	200	400
NNote: IPCC - Integrated Professional Core Courses, (No SEE for lab component, only CIE), PEC – Professional Elective Course, PROJ - Project Work L – Lecture, T - Tutorial, P -Practical, S - Skill Development Activities																

PROFESSIONAL ELECTIVES-2		
SL NO	COURSE CODE	COURSE TITLE
1	24MCA331	DATA SCIENCE
2	24MCA332	ETHICAL HACKING
3	24MCA333	AUGMENTED REALITY AND VIRTUAL REALITY
4	24MCA334	INTERNET OF THINGS
5	24MCA335	UI/UX DESIGN

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
SCHEME OF FOURTH SEMESTER MCA PROGRAM
Scheme 2024 - AY 2026-27

SL NO	BOARD / COURSE	COURSE CODE	COURSE	BOS	CREDIT DISTRIBUTION				OVERALL CREDITS	TLP CONTACT HOURS / SEM	TW & SL / SEM	TOTAL HOURS /SEM	EXAM HRS	MARKS		
					L	T	P	S						CIE	SEE	TOTAL
1	MCA/PEC	24MCA41X	PROFESSIONAL ELECTIVES –3	MCA	3	0	0	0	3	45	45	90	3	50	50	100
2	MCA/PEC	24MCA42X	LAB BASED PROFESSIONAL ELECTIVES - 2	MCA	0	0	2	0	2	60	-	60	3	50	50	100
3	MCA/TS	24MCA43	TECHNICAL SEMINAR	MCA	0	0	0	2	2	-	60	60	3	50	50	100
4	AUD/AEC	24AUD44X	ONLINE COURSE (12 Weeks)		-	-	-	3	3	-	90	90	3	-	-	100
5	AUD/NCMC*	24AUD45	RESEARCH METHODOLOGY AND IPR - Online		Classes and evaluation procedures are as per the policy of the online course providers.											PP
6	MCA/INT	24MCA46	INTERNSHIP	MCA	0	0	0	10	10	-	300	300	3	50	50	100
TOTAL					3	0	2	15	20	105	495	600	15	200	200	500
NNote: IPCC - Integrated Professional Core Courses, (No SEE for lab component, only CIE), PEC - Professional Elective Course, PROJ - Project Work L – Lecture, T - Tutorial, P -Practical, S - Skill Development Activities																

PROFESSIONAL ELECTIVES-3		
SL NO	COURSE CODE	COURSE TITLE
1	24MCA411	AI ETHICS
2	24MCA412	DIGITAL FORENSICS
3	24MCA413	DESIGN THINKING AND INNOVATION
4	24MCA414	DIGITAL MARKETING
5	24MCA415	AGILE SOFTWARE DEVELOPMENT

LAB BASED PROFESSIONAL ELECTIVES -2		
SL NO	COURSE CODE	COURSE TITLE
1	24MCA421	CLOUD SERVICES MANAGEMENT
2	24MCA422	DEVOPS
3	24MCA423	BIG DATA ANALYTICS USING HP VERTICA
4	24MCA424	SOFTWA RE TESTING USING SELENIUM
5	24MCA425	BLOCKCHAIN

MACHINE LEARNING										
Course Code	24MCA31					CIE Marks		50		
L:T:P:S	3:0:1:0					SEE Marks		50		
Hrs / Week	4+2					Total Marks		100		
Credits	04					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA31.1	Identify the practical implications of Machine Learning and its approaches.									
24MCA31.2	Use Supervised machine learning algorithms to solve a given problem.									
24MCA31.3	Apply the concepts of Regression, Clustering and ensemble learning algorithms to solve real-time applications.									
24MCA31.4	Examine the reinforcement algorithms and optimization techniques of Genetic Algorithms.									
24MCA31.5	Derive R Scripts for deploying Machine Learning algorithms.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA31.1	2	-	-	-	-	-	-	-	2	2
24MCA31.2	-	2	2	2	-	-	-	-	3	2
24MCA31.3	-	2	2	2	-	-	-	-	3	3
24MCA31.4	-	2	2	-	-	-	-	-	2	3
24MCA31.5	-	-	3	-	2	-	-	-	3	3
MODULE-1	INTRODUCTION TO MACHINE LEARNING					24MCA31.1			8 Hours	
Definition, Origin, Need, Types of Learning, Uses and abuses, Ethical considerations, Abstraction and Knowledge Representation, Generalization, Assessing the Success, Steps to apply Machine Learning (ML) to data, Choosing ML algorithm, the Input Data, Types of ML Algorithms, Matching Data to an Appropriate Algorithm, ML Models, Applications, Performance Measures.										
Laboratory Component: 2 Hours										
1. Write a Python program to load a dataset, explore basic statistics (mean, median, variance).										
2. Create a summary report on types of machine learning with examples from real-world domains.										
3. Demonstrate performance measures like Accuracy, Precision, Recall, F1-score using a sample confusion matrix in Python.										
Text Book	Text Book 3: Chapter: 1, 2									
MODULE-2	MACHINE LEARNING ALGORITHMS-I					24MCA31.2			8 Hours	
Decision Tree, Neural Networks - Representation, Perceptron, Multilayer Networks and Back Propagation, Bayesian Method, Naïve Bayes Classification, Instance Based Learning – K-Nearest Neighbor.										
Laboratory Component: 2 Hours										
1. Implement Decision Tree algorithm in Python using a standard dataset.										
2. Create a program using Naïve Bayes for classification with confusion matrix.										
3. Write Python code for K-Nearest Neighbour and visualize the results.										
Text Book	Text Book 2: Chapter: 3.2, 3.4, 4.1, 4.2, 4.3, 4.4, 4.5, 6.1, 6.2, 6.9, 8.1, 8.2, Text Book 1: Chapter: 5,7,9,11									
MODULE-3	MACHINE LEARNING ALGORITHMS-II					24MCA31.3			8 Hours	
Regression - Linear Regression, Logistic Regression, Support Vector Machine - Multi Category Generalizations, Ensemble Learning - Model Combination Schemes, Voting, Averaging, Error-Correcting Output Codes, Bagging - Random Forests, Boosting - Adaboost, Stacking. Clustering – Hierarchical Clustering, K-Means Clustering, Soft K-means, K-Mode Clustering, DBScan.										
Laboratory Component: 2 Hours										
1. Implement Linear Regression using python with data visualization.										
2. Formulate a program to implement the SVM classifier.										
3. Use Random Forest for classification on an open dataset and compare accuracy.										
Text Book	Text Book 3: Chapter: 6, 7, 9, 11									
Case Study	Case Studies of Machine Learning Applications in Retail, Hospitality, Education and Insurance Sectors									
MODULE-4	GENETIC & REINFORCEMENT ALGORITHMS					24MCA31.4			8 Hours	

Genetic Algorithms - Genetic Operator, Fitness Function and Selection, An Illustrative Example, Genetic Programming, Models of Evolution and Learning - Lamarkian Evolution, Baldwin Effect.
Reinforcement Learning, Algorithms, Learning Models of Reinforcement - Markov Decision Process, Q learning, Reinforcement Learning vs. Supervised Learning, Applications and Challenges.

Laboratory Component:

2 Hours

1. Implement a Genetic Algorithm to solve the Knapsack Problem.
2. Learn to Reach a Target Number Using Reinforcement Learning.
3. Implement Q-Learning to train an agent to navigate a maze environment.

Text Book | Text Book 2: Chapter: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, Chapter: 13.1, 13.2

MODULE-5

PROGRAMMING IN R AND IMPLEMENTATION OF ML ALGORITHMS USING R

24MCA31.5

8 Hours

R Environment, R Packages and Libraries, Basics, Managing and Understanding Data, Reading Data into Data frames, Lists, Data handling, Statistical Functions & Graphics, Writing Functions, Control Statements, Loops, Strings, Data Interfaces, Charts and Graphs.

Implementation Techniques of Algorithms using R with Standard Datasets – Naïve Bayes, K-Nearest Neighbor, K-Means Clustering.

Laboratory Component:

2 Hours

1. Implement Naïve Bayes classification using R.
2. Implement K-Means Clustering using R.
3. Implement K-Nearest Neighbors (KNN) Classification Using R

Text Book | Text Book 4: Chapter: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 16, Text Book 1: Chapter: 1,2,3,16

Applications | **Hands-on:** R scripts to handle data, to use Statistical functions, R program to solve ML problem using Naïve Bayes, K-Nearest Neighbor, K-Means Clustering.

CIE Assessment Pattern(50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	Lab
		25	5	20
L1	Remember	5	-	-
L2	Understand	10	-	-
L3	Apply	5	3	20
L4	Analyze	5	2	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern(50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) William B. Claster, *Mathematics and Programming for Machine Learning with R*, CRC Press, Taylor & Francis, 2020, ISBN: 978-1-00-019697-9.
- 2) Tom M. Mitchell, *Machine Learning*, McGraw Hill Education, 1st Edition, 2017, ISBN: 978-1-25-909695-2.
- 3) Brett Lantz, *Machine Learning with R: Expert Techniques for Predictive Modeling*, Packt Publishing, 3rd Edition, 2019, ISBN: 978-1-78995-291-2.
- 4) Jared P. Lander, *R for Everyone: Advanced Analytics and Graphics*, Pearson Publication, 2nd Edition, 2017, ISBN: 978-0-13-454692-6.

Reference Books:

- 1) Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, O'Reilly Media, 3rd Edition, 2022, ISBN: 978-93-5542-198-2.
- 2) Saikat Dutt, Subramanian Chandramouli, and Amit Kumar Das, *Machine Learning*, Pearson Education India, 2019, ISBN: 978-93-5306-737-3.
- 3) Andreas C. Müller and Sarah Guido, *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'Reilly Media, 1st Edition, 2016, ISBN: 978-1-4493-6941-5.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=jGwO_UgTS7I&list=PLoROMvody4rMiGQp3WXShtMGgzqpfVfbU
- https://www.youtube.com/watch?v=4b4MUYve_U8&list=PLoROMvody4rMiGQp3WXShtMGgzqpfVfbU&index=2
- <https://www.youtube.com/watch?v=nt63k3bfXS0&list=PLoROMvody4rMiGQp3WXShtMGgzqpfVfbU&index=5>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration of latest trends
- Contents related activities (Activity-based discussions)
 - Organizing Group wise discussions
 - Seminars

WEB DEVELOPMENT USING FULL STACK										
Course Code	24MCA32						CIE Marks	50		
L:T:P:S	3:0:1:0						SEE Marks	50		
Hrs / Week	4+2						Total Marks	100		
Credits	04						Exam Hours	03		
Course outcomes: At the end of the course, the student will be able to:										
24MCA32.1	Use mark-up tags with styles to design aesthetic web pages.									
24MCA32.2	Illustrate client-side scripting to validate the web pages.									
24MCA32.3	Apply the concepts of PHP and MySQL to develop dynamic web applications.									
24MCA32.4	Analyze the core concepts of React JS to build dynamic and responsive user interfaces.									
24MCA32.5	Examine the features and architecture of Angular JS to develop structured web applications.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA32.1	1	-	2	-	1	-	-	-	3	1
24MCA32.2	-	1	1	-	1	-	-	-	3	1
24MCA32.3	-	-	1	-	1	-	-	-	3	2
24MCA32.4	-	-	2	-	1	-	-	-	3	2
24MCA32.5	-	-	1	-	1	-	-	-	3	2
MODULE-1	INTRODUCTION TO WEB PROGRAMMING AND HTML5						24MCA32.1		8 Hours	
Introduction to Full Stack Development, HTML Basic Tags - Syntax, Elements, Attributes, Headings, Paragraph, Style, Formatting, Tables, Links, Images, Lists, Media, Audio and Video, Forms, Cascading Style Sheets - Syntax, Levels of CSS, Selectors, Properties, Background images, Styling Table, Box Model, Span and Div, Conflict Resolution. BootStrap: Introduction, Applications, File Structure, Basic HTML Template, Default Grid System — Basic Grid HTML, Container Layouts, Responsive Design.										
Laboratory Component:										2 Hours
1. Create a simple personal portfolio using basic tags, lists, hyperlinks, images and tables using HTML. 2. Design a student registration form using HTML form elements and Apply Styling with Various CSS Selectors. 3. Program to Create and Style a Student Marks Table Using HTML and CSS with Borders, Row Coloring, and Hover Effects. 4. Create a responsive gallery of images using Bootstrap grid.										
Applications	Design a responsive web page using Bootstrap that includes a header, a three-column layout for content using the default grid system, and footer.									
Text Book	Text Book 1: Chapter: 1, 2, 3									
MODULE-2	SCRIPTING LANGUAGE AND FRAMEWORK						24MCA32.2		8 Hours	
Overview of Javascript, Basics, Standard Input and Screen Output, Conditional statements, Loop and Loop control statements, Object – Creation & Modification, Math Object, Number, String Objects, Arrays, Functions, Constructors. Document Object Model - Elements Access in Java Script, Events and Event Handling, Basic Data Validation.										
Laboratory Component:										2 Hours
1. Javascript Program to count the number of vowels and reverse a string. 2. Javascript Program to Find the Maximum and Minimum Elements in an Array Using a Function. 3. Javascript Program to Validate a Registration Form Ensuring Name, Email, and Password Fields Are Not Empty and Have Proper Format.										
Text Book	Text Book 1: Chapter: 4, 5, 6									

MODULE-3		PHP		24MCA32.3		8 Hours	
Overview, PHP Framework, Applications, General Syntactic Structure, Primitives, Operations and Expressions. Control Statements, Jump Statements, Arrays. Strings, Functions, Pattern Matching, Form Handling, File Handling, Cookies, Session Tracking, Objects, Classes and Exception Handling. Database Access with PHP and MySQL.							
Laboratory Component:						2 Hours	
1. PHP program to implement any 5 string manipulation methods using functions.							
2. Program to Create a PHP Form That Accepts Password, Phone Number, and Email Address, Validates the Inputs, Displays the Submitted Data, and Writes It to a Text File Using File Handling Functions.							
3. Program to create a 'Student Management System' in PHP and MySQL by Creating a Database, Designing a 'students' Table, and Inserting Sample Student Records. Javascript Program to Accept Student Marks and Display Grade Based on Range Using Nested Conditional Statements.							
Text Book		Text Book 2: Chapter: 1, 2, 3					
MODULE-4		REACT JS		24MCA32.4		8 Hours	
Introduction to React JS, Features, Architecture, Creating React Application, JSX, Components, Component Life Cycle, Styling, Properties (Props), Constructor, Event Management, State Management, Forms, Lists, Keys, Hooks.							
Laboratory Component:						2 Hours	
1. Create a Functional Component That Accepts Props and Displays Student Information.							
2. Program to Create a Class Component with Constructor and State to Toggle a Message on Button Click.							
3. Program to Display a List of Items Using Array and Keys in React.							
Self-study		Download and install Node.js and npm (Node Package Manager). Create a New React App and understand its structure.					
Text Book		Text Book 3: Chapter: 6, 7, 9, 10, 11					
MODULE-5		INTRODUCTION TO ANGULARJS		24MCA32.5		8 Hours	
Introduction, Features, Advantages, AngularJS MVC Architecture, Directives, Expressions, Controllers, Filters, Services, Events, Forms, Validations, Examples.							
Laboratory Component:						2 Hours	
1. Program to Perform Arithmetic Operations (Addition, Subtraction, Multiplication, Division) Using AngularJS Expressions and ng-if Directive.							
2. Program to Display and Sort Employee Details by Name or Country Using AngularJS Controller and orderBy Filter.							
3. Program to Count the Number of Times a Button Is Clicked Using AngularJS.							
Text Book		Text Book 4: Chapter: 1, 2, 4, 8, 9, 11, 12					
CIE Assessment Pattern(50 Marks – Theory)							
RBT Levels		Marks Distribution					
		Test (s)	Alternate Assessment Tests AAT1		Lab		
		25	05		20		
L1	Remember	5	-		-		
L2	Understand	5	-		5		
L3	Apply	10	5		10		
L4	Analyze	5	-		5		
L5	Evaluate	-	-		-		
L6	Create	-	-		-		

SEE Assessment Pattern(50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Text Books:**

- 1) Robert W. Sebesta, *Programming the World Wide Web*, Addison-Wesley Professional, 8th Edition, 2014, ISBN: 978-0-13-377598-3.
- 2) Jake Spurlock, *Bootstrap: Responsive Web Development*, O'Reilly Media, 1st Edition, 2013, ISBN: 978-1-4493-4391-0.
- 3) Adam Trachtenberg, *PHP Cookbook: Solutions and Examples for PHP Programmers*, O'Reilly Media, 3rd Edition, 2014, ISBN: 978-1-4493-6375-8.
- 4) Shyam Seshadri and Brad Green, *AngularJS: Up and Running*, O'Reilly Media, 1st Edition, 2018, ISBN: 978-1-4919-0194-6.

Reference Books:

- 1) Mark Meyers, *A Smart Way to Learn JavaScript*, E-book and Kindle Edition, 2013, ISBN: 978-1-4974-0818-0.
- 2) Brad Traversy, *Bootstrap 5 From Scratch*, Packt Publishing, 2023, ISBN: 978-1-83546-055-9.
- 3) Nathan Murray, Felipe Coury, Ari Lerner, and Carlo Taborda, *ng-book: The Complete Guide to Angular*, CreateSpace Independent Publishing Platform, 2018, ISBN: 978-1-98517-028-5.
- 4) Aristeidis Bampakos and Pablo Deeelman, *Learning Angular: A No-Nonsense Guide to Building Web Applications with Angular 15*, Packt Publishing Ltd., 2023, ISBN: 978-1-80324-060-2.

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=3Xly2W1Cisc>
- https://www.youtube.com/watch?v=OK_JCrrv-c
- <https://html-iitd.vlabs.ac.in/exp/introduction-to-html/references.html>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Analyse existing web sites in groups to understand the usage of various full stack development tools.
- Contests on web page designing and development.

PROFESSIONAL ELECTIVES – 2

DATA SCIENCE										
Course Code	24MCA331					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	4					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes: At the end of the course, the student will be able to:										
24MCA331.1	Discuss the basics of Data Science concepts with data exploration methods.									
24MCA331.2	Use random variables and probability distributions in Data Science applications.									
24MCA331.3	Examine the significance of statistical data analysis for deriving inferences through hypothesis testing.									
24MCA331.4	Use Python libraries for data handling and data manipulation.									
24MCA331.5	Derive inferences from data findings using appropriate data visualization techniques.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA331.1	2	2	-	-	-	-	-	-	2	3
24MCA331.2	3	3	-	-	-	-	-	-	2	3
24MCA331.3	3	3	2	2	-	-	-	-	3	3
24MCA331.4	2	1	-	2	-	-	-	-	3	3
24MCA331.5	2	2	-	2	-	-	-	-	3	3
MODULE-1	INTRODUCTION TO DATA SCIENCE & TYPES OF DATA						24MCA331.1		8 Hours	
Data Science-Overview, Terminologies used Steps and Life Cycle, Applications. Structured versus Unstructured Data, Quantitative versus Qualitative Data, Basics of Data Exploration and Data Pre-Processing – Examples, Levels of Data with Mathematical Operations, Other Measures on All Levels of Data. Python Programming for Data Science – Prebuilt Python Modules.										
Case Study	Case studies for - Mathematical Operations and Measures on Data. - Data Preparation and Exploration.									
Text Book	Text Book 1: Chapter: 1.1, 1.2, 1.3, Text Book 2: Chapter: 1.1, 1.3, 1.4 Text Book 3: Chapter: 1.1 to 1.5, 2.1, 2.3, 2.4, 2.6, 3									
MODULE-2	PROBABILITY, RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS						24MCA331.2		8 Hours	
Probability - Basic Definitions, Bayesian versus Frequentist Approach, Compound Events, Rules of Probability, Advanced Probability-Bayes Theorem, Applications. Random Variables-Types of Random Variables-Discrete and Continuous, Probability Mass Function, Probability Density Function; Probability Distributions- Discrete Distributions - Binomial, Poisson, Continuous Distributions, Examples and Applications of Binomial and Poisson Distributions in Solving Business Problems.										
Text Book	Text Book 3: Chapter: 5, 6									
MODULE-3	INFERENTIAL STATISTICS AND HYPOTHESIS TESTING						24MCA331.3		8 Hours	
Introduction to Statistics, Statistical Measures – Central Moments, Variation and Relative Measures. Sampling- Population and Sample, Obtaining Sample Data, Types of Sampling Methods. Principles of Statistical Inference, Test of Hypothesis - Null and Alternative Hypothesis, Procedure for Statistical Testing, Type-I and Type-II Errors, Confidence Levels, One-Tailed and Two-Tailed Tests, Tests of Mean- One Sample, Two Sample and Paired-Sample T-Tests, Hypothesis Test for Categorical Variables – Chi-Square Goodness of Fit Test, Chi-Square Test for Association/Independence, Examples and Applications, Hypothesis testing using Python Libraries.										
Text Book	Text Book 2: Chapter: 2.3, 2.8, 2.10, 3.2, Text Book 3: Chapter: 7, 8									

MODULE-4	DATA MANIPULATION	24MCA331.4	8 Hours
Python Libraries - Significance of Python Libraries for Data Science, Introduction to Numpy – Data Types in Python, Basics of Numpy Arrays, Computation on Numpy Arrays – Universal Functions, Aggregations, Comparisons, Fancy Indexing, Sorting Arrays, Numpy’s Structured Arrays. Data Manipulation - Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Removing Duplicates, Data Filtering, Use cases, Hierarchical Indexing, Concat and Append, Merge and Join, Aggregation and Grouping.			
Case Study	Case Studies on Data Manipulation using Pandas: - Finding and Replacing Missing Data in a Dataset - Merging and Grouping of Data		
Text Book	Text Book 1: Chapter: 4.1, 5.1, 7.1, 8.2, Text Book 4: Chapter: 2.1 to 2.5, 2.7 to 2.9, 3.1 to 3.8		
MODULE-5	DATA VISUALIZATION WITH PLOTS	24MCA331.5	8 Hours
Introduction to Matplotlib – Importing, Setting Styles, Displaying Plots – Simple Line Plots, Bar Plots, Pie Charts, Scatter Plots, Box Plots, Histograms and Binnings. Customizing Plot Legends, Multiple Subplots, Visualizing Errors, Density Plots and 3D Plotting in Matplotlib, Time series Plots, Data Storytelling and Communication.			
Case Study	Case Studies to Explore Various Types of Data Visualization: - Depiction of Various Types of Plots using Matplotlib - Box Plots to Understand Outliers		
Text Book	Text Book 1: Chapter: 9.1, Text Book Chapter: 4: 4.1 to 4.10, 4.14		
CIE Assessment Pattern(50 Marks – Theory)			
RBT Levels		Marks Distribution	
		Test (s)	Alternate Assessment Tests AAT1
		25	15
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-
SEE Assessment Pattern(50 Marks – Theory)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	10	
L2	Understand	10	
L3	Apply	20	
L4	Analyze	10	
L5	Evaluate	--	
L6	Create	--	
Suggested Learning Resources:			
Text Books:			
1) Wes McKinney, <i>Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython</i> , O'Reilly Media, 3rd Edition, 2022, ISBN: 978-1-098-10403-0.			
2) Peter Bruce, Andrew Bruce, and Peter Gedeck, <i>Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python</i> , O'Reilly Media, 2nd Edition, 2020, ISBN: 978-1-4920-7294-2.			
3) Sinan Ozdemir, Sunil Kakade, and Marco Tibaldeschi, <i>Principles of Data Science</i> , Packt Publishing, 2nd Edition, 2018, ISBN: 978-1-78980-454-6.			
4) Jake VanderPlas, <i>Python Data Science Handbook: Essential Tools for Working with Data</i> , O'Reilly Media, 1st Edition, 2016, ISBN: 978-1-4919-1205-8.			
Reference Books:			
1) Joel Grus, <i>Data Science from Scratch: First Principles with Python</i> , O'Reilly Media, 2nd Edition, 2019, ISBN: 978-93-5213-832-6.			

- 2) Jeffrey S. Saltz and Jeffrey M. Stanton, *An Introduction to Data Science*, SAGE Publications, 2017, ISBN: 978-1-5063-7753-7.
- 3) Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, and Keying E. Ye, *Probability & Statistics for Engineers & Scientists*, Pearson Education, 9th Edition, 2016, ISBN: 978-0-13-411585-6.

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=xvEKQefqQ7A>
- <https://www.youtube.com/watch?v=r-uOLxNrNk8>
- <https://www.youtube.com/watch?v=GPVsH0lRBBI>
- <https://www.youtube.com/watch?v=q68Qundmans>
- <https://www.analyticsvidhya.com/blog/2021/06/must-known-data-visualization-techniques-for-data-science/>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of data pre-processing operations.
- Demonstration of data manipulation process.
- Demonstration of data visualization.
- Video demonstration of real time applications of data science.
- Contents related activities (Activity-based discussions)
 - For active participation of students, instruct the students to import any dataset from repositories for data exploration and visualization process.
 - Seminars.

ETHICAL HACKING										
Course Code	24MCA332					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	4					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA332.1	Describe the fundamental concepts of ethical hacking.									
24MCA332.2	Discuss the preliminary techniques used in information gathering about target systems.									
24MCA332.3	Apply exploitation techniques on Windows, Linux Operating Systems.									
24MCA332.4	Analyze various web application attacks and the defense mechanisms.									
24MCA332.5	Analyze security threats in mobile computing environments.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA332.1	2	2	-	-	-	-	-	-	2	3
24MCA332.2	2	2	-	2	-	-	-	-	2	3
24MCA332.3	2	2	-	-	-	-	-	-	3	3
24MCA332.4	-	2	2	2	-	-	-	-	3	3
24MCA332.5	-	2	2	-	-	-	-	-	2	3
MODULE-1	INTRODUCTION TO ETHICAL HACKING						24MCA332.1		8 Hours	
Introduction to Ethical Hacking, Federal Laws, Ethical Hacking Concepts, Elements of Information Security, Intrusion and Attacks, Types and Profiles of Attackers and Defenders, Attack Targets and Types, the Anatomy of an Attack, Ethical Hacking and Penetration Testing.										
Text Book	Text Book 1: Chapter: 1, Text Book 2: Chapter: 1									
MODULE-2	ETHICAL HACKING FOOTPRINTING AND RECONNAISSANCE, SCANNING AND ENUMERATION						24MCA332.2		8 Hours	
Foot printing and Reconnaissance: Technical Requirements, Web Searches and Google Hacks, WHOIS Database Records. Scanning and Enumeration: Exploring Scanning Techniques, Understanding Service Enumeration, Introducing the Nmap Network Scanning Tool.										
Text Book	Text Book 1: Chapter: 2, 3									
Self-study	Information Gathering on a Public-Facing E-Commerce Website.									
MODULE-3	HACKING THE OPERATING SYSTEM						24MCA332.3		8 Hours	
Hacking the Windows Operating System: Exploiting the Windows OS, Exploiting Windows Networking, Exploiting Windows Authentication, User Authentication and Movement. Hacking the Linux Operating System: Exploring the Linux File System, Exploiting the Linux OS, Exploring the Linux File System, Exploiting Linux Networking and Authentication.										
Text Book	Text Book 1: Chapter: 5, 6									
MODULE-4	WEB APPLICATION HACKING						24MCA332.4		8 Hours	
Types of web server/website attacks: Cross-Site Request Forgery, Deep linking, Man-in-the-Middle/sniffing attack, Cookie tampering, Cookie-based session attacks, SQL Injection, Cross- Site Scripting (XSS). Core Defense Mechanisms: Handling User Access, Handling User Input, Handling Attackers, Managing the Application.										
Text Book	Text Book 1: Chapter: 7, Text Book 3: Chapter: 2									
MODULE-5	HACKING DATABASES						24MCA332.5		8 Hours	
Hacking Databases: Finding Databases on the Network, Exploring Databases and Database Structures, Database Threats and Vulnerabilities. Social Engineering: Introducing Social Engineering, Phases of a Social Engineering Attack, Social Engineering Attack Techniques. Mobile Application Security: Evolution of Mobile Applications. Mobile Application Security. Understanding the Security Model, Understanding IOS Applications.										
Case Study	Analyzing a Real-World Social Engineering Breach via Phishing in Mobile Environments.									

Text Book

Text Book 1: Chapter: 8, 12, Text Book 4: Chapter: 1, 2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
			25	15
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	5	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Shane Hartman, *Hands-On Ethical Hacking Tactics: Strategies, Tools, and Techniques for Effective Cyber Defense*, Packt Publishing Ltd., 1st Edition, 2024, ISBN: 978-1-80181-008-1.

2) Michael T. Simpson, Nicholas Antill, and Rob Wilson, *Hands-On Ethical Hacking and Network Defense*, Cengage Learning, 1st Edition, 2022, ISBN: 978-0-357-50975-3.

3) Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*, Wiley, 2nd Edition, 2011, ISBN: 978-1-118-02647-2.

4) Dominic Chell, Tyrone Erasmus, and Shaun Colley, *The Mobile Application Hacker's Handbook*, Wiley, 2015, ISBN: 978-1-118-95850-6.

Reference Books:

1) Rafay Baloch, *Web Hacking Arsenal: A Practical Guide to Modern Web Pentesting*, CRC Press, 1st Edition, 2024, ISBN: 978-1-032-44717-9.

2) Scott J. Shapiro, *Fancy Bear Goes Phishing: The Dark History of the Information Age, in Five Extraordinary Hacks*, Picador, 2024, ISBN: 978-0-374-60117-1.

Web links and Video Lectures (e-Resources):

• https://onlinecourses.nptel.ac.in/noc22_cs13/preview

• <https://www.youtube.com/watch?v=cKEf8H9cQGM&list=PLwO5-rumi8A4J7h4Fm92TEC00gfZUk7ls>

• <https://www.coursera.org/specializations/introduction-to-ethical-hacking>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

• Video demonstration of latest trends

• Contents related activities (Activity-based discussions)

• Organizing Group wise discussions

AUGMENTED REALITY AND VIRTUAL REALITY										
Course Code	24MCA333						CIE Marks	50		
L:T:P:S	3:0:0:0						SEE Marks	50		
Hrs / Week	4						Total Marks	100		
Credits	03						Exam Hours	03		
Course outcomes: At the end of the course, the student will be able to:										
24MCA333.1	Define the foundational concepts and evolution of Virtual Reality (VR) and Augmented Reality (AR).									
24MCA333.2	Discuss the role of sensory systems and input/output devices in immersive AR/VR experiences.									
24MCA333.3	Demonstrate the use of Unity 3D to develop basic AR/VR applications using imported assets and interactions.									
24MCA333.4	Design simple immersive applications using Unity features like physics, animation, and UI.									
24MCA333.5	Analyze AR/VR use cases in fields like education, healthcare, and entertainment for usability and effectiveness.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA333.1	2	-	-	-	-	-	-	-	1	3
24MCA333.2	-	-	-	2	2	-	-	-	2	3
24MCA333.3	2	1	-	-	2	-	-	-	3	3
24MCA333.4	2	-	-	2	-	-	-	-	3	3
24MCA333.5	1	2	1	-	-	-	-	-	2	3
MODULE-1	INTRODUCTION						24MCA333.1		8 Hours	
Introduction to VR, Modern Experiences, Historical Perspective, Birds-Eye View for the Hardware, Sensors, Displays, Software, Virtual World Generator, Human Senses, Human Psychology and Perceptions.										
Text Book	Text Book 1: Chapter: 1, 2									
MODULE-2	OVERVIEW OF INPUT/OUTPUT DEVICES IN AR/VR						24MCA333.2		8 Hours	
Input Devices, Output Devices, Graphics Display, Human Visual System, Personal Graphics Displays, Large Volume Displays, Sound Displays, Human Auditory System										
Text Book	Text Book 1: Chapter: 2, 3 Text Book 2: Chapter: 2, 3, 9									
MODULE-3	INTRODUCTION TO AR AND DISPLAYS						24MCA333.3		8 Hours	
Introduction to AR, Examples, Related Fields. Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays.										
Text Book	Text Book 1: Chapter: 9 Text Book 2: Chapter: 1, 2, 3									
MODULE-4	EXPLORING THE UNITY 3D PROGRAMMING TOOLKIT						24MCA333.4		8 Hours	
Introduction to Unity 3D Interface – Importing and creating assets – User Interfaces for AR and VR – Combining assets into complex models – Adding physics to the interactions - Creating an AR Application and publishing to a mobile device.										
Case Study	Explore the usage of real time Applications in VR.									
Text Book	Text Book 1: Chapter: 5, 6, Text Book 2: Chapter: 12, 13									
MODULE-5	EVALUATING VR EXPERIENCES AND AR/VR APPLICATIONS						24MCA333.5		8 Hours	
Perceptual Training, Recommendations for Developers, Comfort and VR Sickness, Frontiers, Touch and Proprioception, Smell and Taste, applications- healthcare, manufacturing, Entertainment, Science, retail and branding Training, Game Development.										
Case Study	Case studies related to application of VR/AR.									
Text Book	Text Book 1: Chapter: 7, 8, 9 Text Book 2: Chapter: 9, 10, 11									

CIE Assessment Pattern(50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	5	5	-
L2	Understand	10	5	5
L3	Apply	5	3	5
L4	Analyze	5	2	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern(50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Text Book**

- 1) Steven M. LaValle, *Virtual Reality*, Cambridge University Press, 2023, ISBN: 978-1-108-18287-4.
- 2) Grigore C. Burdea and Philippe Coiffet, *Virtual Reality Technology*, Wiley-IEEE Press, 2nd Edition, 2017, ISBN: 978-1-119-48572-8.

Reference Books:

- 1) Dieter Schmalstieg and Tobias Höllerer, *Augmented Reality: Principles and Practice*, Addison-Wesley Professional, 1st Edition, 2016, ISBN: 978-0-321-88357-5.
- 2) Erin Pangilinan, Steve Lukas, and Vasanth Mohan, *Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation AR and VR*, O'Reilly Media, Inc., 2019, ISBN: 978-1-4920-4419-2.
- 3) Paul Mealy, *Virtual & Augmented Reality for Dummies*, Wiley, 1st Edition, 2018, ISBN: 978-1-119-48134-8.
- 4) Steve Aukstakalnis, *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR*, Addison-Wesley Professional, 1st Edition, 2016, ISBN: 978-0-134-09432-8.

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=h3rKvsFTfPA>
- <https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/>
- <https://youtu.be/ZFTgGi06vbM>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions).
 - For active participation of students, student presentations on case studies.
 - Organizing Group wise discussions on issues related to the subject matter.

INTERNET OF THINGS										
Course Code	24MCA334					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	4					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA334.1	Discuss the underlying concepts of M2M and IoT.									
24MCA334.2	Illustrate the technological readiness required for integration with smart objects.									
24MCA334.3	Apply IoT protocols for efficient device communication and data exchange.									
24MCA334.4	Analyze and select the appropriate microcontroller for IoT applications.									
24MCA334.5	Analyze the usage of Data-driven IoT sensing and detection with Raspberry Pi.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA334.1	3	2	2	2	-	-	-	-	2	3
24MCA334.2	3	2	1	3	-	-	-	-	2	3
24MCA334.3	3	2	-	2	-	-	-	-	3	3
24MCA334.4	3	1	1	3	-	-	-	-	3	3
24MCA334.5	2	1	-	2	-	-	-	-	3	3
MODULE-1	INTRODUCTION TO IOT EVOLUTION OF INTERNET OF THINGS						24MCA334.1		8 Hours	
Enabling Technologies – IoT Architectures: one M2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack - Fog, Edge and Cloud in IoT, -IoT and Digitization – Convergence of IT and IoT – IoT Challenges.										
Text Book	Text Book 1: Chapter: 1, 2									
MODULE-2	M2M AND IOT TECHNOLOGY FUNDAMENTALS						24MCA334.2		8 Hours	
Devices and Gateways, Actuators and its Types, Data Management, Connecting Smart Objects, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.										
Text Book	Text Book 1: Chapter: 3, 4									
MODULE-3	IOT PROTOCOLS AND PLATFORMS						24MCA334.3		8 Hours	
6LowPAN, Wi-fi, Bluetooth, COAP, MQTT, Zigbee Architecture, LoRaWAN Platforms- Components of Microsoft Azure, Google Cloud.										
Text Book	Text Book 1: Chapter: 5, 6									
MODULE-4	IOT PROGRAMMING						24MCA334.4		8 Hours	
Introduction to RaspberryPI, Rasbian OS, Interfacing Analog and Digital Devices, Enabling Network Connectivity, Connecting with Web Server, API Connectivity- Open Weather Map API.										
Self-study	- Exploring different components of RaspberryPI - Setting up of the board and booting the board. - Working with sensors on RaspberryPI - Practices on python coding									
Text Book	Text Book 2: Chapter: 4									
MODULE-5	APPLICATIONS OF IOT						24MCA334.5		8 Hours	
Use of Big Data and Visualization in IoT - Industry 4.0 Concepts , Web Enabled Constrained Devices, Role of Machine Learning, Monitoring Ambient Room Temperature using DHT11 Sensor, Using an RPi to Control an RGB LED, Using a PIR Motion Sensor and Detecting an Object with Raspberry Pi.										
Self-study	- Working with Simple IoT Applications - Project Work									
Text Book	Text Book 1: Chapter: 6									

CIE Assessment Pattern(50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	5	4
L3	Apply	10	5	4
L4	Analyze	5	5	2
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern(50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:**Text Books:**

- 1) Maciej Kranz, *Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry*, Wiley, 1st Edition, 2016, ISBN: 978-1-119-28566-1.
- 2) David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, 1st Edition, 2017, ISBN: 978-1-58714-456-2.

Reference Books:

- 1) Qinghao Tang and Fan Du, *Internet of Things Security: Principles and Practice*, Springer, 1st Edition, 2021, ISBN: 978-0-13-430706-0.
- 2) Chandrasekar Vuppapapati, *Building Enterprise IoT Applications*, Academic Press, 1st Edition, 2019, ISBN: 978-0-429-50869-1.
- 3) Peter Waher, *Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3*, Packt Publishing, 1st Edition, 2018, ISBN: 978-1-78839-743-8.
- 4) Colin Dow, *Internet of Things Programming Projects: Build Modern IoT Solutions with the Raspberry Pi 3 and Python*, Packt Publishing, 1st Edition, 2018, ISBN: 978-1-78839-743-8.

Web links and Video Lectures (e-Resources):

- <https://www.raspberrypi.org/>
- <https://www.postscapes.com/internet-of-things-protocols/>
- <https://www.javatpoint.com/iot-tutorial>
- https://onlinecourses.nptel.ac.in/noc22_cs53/preview
- <https://www.coursera.org/specializations/iot>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of working of M2M.
- Demonstration of basic IoT Protocols & IoT Programming.
- Video demonstration of latest trends in IoT applications.
- Contents related activities (Activity-based discussions).
 - For active participation of students, instruct the students to prepare IoT projects
 - Organizing Group wise discussions on issues & Expert Talk

UI/UX DESIGN										
Course Code	24MCA335					CIE Marks	50			
L:T:P:S	3:0:0:0					SEE Marks	50			
Hrs / Week	4					Total Marks	100			
Credits	03					Exam Hours	03			
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA335.1	Understand the iterative user-centred design of graphical user interfaces.									
24MCA335.2	Explain the basics of user experience design and its key components.									
24MCA335.3	Apply design and evaluation methods to manage and assess user interface development.									
24MCA335.4	Implement interface techniques and components to support effective user input.									
24MCA335.5	Analyze user needs to design wireframes and prototypes using suitable tools.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PS01	PS02
24MCA335.1	2	1	2	-	-	-	-	-	1	2
24MCA335.2	2	1	2	-	-	-	-	-	2	2
24MCA335.3	2	1	2	-	-	-	-	-	2	2
24MCA335.4	2	1	2	-	-	-	-	-	2	2
24MCA335.5	2	1	-	-	-	-	-	-	2	2
MODULE-1	INTRODUCTION TO UI					24MCA335.1			8 Hours	
What is User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief Historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design.										
Text Book	Text Book 1: Chapter: 1, 2 Text Book 2: Chapter 6									
Hands-on	Study the process of creating Graphically User Interface									
MODULE-2	INTRODUCTION TO UX					24MCA335.2			8 Hours	
UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design.										
Reference Book	Text Book 1: Chapter: 1 Text Book 2: Chapter 6									
MODULE-3	DEVELOPMENT PROCESS					24MCA335.3			8 Hours	
Managing Design Processes- Introduction, Organizational Design to support Usability, The Four Pillars of Design, and Development methodologies: Ethnographic Observation, Participatory Design, Scenario Development, and Social Impact statement for Early Design Review, Legal Issues. Evaluating Interface Design- Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance tests, Evaluation during Active Use, Controlled Psychologically Oriented Experiments.										
Skill Development Activities	Develop the complete design process									
Text Book	Text Book 3: Chapter 14									
MODULE-4	INTERACTION STYLES & DEVICES					24MCA335.4			8 Hours	
Direct Manipulation and Virtual Environments- Introduction, Examples of Direct Manipulation, Discussion of direct manipulation, 3D Interfaces, Tele-operation, Virtual and Augmented Reality. Menu Selection, Form Filling and Dialog Boxes- Introduction, Task-Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement Through Menus, Data Entry with Menus, Form Filling, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays. Interaction Devices- Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory interfaces, Displays-Small and Large.										
Text Book	Text Book 3: Chapter 4									
MODULE-5	UI/ UX DESIGN TOOLS					24MCA335.5			8 Hours	
User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wire framing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design.										

Skill Development Activities	Study the implementation of GUI to different devices.		
Reference Book	Text Book 3: Chapter 8		
CIE Assessment Pattern(50 Marks – Theory)			
RBT Levels		Marks Distribution	
		Test (s)	Alternate Assessment Tests AAT1
		25	15
L1	Remember	5	-
L2	Understand	10	5
L3	Apply	5	5
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-
SEE Assessment Pattern(50 Marks – Theory)			
RBT Levels		Exam Marks Distribution (50)	
L1	Remember	10	
L2	Understand	10	
L3	Apply	20	
L4	Analyze	10	
L5	Evaluate	-	
L6	Create	-	
Suggested Learning Resources			
Text Book:			
1) Russ Unger and Carolyn Chandler, <i>A Project Guide to UX Design: For User Experience Designers in the Field or in the Making</i> , New Riders Publishing, 2nd Edition, 2012, ISBN: 978-0-321-91538-2.			
2) Jesse James Garrett, <i>The Elements of User Experience: User-Centered Design for the Web and Beyond</i> , Pearson Education, 2nd Edition, 2011, ISBN: 978-0-321-68368-7.			
3) Wilbert O. Galitz, <i>The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques</i> , Wiley Publishing, 3rd Edition, 2007, ISBN: 978-0-470-05342-3.			
Reference Books:			
1) Elvis Canziba, <i>Hands-On UX Design for Developers: Design, Prototype, and Implement Compelling User Experiences from Scratch</i> , Packt Publishing, 1st Edition, 2018, ISBN: 978-1-78862-669-9.			
2) Wilbert O. Galitz, <i>The Essential Guide to User Interface Design: An Introduction to GUI Design, Principles and Techniques</i> , Wiley-Dreamtech India Pvt. Ltd., 3rd Edition, 2015, ISBN: 978-0-470-05342-3.			
3) Thomas A. Eberts, <i>User Interface Design</i> , Prentice Hall, 1st Edition, 1994, ISBN: 978-0-131-40328-4.			
Web links and Video Lectures (e-Resources):			
• https://www.udemy.com/ User Interface / User Experience			
• https://www.coursera.org/learn/ User Interface / User Experience			
• https://nptel.ac.in/courses/106106129/			
• https://www.youtube.com/watch?v=N-xuqy6x1Bw			
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning			
• Seminars.			
• Video on latest UX.			
• Case Study on design creation and exporting.			
• Hands-on Sessions.			

PROJECT WORK										
Course Code	24MCA34					CIE Marks		50		
L:T:P:S	0:0:9:0					SEE Marks		50		
Hrs / Week	18					Total Marks		100		
Credits	09					Exam Hours		3		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA34.1	Identify the problem definition statement and requirements for the project.									
24MCA34.2	Apply the design methodology for the identified requirements.									
24MCA34.3	Implement the functional modules with necessary interfaces.									
24MCA34.4	Evaluate appropriate testing strategies and generate test cases.									
24MCA34.5	Formulate all project findings in the prescribed report template.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA34.1	1	2	-	-	-	-	-	1	3	3
24MCA34.2	-	-	3	-	3	-	-	-	3	3
24MCA34.3	-	-	3	-	3	-	-	-	3	3
24MCA34.4	-	-	-	3	-	-	-	-	3	3
24MCA34.5	-	-	-	-	-	-	-	-	3	3
GUIDELINES										
1. The student shall complete the project within the stipulated timeline by adopting an appropriate software development methodology. 2. The Project Guide(s) and the Project Coordinator shall evaluate the project in accordance with the rubrics prescribed by the department. 3. The Continuous Internal Evaluation (CIE) marks for the project shall be awarded by an Evaluation Committee comprising the Head of the Department (Chairperson), the Project Guide/Co-Guide (if applicable), and a senior faculty member of the department. 4. The CIE for the project shall be based on the evaluation of the Project Report (subject to a satisfactory plagiarism check), the quality of the project presentation, and the student's performance in the viva-voce examination. 5. The Semester End Examination (SEE) for the project shall consist of the evaluation of the project work followed by a viva-voce examination. 6. The project shall be evaluated based on the following criteria: i. Review of Objectives, Methodology, and Implementation ii. Design, Implementation, and Testing iii. Experimental Results and Analysis, Conclusions, Future Scope of Work, and Report Writing iv. Project Presentation and Viva-Voce Performance										

CIE- Continuous Internal Evaluation: Practical Demonstration (50 Marks)

Continuous Internal Evaluation	Tests Marks (50)
Problem Identification and literature	10
Data Sampling and Cleaning	5
Objectives	5
Developing the solution	10
Project Report	10
Project Presentation	5
Project Evaluation	5

SEE- Continuous Internal Evaluation: Practical Demonstration (50 Marks)

Semester End Evaluation	Marks (50)
Problem Identification and literature	10
Data Sampling and Cleaning	5
Objectives	5
Developing the solution	10
Project Report	10
Project Presentation	5
Project Evaluation	5

Suggested Learning Resources:**Web links:**

- <https://www.youtube.com/watch?v=-GwBNwZOPUs>
- <https://www.youtube.com/watch?v=9PgZCJNzY9M>

Fourth Semester MCA AY -2026-27

PROFESSIONAL ELECTIVES - 3

AI ETHICS										
Course Code	24MCA411					CIE Marks	50			
L:T:P:S	3:0:0:0					SEE Marks	50			
Hrs / Week	3					Total Marks	100			
Credits	03					Exam Hours	03			
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA411.1	Explain the importance of AI ethics and key concerns while interpreting ethical theories.									
24MCA411.2	Apply ethical principles to assess data use, bias & accountability in AI through case studies.									
24MCA411.3	Apply ethical principles to address challenges in AI use and governance.									
24MCA411.4	Investigate computer technologies for accessibility issues.									
24MCA411.5	Identify software development strategies that align with engineering standards.									
Mapping of Course Outcomes to Program Outcomes:										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA411.1	-	-	-	-	-	-	3	-	1	3
24MCA411.2	-	-	-	-	-	-	3	-	1	3
24MCA411.3	-	-	-	-	-	-	3	-	1	3
24MCA411.4	-	-	-	-	-	-	3	-	-	3
24MCA411.5	-	-	-	-	-	-	3	-	1	3
MODULE-1	FOUNDATIONS OF AI ETHICS AND MORAL REASONING						24MCA411.1		8 Hours	
Introduction to AI Ethics, Importance, Definitions, and Scope, Current Initiatives in AI and Ethics, Codes of Ethics in Context: Other Approaches to Ethical Questions in AI, Epistemic Strategies: Precision and the Reduction of Uncertainty, Technological Strategies to Ensure Safe and Beneficial AI, Moral Strategies in the Pursuit of Beneficial AI, Key Ethical Concerns: Bias, Privacy, Surveillance, Automation, Accountability, Ethical Theories: Utilitarianism, Deontology, Legal Frameworks, Professional Codes (ACM, IEEE), Case Studies, Ethical Dilemmas in Decision-Making, Responsible AI Design, Hacking and Security Ethics.										
Text Book	Text Book 1: Chapter: 3, 4, 7									
MODULE-2	DATA, DECISION-MAKING AND ACCOUNTABILITY IN AI						24MCA411.2		8 Hours	
Introduction to Data Ethics in AI, Privacy and Consent in Data Collection, Data Ownership and Ethical Use, Differential Privacy and Metadata Risks, Transparency in Model Training, Algorithmic Bias and Fairness, the Black-Box Problem, Accountability in Automated Decisions, Case Studies in Predictive Policing and Hiring, Explain ability and Audit ability in AI Design, Professional Responsibility and Ethical Audits.										
Case Study	Analyze a recent AI ethics controversy (e.g., ChatGPT misuse) and identify the ethical concerns involved.									
Text Book	Text Book 1: Chapter: 6, 7, 8									
MODULE-3	GOVERNANCE, CONTROVERSIES AND THE FUTURE OF ETHICAL AI						24MCA411.3		8 Hours	
Autonomous Systems and Moral Dilemmas, AI in Military and Surveillance, Generative AI in Creative Industries, Cultural Relativism and Global Justice, Governance Models and Regulatory Challenges, Stakeholder Diversity and Ethical Guidelines, Emerging Technologies and Alignment Problem, Transparent and Adaptive Ethical Frameworks.										
Text Book	Text Book 1: Chapter: 9, 10									
MODULE-4	COMPUTER TECHNOLOGIES ACCESSIBILITY ISSUES						24MCA411.4		8 Hours	
Principle of Equal Access, Obstacles to Access for Individuals, Professional Responsibility, Empowering Computers in the Workplace, Introduction to Computers and Employment, Computers and the Quality of Work, Computerized Monitoring in the Work Place, Telecommuting, Social, Legal and Professional Issues, Use of Software, Computers and Internet-based Tools, Liability for Software Errors, Documentation Authentication and Control, Software Engineering Code of Ethics and Practices.										
Text Book	Text Book 2: Chapter: 1, 3 ,11									

MODULE-5	SOFTWARE DEVELOPMENT AND SOCIAL NETWORKING		24MCA411.5	8 Hours
Strategies for Engineering Quality Standards, Quality Management Standards, Social Networking, Company Owned Social Network Web Site, The Use of Social Networks in the Hiring Process, Social Networking Ethical Issues, Cyber Bullying, Stalking, Online Virtual World, Crime in Virtual World, Digital Rights Management, Online Defamation, Privacy and Fraud.				
Self-study		Prepare a report on current trends in privacy breach and frauds.		
Text Book		Text Book 3: Chapter: 6, 7, 9		
CIE Assessment Pattern (50 Marks – Theory)				
RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	10	-	-
L2	Understand	10	10	5
L3	Apply	5	5	5
L4	Analyze	-	-	-
L5	Evaluate	-	-	-
L6	Create	-	-	-
SEE Assessment Pattern(50 Marks – Theory)				
RBT Levels		Exam Marks Distribution (50)		
L1	Remember	20		
L2	Understand	20		
L3	Apply	5		
L4	Analyze	5		
L5	Evaluate	-		
L6	Create	-		
Suggested Learning Resources:				
Text Books:				
1) Paula Boddington, <i>AI Ethics: A Textbook</i> , Springer, 1st Edition, 2024, ISBN: 978-981-199-384-8.				
2) Barry G. Blundell, <i>Ethics in Computing, Science and Engineering</i> , Springer International Publishing, 1st Edition, 2020, ISBN: 978-3-030-27126-8.				
3) George Reynolds, <i>Ethics in Information Technology</i> , Cengage Learning, 5th Edition, 2011, ISBN: 978-1-111-53412-7.				
References Books:				
1) Mark Coeckelbergh, <i>AI Ethics (The MIT Press Essential Knowledge Series)</i> , MIT Press, 1st Edition, 2020, ISBN: 978-0-262-53819-0.				
2) Caroline Whitbeck, <i>Ethics in Engineering Practice and Research</i> , Cambridge University Press, 2011, ISBN: 978-0-521-72398-5.				
3) Sara Baase, <i>A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet</i> , Pearson, 3rd Edition, 2008, ISBN: 978-0-136-00848-4.				
Web links and Video Lectures (e-Resources):				
• https://www.elementsofai.com				
• https://www.scu.edu/ethics/focus-areas/technology-ethics/resources/ai-ethics				
• https://www.partnershiponai.org				
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning				
• Video demonstration of latest tools and trends in design thinking.				
• Case Study Analysis: Examine a real-world ethical dilemma (e.g., autonomous vehicle accident) using decision-making frameworks.				

DIGITAL FORENSICS										
Course Code	24MCA412					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	3					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA412.1	Explain the principles, lifecycle, and legal standards of digital forensics.									
24MCA412.2	Analyze hardware, OS, and memory components in forensic investigation.									
24MCA412.3	Perform forensics on hosts, emails, and dark web artifacts.									
24MCA412.4	Apply forensic methods for network, mobile, cloud, and IoT environments.									
24MCA412.5	Examine malware, anti-forensics, and apply forensic frameworks to cases.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA412.1	2	1	1	-	-	-	-	-	2	3
24MCA412.2	2	-	2	-	-	-	-	-	2	3
24MCA412.3	-	2	-	-	-	-	-	-	3	3
24MCA412.4	2	3	2	-	-	2	-	-	3	3
24MCA412.5	3	3	3	2	2	-	-	-	2	3
MODULE-1	PRINCIPLES CYPBER FORENSICS						24MCA412.1		8 Hours	
Introduction & Scope of Digital Forensics: Forensic Investigation Lifecycle: Identification → Acquisition → Analysis → Reporting, Digital Evidence Collection & Preservation, Encryption/Decryption Techniques, Password Cracking Basics, Legal Framework: ITS Act 2000, Cybercrime Case Studies, Forensic Standards: ISO, NIST Guidelines.										
Text Book	Text Book 1: Chapter: 1, 2, Text Book 5: Chapter: 1									
MODULE-2	FORENSICS HARDWARE & OS FORENSICS						24MCA412.2		8 Hours	
Disk & SSD Imaging Techniques, File System Analysis: NTFS, FAT32, ext4 Deleted/Hidden Data Recovery OS Artifacts: Prefetch, Registry, Log Files Memory Dump & RAM Forensics, Volatility, Sleuth Kit, FTK Imager.										
Text Book	Text Book 1: Chapter: 4, 5, Text Book 5: Chapter: 2									
Self-study	Perform RAM dump and analyze with Volatility to find active processes.									
MODULE-3	FORENSICS HOST, EMAIL & DARK WEB FORENSICS						24MCA412.3		8 Hours	
Windows, Linux, Android, IOS Forensics, Email Header Analysis & Metadata Tracing, Browser Cache, History Forensics, Steganography and Anti-Forensics, Dark Web Analysis (Tor, Hidden Services).										
Text Book	Text Book 5: Chapter: 5, 6									
Applications	Analyze an email header using MxToolbox.									
MODULE-4	FORENSICS NETWORK, MOBILE, CLOUD & IOT FORENSICS						24MCA412.4		8 Hours	
Packet Capture: TCP Dump, Wireshark, Network Intrusion Detection & Logging, Mobile Analysis: ADB, App Data, SD Card, Cloud Forensics: Cloud Storage Logs, VMs, IoT & Embedded Device Forensics.										
Text Book	Text Book 2: Chapter: 3.2, 3.4, Text Book 3: Chapter: 4.1									
Self-study	Capture network traffic using Wireshark and analyze login patterns.									
MODULE-5	FORENSICS MALWARE & ADVANCED TOPICS IN FORENSICS						24MCA412.5		8 Hours	
Malware Types: Viruses, Trojans, Ransomware, Obfuscation, Rootkits, Code Injection, Static/Dynamic Malware Analysis, Image/File Signature Matching, Case Studies: Insider Threats, Financial Fraud, Forensic Frameworks: MITRE ATT&CK, NIST CFReDS.										
Self-study	Scan file on Virus Total, document suspicious indicators.									
Text Book	Text Book 3: Chapter: 6.2, 6.3, Text Book 4: Chapter: 5									

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	10	5	5
L3	Apply	5	5	5
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) Brian Carrier, *File System Forensic Analysis*, Addison-Wesley, 1st Edition, 2005, ISBN: 978-0-321-26817-4.
- 2) Jason Luttgens, Matthew Pepe, and Kevin Mandia, *Incident Response and Computer Forensics*, McGraw-Hill Education, 3rd Edition, 2014, ISBN: 978-0-07-179868-6.
- 3) Michael Sikorski and Andrew Honig, *Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software*, No Starch Press, 1st Edition, 2012, ISBN: 978-1-59327-290-6.
- 4) Andrew Hoog and Katie Strzempka, *iPhone and iOS Forensics: Investigation, Analysis and Mobile Security for Apple iPhone, iPad and iOS Devices*, Syngress, 1st Edition, 2011, ISBN: 978-1-59749-659-9.
- 5) Eoghan Casey, *Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet*, Academic Press, 3rd Edition, 2011, ISBN: 978-0-12-374268-1.

Reference Books:

- 1) Dan Farmer and Wietse Venema, *Forensic Discovery*, Addison-Wesley, 1st Edition, 2005, ISBN: 978-0-201-63437-2.
- 2) Bill Nelson, Amelia Phillips, and Christopher Steuart, *Computer Forensics and Investigations*, Cengage Learning, 6th Edition, 2018, ISBN: 978-1-337-60055-1.
- 3) Robert M. Slade, *Software Forensics: Collecting Evidence from the Scene of a Digital Crime*, McGraw-Hill, 1st Edition, 2004, ISBN: 978-0-07-142804-0.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_cs54/preview
- https://onlinecourses.nptel.ac.in/noc21_cs14/preview
- <https://www.vlab.co.in/broad-area-cyber-security>
- <https://www.skytap.com/terms-glossary/virtual-lab-cloud/>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Setup and analysis of forensic cases using FTK Imager and Autopsy.
- Hands-on with public datasets from NIST CFReDS.
- Capture & analyze network packets using Wireshark.
- Student seminar on malware trends and forensic toolkits.
- Simulation of dark web access using Tor for analysis demo.

DESIGN THINKING AND INNOVATION										
Course Code	24MCA413					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	3					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA413.1	Discuss the entrepreneurial characteristics, business ideas, and aspects of management and administration.									
24MCA413.2	Apply ideas for businesses with innovative problem-solving approach.									
24MCA413.3	Apply strategic planning for entrepreneurial management and legal forms of business.									
24MCA413.4	Examine principles in management and planning process.									
24MCA413.5	Investigate the characteristics of successful leadership.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA413.1	3	2	2	1	-	-	-	-	2	2
24MCA413.2	2	3	3	2	-	-	-	-	3	2
24MCA413.3	2	3	3	2	2	2	-	-	3	3
24MCA413.4	1	2	2	2	2	3	-	-	3	3
24MCA413.5	1	2	3	-	-	-	3	-	3	3
MODULE-1	INTRODUCTION TO DESIGN THINKING					24MCA413.1			8 Hours	
Introduction to elements and principles of Design, basics of design—dot, line, shape, form as fundamental Design components. Principles of design. Introduction to design thinking, history of Design Thinking, New Materials in Industry.										
Text Book	Text Book 1: Chapter: 1.1, 1.2, 3.1 Text Book 2: Chapter: 2.1, 2.2, 2.4									
MODULE-2	DESIGN THINKING PROCESS					24MCA413.2			8 Hours	
Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving Inventions, design thinking in social innovations. Tools of design thinking – person, customer, journey map, Brainstorming, product development.										
Self-study	Explore new ideas for getting opportunity for the business.									
Text Book	Text Book 1: Chapter: 2.1, 3.1, 4.1, 6.2 Text Book 2: Chapter: 3.1, 3.2, 4.1									
MODULE-3	INNOVATION					24MCA413.3			8 Hours	
Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations – Creativity to Innovation – Teams for innovation – Measuring the impact and value of creativity.										
Text Book	Text Book 1: Chapter: 7.1, 10.1, 10.2 Text Book 2: Chapter: 4.2, 4.3, 4.5									
MODULE-4	PRINCIPLES OF MANAGEMENT					24MCA413.4			8 Hours	
Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications – Innovation towards product design – Case studies.										
Applications	Practice writing a design brief for a product problem (e.g., redesign a water bottle for elderly users). Choose a popular product (e.g., Apple AirPods) and perform SWOT (Strengths, Weaknesses, Opportunities, Threats).									
Text Book	Text Book 1: Chapter: 5.1, 6.1, 6.2 Text Book 2: Chapter: 5.1, 5.2, 5.3									
MODULE-5	DESIGN THINKING IN BUSINESS PROCESSES					24MCA413.5			8 Hours	
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs – Design thinking for Startups – Defining and testing Business Models and Business Cases – Developing & testing prototypes.										
Case Study	Pick a startup idea (e.g., a food delivery app for rural areas) and build a Business Model Canvas. Sketch a wireframe prototype (paper-based) for a new service/product idea.									

Text Book

Text Book 1: Chapter: 7.1, 8.1, 9.1 Text Book 2: Chapter: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6,7.1

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
			25	15
L1	Remember	5	5	-
L2	Understand	10	5	5
L3	Apply	5	3	5
L4	Analyze	5	2	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, HarperCollins, 1st Edition, 2009, ISBN: 978-0-06-176608-4.

2) Idris Mootee, *Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School*, John Wiley & Sons, 1st Edition, 2013, ISBN: 978-1-118-62012-0.

Reference Books:

1) David Lee, *Design Thinking in the Classroom*, Ulysses Press, ISBN: 978-1-61243-801-6.

2) Shruti N. Shetty, *Design the Future*, Norton Press, ISBN: 978-1-59253-587-3.

3) William Lidwell, Kritina Holden, and Jill Butler, *Universal Principles of Design: 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach through Design*, Rockport Publishers, 2010, ISBN: 978-1-59253-587-3.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/110/106/110106124/

https://nptel.ac.in/courses/109/104/109104109/

https://swayam.gov.in/nd1_noc19_mg60/preview

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:

Contents related activities (Activity-based discussions).

For active participation of students, student presentations on case studies.

Organizing Group wise discussions on issues related to the subject matter.

DIGITAL MARKETING										
Course Code	24MCA414					CIE Marks	50			
L:T:P:S	3:0:0:0					SEE Marks	50			
Hrs / Week	3					Total Marks	100			
Credits	03					Exam Hours	03			
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA414.1	Apply the concepts of digital marketing as a tool.									
24MCA414.2	Analyze Ad placements for creating Ad. Campaigns.									
24MCA414.3	Use SEO tactics with off-page and on-page optimization.									
24MCA414.4	Examine Ad campaigns.									
24MCA414.5	Justify the usage of social media strategies.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA414.1	-	-	-	-	2	-	-	-	1	3
24MCA414.2	-	2	-	-	-	-	-	-	1	3
24MCA414.3	-	-	-	-	2	-	-	-	1	3
24MCA414.4	-	-	-	-	-	-	-	-	1	3
24MCA414.5	-	-	-	-	-	2	-	-	1	3
MODULE-1	INTRODUCTION TO DIGITAL MARKETING					24MCA414.1			8 Hours	
Traditional vs Digital Marketing, Significance and Process, E-Contents - Web Site Planning and Development, Keywords, Domain and Web - Hosting. P.O.E.M. Framework, Digital Landscape, Plan and Models.										
Text Book	Text Book 1: Chapter: 1.1, 1.3, 1.6, Text Book 2: Chapter: 1.1, 1.2, 1.4, 2.3									
MODULE-2	INTERNET MARKETING AND DIGITAL MARKETING MIX					24MCA414.2			8 Hours	
Internet Marketing, Opportunities and Challenges, Digital Marketing Framework, Digital Marketing Mix, Impact of Digital Channels on IMC, Search Engine Advertising, Campaign Report Generation, Display Marketing, Analytics Tools, YouTube Marketing.										
Text Book	Text Book 1: Chapter: 2.1, 2.2, 2.3, 2.7, 2.8, 2.9, 3.1, 3.2, 3.3, 3.4, Text Book 2: Chapter: 3.3, 3.4, 5.2									
MODULE-3	INTRODUCTION TO SEARCH ENGINE OPTIMIZATION					24MCA414.3			8 Hours	
SEO, SEM, Web Analytics, Mobile Marketing, Trends in Digital Advertising, On-Page and Off-Page Optimization, SEO Tactics, Google Analytics, Google Adwords, Multi-Channel Attribution, Universal Analytics, Type of Tracking Codes.										
Text Book	Text Book 1: Chapter: 10, Text Book 2: Chapter: 8.2, 8.5, 10, 11									
MODULE-4	SOCIAL MEDIA MARKETING					24MCA414.4			8 Hours	
Role of Influencer Marketing, Tools & Plan, Facebook-Business through Facebook, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools, Linkedin - Marketing, Content Strategy, Analytics and Targeting, Twitter-Marketing, Instagram & Snapchat- Strategies for Marketing.										
Case Study	Facebook Marketing tools, LinkedIn Marketing tools									
Text Book	Text Book 1: Chapter: 4.1, 6.7, 8.1, 8.2, 9									
MODULE-5	ADDRESSING SOCIAL MEDIA CHANNELS					24MCA414.5			8 Hours	
Introduction, Traditional Media vs Social Media, Social Media Channels, Tracking Social Media Campaigns, Rules of Engagement, Advantages, Challenges, Social Media Strategy, Step-by-Step Guide to Create a Social Media Strategy, Dealing with Opportunities and Threats.										
Case Study	Data collection for web analytics, Google Analytics.									
Text Book	Text Book 2: Chapter: 6.3, 6.4, 6.5, 9.3									

CIE Assessment Pattern(50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	5
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern(50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:**Text Books:**

- 1) Seema Gupta, *Digital Marketing*, McGraw Hill Education, 1st Edition, 2017, ISBN: 978-93-87067-615-0.
- 2) Puneet Singh Bhatia, *Fundamentals of Digital Marketing*, Pearson Education, 1st Edition, 2017, ISBN: 978-93-3258-737-3.

Reference Books:

- 1) Ian Dodson, *The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns*, Wiley, 1st Edition, 2016, ISBN: 978-1-119-26570-2.
- 2) Nitin C. Kamat and Chinmay Nitin Kamat, *Digital Social Media Marketing*, Himalaya Publishing House Pvt. Ltd., 1st Edition, 2018, ISBN: 978-93-5299-115-0.
- 3) Seema Gupta and Avadhoot Jathar, *Marketing Analytics*, Wiley India Pvt. Ltd., 1st Edition, 2021, ISBN: 978-93-5424-262-5.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.swayam2.ac.in/ugc19_hs26/preview
- <https://www.classcentral.com/course/swayam-digital-marketing-14006>
- <https://www.tutorialsduniya.com/notes/digital-marketing-notes/>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of facebook and LinkedIn marketing tools.
- Hands on session.
- Contents related activities (Activity-based discussions).
 - Seminars

AGILE SOFTWARE DEVELOPMENT										
Course Code	24MCA415					CIE Marks		50		
L:T:P:S	3:0:0:0					SEE Marks		50		
Hrs / Week	3					Total Marks		100		
Credits	03					Exam Hours		03		
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA415.1	Categorize the activities covered in project management and related terms.									
24MCA415.2	Examine key criterions used for project evaluation.									
24MCA415.3	Examine the evolution of Agile methodologies and various Agile frameworks.									
24MCA415.4	Apply the Scrum framework using its core components.									
24MCA415.5	Discuss the principles and practices of agile-based software design, development, and testing.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA415.1	-	1	-	-	-	3	-	-	2	2
24MCA415.2	-	-	2	-	-	3	2	-	3	2
24MCA415.3	-	-	2	-	-	3	-	-	2	3
24MCA415.4	-	-	-	-	1	3	-	-	2	3
24MCA415.5	1	-	3	2	1	3	-	-	3	3
MODULE-1	INTRODUCTION & PROJECT PLANNING					24MCA415.1			8 Hours	
Types of Projects, Contract Management, Technical Project Management, Underlying Activities, Planning, Methods and Methodologies, Stakeholders, Project Objectives, Project Management Life Cycle, Project Schedules, Work Break-Down Structure, CPM, PERT.										
Text Book	Text Book 1: Chapter: 1.1, 1.2 , 1.4, 1.5, 1.6, 1.7, 1.10, 1.11, 1.16, 1.17, Text Book 2: Chapter: 1,2									
MODULE-2	PROJECT EVALUATION & MANAGEMENT					24MCA415.2			8 Hours	
Evaluation - Individual Projects, Cost-Benefit, Risks, Program Management – Allocation of Resources, Special Aids, Performance Management, Strategic Program Management and Benefits, Software Configuration Management (SCM).										
Self-study	Explore the key criteria used to evaluate individual projects, such as feasibility, return on investment, and alignment with organizational goals.									
Text Book	Text Book 1: Chapter: 2.2, 2.3, 2.4 to 2.13									
MODULE-3	FUNDAMENTALS OF AGILE PROCESS					24MCA415.3			8 Hours	
Introduction and Background, Traditional Model vs. Agile model - Agile Manifesto, Principles, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development.										
Text Book	Text Book 3: Chapter: 1, Text Book 5: Chapter: 5.4,5.5									
MODULE-4	SCRUM FRAMEWORK					24MCA415.4			8 Hours	
Introduction to Scrum, Scrum Artifacts, Meetings, Activities and Roles, Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning, Sprinting: Planning, Execution, Review and Retrospective; User Story Definition and Characteristics, Acceptance Tests and Verifying Stories, Burn Down Chart, Daily Scrum.										
Self-study	Understand how Scrum roles and meetings contribute to project transparency.									
Text Book	Text Book 4: Chapter: 1, 2, 4, 5, 7, 14, 17, 18, 19, 20, 21, 22									
MODULE-5	AGILE DESIGN, DEVELOPMENT AND TESTING					24MCA415.5			8 Hours	
Agile Design Practices, Role of Design Principles, Need and Significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated Build Tools, Version Control; Agility and Quality Assurance: Agile										

Interaction Design, Agile Approach to Quality Assurance, Test Driven Development, Pair programming: Issues and Challenges.

Text Book Text Book 3: Chapter: 2, 4 5, 7, 8-11

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	10	5	5
L3	Apply	5	5	5
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- 1) Bob Hughes, Mike Cotterell, and Rajib Mall, *Software Project Management*, McGraw-Hill Education, 6th Edition, 2018, ISBN: 978-93-5316-234-6.
- 2) Ralph Cybulski, *PMP PMBOK Study Guide*, Project Management Institute, 7th Edition, 2020, ISBN: 978-1-62825-664-2.
- 3) Robert C. Martin, *Agile Software Development: Principles, Patterns, and Practices*, Prentice Hall, 1st Edition, 2013, ISBN: 978-0-135-97444-5.
- 4) Kenneth S. Rubin, *Essential Scrum: A Practical Guide to the Most Popular Agile Process*, Addison-Wesley Professional, 1st Edition, 2012, ISBN: 978-0-137-04329-3.
- 5) Roger S. Pressman and Bruce R. Maxim, *Software Engineering: A Practitioner's Approach*, McGraw-Hill Education, 8th Edition, 2015, ISBN: 978-0-078-02212-8.

Reference Books:

- 1) Kalpesh Ashar, *Project Management Essentials You Always Wanted to Know*, Vibrant Publishers, 4th Edition, 2021, ISBN: 978-1-63651-009-0.
- 2) Jack T. Marchewka, *Information Technology Project Management*, Wiley Student Edition, 4th Edition, Wiley India, 2013, ISBN: 978-81-265-5601-2.
- 3) Lisa Crispin and Janet Gregory, *Agile Testing: A Practical Guide for Testers and Agile Teams*, Addison-Wesley Professional, 1st Edition, 2009, ISBN: 978-0-321-53446-0.
- 4) Ken Schwaber and Mike Beedle, *Agile Software Development with Scrum*, International Edition, Pearson Education, 1st Edition, 2002, ISBN: 978-0-130-67634-4.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/110107081>
- <https://www.youtube.com/watch?v=Z9QbYZh1YXY>
- <https://www.youtube.com/watch?v=9TycLR0TqFA>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration of latest trends in Software Project Management.
- Expert talk on topics like impact of Prompt Engineering in current Software Projects, Agile in the Real World.
- Brainstorming session on usage of tools and techniques in projects undertaken in current semester.
- Assign pairs to write and review each other's code based on a user story using Test-Driven Development approach.

LAB BASED PROFESSIONAL ELECTIVES – 2

CLOUD SERVICES MANAGEMENT										
Course Code	24MCA421					CIE Marks		50		
L:T:P:S	0:0:2:0					SEE Marks		50		
Hrs / Week	4					Total Marks		100		
Credits	02					Exam Hours		03		
Course outcomes: At the end of the course, the student will be able to:										
24MCA421.1	Explain the fundamentals of cloud computing and commonly used cloud service platforms.									
24MCA421.2	Use virtual machines and cloud storage for hosting applications and handling data.									
24MCA421.3	Apply cloud-based relational and NoSQL databases in real-world applications.									
24MCA421.4	Identify components of secure identity and network management in cloud.									
24MCA421.5	Examine techniques for monitoring resource usage and managing service expenses.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA421.1	1	-	-	-	-	-	-	-	3	3
24MCA421.2	3	-	-	-	-	-	-	-	3	3
24MCA421.3	3	2	1	1	-	-	-	-	3	3
24MCA421.4	3	3	3	2	-	-	-	-	3	3
24MCA421.5	3	3	3	2	-	-	-	-	3	3
Pgm. No.	List of Programs							Hours	COs	
Prerequisite Programs / Demo										
	Create a new IAM user with console access and assign Administrator Access temporarily and explore different features of AWS cloud.							4	NA	
PART-A										
1	• Install Apache Web Server on your EC2 instance and host a web page.							4	24MCA421.1	
2	• Use the cloud pricing calculator: estimate the cost of running a basic virtual machine.							4	24MCA421.1	
3	• Create an S3 bucket, upload a sample file, and configure it for public access. Display the public URL of the uploaded file. • Enable Versioning on the same S3 bucket, upload a file twice with different content, and verify the version history from the console.							4	24MCA421.1	
4	• Create a static website using an S3 bucket, upload an index.html file, enable static website hosting, and access the site via the public URL.							4	24MCA421.2	
5	• Connect using a database client tool and create a database and table. Perform SQL operations such as creating a student table and inserting 5 sample records.							4	24MCA421.2	
6	• Create a NoSQL table with “StudentID” as the primary key and add 3 records. Query the NoSQL database using the console’s built-in query editor.							4	24MCA421.3	

PART-B

7	Create a PostgreSQL database using Amazon RDS, connect to it with pgAdmin, create a table, and insert & query sample student records.	4	24MCA421.3
8	Enable Multi-Factor Authentication (MFA) for your AWS root account and verify login.	4	24MCA421.3
9	- Create a Security Group that allows only SSH (port 22) to a virtual machine. - Launch a t2.micro EC2 instance in the default VPC and attach the security group created above.	4	24MCA421.4
10	Create a new IAM user and assign "S3 Read Only" access using pre-defined policies. Log in as the new user and verify that they can list S3 buckets but not delete anything.	4	24MCA421.4
11	Create a CloudWatch alarm to notify when CPU usage exceeds 60%.	4	24MCA421.5
12	Set up a billing alert to trigger an email if AWS usage exceeds \$1.	4	24MCA421.5

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- Create a Lambda function triggered by uploading a file to S3. Verify the Lambda function logs the event in CloudWatch.
- Enable MFA Delete on an S3 bucket and demonstrate that deletion requires MFA authentication.

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Test (s)	Weekly Assessment
		40	10
L1	Remember	10	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	-
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

- 1) Douglas E. Comer, *The Cloud Computing Book: The Future of Computing Explained*, Routledge, 1st Edition, 2022, ISBN: 978-0-367-70684-5.
- 2) Bruce W. Fraser, *Cloud Computing Basics: A Non-Technical Introduction*, Springer, 1st Edition, 2021, ISBN: 978-1-4842-6921-3.
- 3) Michael J. Kavis, *Accelerating Cloud Adoption: Optimizing the Enterprise for Speed and Agility*, O'Reilly Media, 1st Edition, 2021, ISBN: 978-1-4920-9361-3.
- 4) Michael Wittig and Andreas Wittig, *Amazon Web Services in Action*, Manning Publications, 2nd Edition, 2021, ISBN: 978-1-61729-511-9.

DEVOPS										
Course Code	24MCA422						CIE Marks		50	
L:T:P:S	0:0:2:0						SEE Marks		50	
Hrs / Week	4						Total Marks		100	
Credits	02						Exam Hours		03	
Course outcomes: At the end of the course, the student will be able to:										
24MCA422.1	Explain DevOps principles and AWS cloud fundamentals.									
24MCA422.2	Apply Git and GitHub for version control and collaboration.									
24MCA422.3	Use AWS to configure CI/CD pipelines for automation.									
24MCA422.4	Identify key components for containerization with Docker and automation.									
24MCA422.5	Examine cloud monitoring with AWS Cloud Watch and IAM-based security in DevOps workflows.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA422.1	1	-	-	-	-	-	-	-	3	3
24MCA422.2	3	-	-	-	-	-	-	-	3	3
24MCA422.3	3	2	1	1	-	-	-	-	3	3
24MCA422.4	3	3	3	2	-	-	-	-	3	3
24MCA422.5	3	3	3	2	-	-	-	-	3	3
Pgm. No.	List of Programs							Hours	Cos	
Prerequisite Programs / Demo										
	- Configure basic IAM roles and attach them to a user. - Explore AWS Management Console and list any commonly used services and install Git and initialize a local repository.							4	NA	
PART-A										
1	Create a free-tier AWS account and launch your first EC2 instance.							4	24MCA422.1	
2	Create an S3 bucket and upload/download a file from it.							4	24MCA422.1	
3	Create a GitHub account and push a local project to a remote repository.Perform commit, push, and pull operations using Git CLI.							4	24MCA422.1	
4	Create a new branch in GitHub, make changes, and merge it with the main branch.							4	24MCA422.2	
5	Integrate GitHub with AWS CodePipeline and test repository trigger.							4	24MCA422.2	
6	Create a CodeCommit repository and push your code into it.							4	24MCA422.3	
PART-B										
7	Set up AWS CodeDeploy to deploy an app to EC2 using a simple AppSpec file.							4	24MCA422.3	
8	Create a CI/CD pipeline using AWS CodePipeline that builds and deploys an app automatically.							4	24MCA422.3	

9	Create a Dockerfile for a basic web server and build an image.	4	24MCA422.4
10	Push the Docker image to Amazon ECR.	4	24MCA422.4
11	Create a CloudWatch dashboard to monitor CPU usage of an EC2 instance.	4	24MCA422.5
12	Set up an alarm in CloudWatch that sends a notification when CPU exceeds 60%.	4	24MCA422.5

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- Add GitHub as a source stage to your CodePipeline. Trigger a deployment by modifying code and observe automatic pipeline execution.
- Build and deploy a Dockerized web application with CodePipeline, monitor it using CloudWatch, and manage credentials securely with Secrets Manager.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		40	10
L1	Remember	10	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	-
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- Gene Kim, Jez Humble, Patrick Debois, and John Willis, *The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations*, IT Revolution Press, 2nd Edition, 2021, ISBN: 978-1-950508-40-5.
- Len Bass, Ingo Weber, and Liming Zhu, *DevOps: A Software Architect's Perspective*, Addison-Wesley Professional, 1st Edition, 2015, ISBN: 978-0-134-04984-7.

Reference Books:

- Jez Humble and David Farley, *Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation*, Addison-Wesley Professional, 1st Edition, 2010, ISBN: 978-0-321-60191-9.

BIG DATA ANALYTICS USING HP VERTICA										
Course Code	24MCA423					CIE Marks	50			
L:T:P:S	0:0:2:0					SEE Marks	50			
Hrs / Week	4					Total Marks	100			
Credits	02					Exam Hours	03			
Course outcomes: At the end of the course, the student will be able to:										
24MCA423.1	Demonstrate the ability to write basic structured queries by applying fundamental SQL commands.									
24MCA423.2	Discuss the architecture and key features of HP Vertica.									
24MCA423.3	Demonstrate data manipulation and optimization in HP Vertica.									
24MCA423.4	Apply the MapReduce concept to solve data processing problems using Hadoop.									
24MCA423.5	Evaluate the usage of various Hadoop ecosystem tools based on their functionality and application scenarios.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA423.1	3	2	-	3	-	-	-	-	3	3
24MCA423.2	3	2	-	3	-	-	-	-	3	3
24MCA423.3	3	2	2	3	-	-	-	-	3	3
24MCA423.4	3	2	2	3	-	-	-	-	3	3
24MCA423.5	3	2	2	3	-	-	-	-	3	3
Pgm. No.	List of Programs							Hours	Cos	
Prerequisite Programs / Demo										
	Demonstration and exploration of SQL commands.							4	NA	
PART-A										
1	- Create a table named Students with appropriate columns to store student ID, name, age, and marks. Insert records for five students into the table. Write the necessary SQL queries to perform all these operations and display the final contents of the table. (i) Insert records for five students into the Students table. Provide appropriate values for all columns. (ii) Update the marks of one specific student using their student_id. (iii) Delete all records of students who have secured marks below 35. (iv) Increase the marks of all students who are older than 20 years by adding 5 bonus marks. - Given a table named Employees containing details such as employee ID, name, department, and salary, Write SQL queries to perform the following tasks using aggregate functions: (i) Count the total number of employees in the company. (ii) Find the average salary for each department. (iii) Retrieve the highest salary paid in the company. (iv) Display the total salary expenditure for each department. (v) Identify and display the department with the highest total salary expenditure.							4	24MCA423.1	

2	- Consider two tables: Products (with columns like ProductID, ProductName, Price) and Orders (with columns like OrderID, ProductID, Quantity). Write SQL queries to perform the following operations using subqueries and/or joins: (i) Retrieve the names and prices of products that are priced above the average price of all products. (ii) List all orders where the corresponding product price is greater than Rs. 500. (iii) Display all products that are cheaper than the most expensive product. (iv) Show all orders placed for the cheapest product in the catalog. (v) Display all products that have never been ordered. - Given two tables — Employees (with columns such as EmployeeID, Name, DeptID) and Departments (with columns such as DeptID and DeptName) (i) Write a query to display the names of all employees along with the names of their respective departments. (ii) Use an INNER JOIN to combine the data based on the department ID. (iii) Display all departments along with the employees in them using LEFT JOIN. (iv) List employee names and their salaries in each department.	4	24MCA423.1
3	- Create a manual projection on the Employee table using REPLICATION with a K-SAFETY level of 1 and level of 0. - Create a manual projection on the Employee table using SEGMENTATION with a K-SAFETY level of 1 and level of 0.	4	24MCA423.2
4	- Create a schema and a table employee with columns emp_id, emp_name, dept, and salary. Insert at least 5 records into the table. After the data insertion, retrieve and display the current epoch, latest epoch, last good epoch, from the system metadata before and after COMMIT statement is executed. - Create a schema and a table employee with columns emp_id, emp_name, dept, and salary. Insert at least 5 records into the table. After the data insertion, retrieve and display the ancient history mark (AHM), and checkpoint epoch from the system metadata.	4	24MCA423.2
5	- Create a schema company and a table employee with columns emp_id, emp_name, dept, and salary. Load data into the employee table from an external CSV file named employee_data.csv using the COPY command. After loading, display all records and write a query to show the total salary grouped by department. - Create a table employee with columns emp_id, emp_name, dept, and salary, and insert at least 5 initial records. Then, using a staging table employee_updates containing updated or new employee records, perform a MERGE operation to update existing records and insert new ones	4	24MCA423.3

	into the employee table accordingly. After the merge, display the contents of the employee table.		
6	- Create a table Student with columns USN, name, dept and insert at least 5 records. Perform the operation to Delete specific records from the table using the DELETE command. - Create a tableSales with the columns sale_id, product_name, quantity and price and insert at least 5 records.Delete specific records from the table and use the PURGE command to remove the deleted data from the delete vector.	4	24MCA423.3
PART-B			
7	- Create a partitioned table Sales with columns sale_id, product, quantity, and sale_date, partitioned by sale_date. Insert records spanning multiple dates, then perform MOVEOUT to shift data from WOS to ROS and MERGEOUT to optimize ROS containers. Display storage details before and after these operations. - Install and configure Hadoop in pseudo-distributed mode. Verify the installation by running basic Hadoop commands and checking if the Hadoop daemons are running properly.Configure the Java environment variable (JAVA_HOME) required for Hadoop. Verify that the Java path is correctly set and Hadoop can access it.	4	24MCA423.3 24MCA423.4
8	- Identify the Hadoop installation directory on your system. Locate and describe the purpose of important Hadoop configuration files like core-site.xml, hdfs-site.xml, mapred-site.xml, and yarn-site.xml. - Set up the NameNode by formatting the Hadoop filesystem. Start the NameNode daemon and verify its running status.	4	24MCA423.4
9	- Configure and start the JobTracker daemon in Hadoop. Confirm that it is running and ready to accept MapReduce jobs. - Access the Hadoop NameNode and JobTracker web UIs using a browser. Note the URLs and verify the status and health of the Hadoop cluster.	4	24MCA423.4
10	- Using Hadoop commands, create a new directory in HDFS. Verify that the directory has been created successfully. Before creating a file in your local system, note down the current directory location using a command. Provide the commands used and the output after each step. - Create a file named test in the local file system (e.g., /home/cloudera) and enter some sample text data into it. Verify that the file has been created successfully. Then, use Hadoop commands to copy this local file into the HDFS. Provide the commands used and show the verification output after each step.	4	24MCA423.5
11	Using Hadoop MapReduce, run the WordCount program on a text file that is already loaded into HDFS. Specify an output directory in HDFS where the results will be stored. Verify the output by displaying the contents of the result	4	24MCA423.5

	files. Provide all commands used during the process. Run the Hadoop MapReduce WordCount program on a text file loaded into HDFS, specifying an output directory in HDFS for the results. After the job completes, verify the output by accessing the Hadoop JobTracker or ResourceManager web UI in your browser to view the output.		
12	- Using Hadoop MapReduce, run the grep program on a text file that is already loaded into HDFS. Specify an output directory in HDFS where the results will be stored. Verify the output by displaying the contents of the result files. Provide all commands used during the process. - Run the Hadoop MapReduce grep program on a text file loaded into HDFS, specifying an output directory in HDFS for the results. After the job completes, verify the output by accessing the Hadoop browser to view the output.	4	24MCA423.5

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- Build a complete Hadoop data processing pipeline
- Integrate HBase with Hadoop for Real-Time Querying

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Test (s)	Weekly Assessment
		40	10
L1	Remember	10	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	-
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- Paul N. Weinberg, James R. Groff, and Andrew J. Oppel, *SQL: The Complete Reference*, McGraw-Hill, 3rd Edition, ISBN: 978-0-07-159256-7.
- Rishabh Agrawal, *HP Vertica Essentials*, Packt Publishing, 1st Edition, ISBN: 978-1-78217-156-0.
- Tom White, *Hadoop: The Definitive Guide*, O'Reilly Media, 4th Edition, ISBN: 978-1-491-90163-2.

Reference Books:

- Ben Forta, *SQL in 10 Minutes, Sams Teach Yourself*, Pearson Education, 4th Edition, ISBN: 978-0-672-33607-2.
- Benjamin Bengfort and Jenny Kim, *Data Analytics with Hadoop: An Introduction for Data Scientists*, O'Reilly Media, 1st Edition, ISBN: 978-1-4919-1370-3.

SOFTWARE TESTING USING SELENIUM										
Course Code	24MCA424					CIE Marks	50			
L:T:P:S	0:0:2:0					SEE Marks	50			
Hrs / Week	4					Total Marks	100			
Credits	02					Exam Hours	03			
Course outcomes:										
At the end of the course, the student will be able to:										
24MCA424.1	Discuss the fundamental concepts of software testing and testing lifecycle.									
24MCA424.2	Compare various levels and types of testing.									
24MCA424.3	Apply automation commands to record and execute test cases.									
24MCA424.4	Apply Selenium Web Driver for advanced browser automation and interaction with dynamic web elements.									
24MCA424.5	Apply Test NG framework for organizing and executing automated tests.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA424.1	2	-	-	1	-	-	-	-	3	2
24MCA424.2	3	-	2	1	-	-	-	-	3	2
24MCA424.3	3	-	2	1	-	-	-	-	3	2
24MCA424.4	3	3	2	1	-	-	-	-	3	2
24MCA424.5	3	3	2	1	-	-	-	-	3	2
Pgm. No.	List of Programs							Hours	Cos	
Prerequisite Programs / Demo										
	Installation of Selenium and Web-Drivers.							4	NA	
PART-A										
1	- Write a java program to implement a login system that accepts correct combinations of username and password. Design a decision table to test combinations (correct, wrong username, wrong password, both wrong). - Write a Java program that accepts a valid date (day, month, year) and displays the next date. The program should account for different month lengths and leap years. Use Boundary Value Analysis (BVA) to design test cases.							4	24MCA424.1	
2	- Write a Java program to calculate the commission for a salesperson based on the following rules: If sales amount is less than ₹5000 → No commission If sales amount is between ₹5000 and ₹10000 → 5% commission If sales amount is between ₹10001 and ₹20000 → 10% commission sales amount is more than ₹20000 → 15% commission Use Boundary Value Analysis (BVA) to design and execute test cases. - Write a Java program that takes an input score (0 to 100) and prints the corresponding grade using the following criteria: 90-100 → Grade A 75-89 → Grade B 50-74 → Grade C 0-49 → Grade D							4	24MCA424.1	

	Any value outside 0-100 → Invalid input. Use Equivalence Partitioning to design and test different input classes (valid and invalid)		
3	- Write a Java program to calculate the factorial of a number and demonstrate how unit testing is used to verify the output for different input values. Test cases must handle valid and invalid inputs (e.g., negative numbers). - Create a calculator program with add() and multiply() methods. Show how integration testing is applied by verifying the combined behavior of both methods.	4	24MCA424.2
4	- Develop a basic shopping cart simulation. The program should place an order only if there are items in the cart and the payment is successful. Perform system testing with different scenarios. - Write a simple program to simulate alpha testing feedback. Include a message indicating this is an internal product test.	4	24MCA424.2
5	- Write a Java program that mimics a beta test by displaying a placeholder message for feedback collected from real users. - Write a Java program that calculates the execution time for a dummy loop to simulate performance testing.	4	24MCA424.2
6	- Write a Selenium IDE test script to automate login functionality. The script should open the login page, enter valid credentials, click the login button, and verify that the welcome message is displayed. - Create a Selenium IDE test case to validate the search functionality of a website. The script should enter a keyword in the search box, click the search button, and verify that the results page displays a relevant heading.	4	24MCA424.3
PART-B			
7	- Design a Selenium IDE test case to test menu navigation. The script should click on the 'Products' menu link from the home page and verify the page title after navigation. - Write a Selenium IDE test case to automate the submission of a contact form. The script should enter the name, email, and message, click the submit button, and confirm the appearance of a success message.	4	24MCA424.3
8	- Write a Java program to Create a Selenium WebDriver program to locate and interact with web elements using different locator strategies (ID, name, className). - Write a Java program using Selenium WebDriver to retrieve and display the content of a list in sorted order.	4	24MCA424.4
9	- Write a Java program using Selenium WebDriver to handle a JavaScript alert box. Trigger the alert and accept it. - Develop a Java program that uses Selenium's implicit wait to handle delayed elements.	4	24MCA424.4

10	- Write a Java program using Selenium WebDriver to use explicit wait to wait for a dynamic element. - Write a Java program using Selenium WebDriver and TestNG to launch Google and verify the title using @Test and assertions.	4	24MCA424.5
11	- Develop a Selenium WebDriver Java script using TestNG @Parameters annotation to test a login page with different user credentials. - Write a Java program using TestNG to demonstrate the concept of grouping test cases.	4	24MCA424.5
12	- Design a data-driven login test in Selenium WebDriver using Java and TestNG. - Write a Java program to test a database connection using JDBC and TestNG.	4	24MCA424.5

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- Automate filling out a multi-page web form that loads content dynamically.
- Scrape Dynamic Website Data & Store in CSV.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		40	10
L1	Remember	10	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	-
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- 1) Rajib Mall, *Fundamentals of Software Engineering*, Prentice Hall of India, 5th Edition, 2025, ISBN: 978-93-88028-02-8.
- 2) Ilene Burnstein, *Practical Software Testing: A Process-Oriented Approach*, Springer, 1st Edition, 2003, ISBN: 978-0-387-95131-7.
- 3) Pallavi Sharma, *Selenium with Java: A Beginner's Guide*, BPB Publications, 1st Edition, 2022, ISBN: 978-93-91392-68-0.

Reference Books:

- 1) Srinivasan Desikan and Gopalaswamy Ramesh, *Software Testing: Principles and Practices*, Pearson Education India, 1st Edition, 2007, ISBN: 978-81-7758-121-8.
- 2) Roger S. Pressman and Bruce R. Maxim, *Software Engineering: A Practitioner's Approach*, McGraw-Hill International Edition, 9th Edition, 2023, ISBN: 978-93-5532-504-4.

BLOCKCHAIN										
Course Code	24MCA425					CIE Marks	50			
L:T:P:S	0:0:2:0					SEE Marks	50			
Hrs / Week	4					Total Marks	100			
Credits	02					Exam Hours	03			
Course outcomes: At the end of the course, the student will be able to:										
24MCA425.1	Discuss the fundamentals of Blockchain technology in different domains.									
24MCA425.2	Illustrate different types of cryptographic mechanisms used in Blockchain.									
24MCA425.3	Examine various Ethereum environment and wallets.									
24MCA425.4	Identify the use of solidity in designing smart contracts.									
24MCA425.5	Use open-source tools to derive Blockchain solutions.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA425.1	2	-	-	-	-	-	-	-	2	3
24MCA425.2	3	2	-	-	-	-	-	-	2	3
24MCA425.3	3	-	-	-	-	-	-	-	2	3
24MCA425.4	3	-	-	-	-	-	-	-	2	3
24MCA425.5	3	2	3	2	-	-	-	1	2	3
Pgm. No.	List of Programs							Hours	Cos	
Prerequisite Programs / Demo										
	- Install MetaMask and create a new Ethereum wallet. - Demonstration of steps to get free test Ethers using a faucet.							4	NA	
PART-A										
1	- Write a program or steps to view live Ethereum transactions and mined blocks using blockchain explorer. - Write a program or steps to find details of a past Ethereum transaction. - Write a program or use a tool to view block details like block number, miner address, and number of transactions.							4	24MCA425.1	
2	- Use an online blockchain demo to create blocks. - Write a program to input a message and generate its MD5 hash. Display the original message and the hashed value. - Write a program to input a message and generate its SHA-256 hash. Display the message and the hash.							4	24MCA425.2	
3	- Write a program to encrypt and decrypt a message using the Caesar cipher with a fixed key. - Write a program to generate a public and private key pair using RSA algorithm and display both keys.							4	24MCA425.2	
4	- Write a program for implementing Elliptic Curve Cryptography (ECC) Signing. - Write a program to encrypt a message using the public key and decrypt it using the private key. Display original, encrypted, and decrypted messages.							4	24MCA425.2	
5	- Write a program to start a Private Ethereum Network by Initializing the Genesis Block Using Geth. - Write a program to check the Ether balance of an Ethereum account on a test network.							4	24MCA425.3	

6	- Write the steps or program to send Ether from one Ethereum account to another using MetaMask on a test network. - Write a program or use Etherscan to view details of a recent transaction such as sender, receiver, gas used, and status.	4	24MCA425.3
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PART-B

7	- Write a program to demonstrate the Lifecycle of a Smart Contract. - Write a Solidity smart contract named HelloWorld that stores and returns message string.	4	24MCA425.4
8	Write a program or use Remix to call functions from a deployed smart contract.	4	24MCA425.4
9	Develop a Solidity Smart Contract demonstrating the use of Control Flow Statements (if-else, for, while).	4	24MCA425.4
10	Write commands to unlock an account, check account balance, and attach to the running Geth console.	4	24MCA425.5
11	Write a program to track Smart Contract Events Using Remix IDE.	3	24MCA425.5
12	- Write a Simple Solidity Contract Using Structs and Mappings. - Write a program to create a Time-Locked Smart Contract.	4	24MCA425.5

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- Understand how mining works by finding a hash that meets a difficulty level.
- Simulate how multiple nodes share and verify blockchain data.

CIE Assessment Pattern (50 Marks - Lab)

RBT Levels		Test (s)	Weekly Assessment
		40	10
L1	Remember	10	-
L2	Understand	10	5
L3	Apply	10	5
L4	Analyze	10	-
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Book:

- 1) Imran Bashir, *Mastering Blockchain: Distributed Ledgers, Decentralization and Smart Contracts Explained*, Packt Publishing Ltd., 2nd Edition, 2017, ISBN: 978-1-78712-544-5.
- 2) G. H. Laursen and J. Thorlund, *Business Analytics for Managers: Taking Business Intelligence Beyond Reporting*, John Wiley & Sons, 2016, ISBN: 978-1-119-29585-0.

Reference Books:

- 1) Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, 1st Edition, 2016, ISBN: 978-0-691-17169-2.
- 2) Daniel Drescher, *Blockchain Basics: A Non-Technical Introduction in 25 Steps*, Apress, 1st Edition, 2017, ISBN: 978-1-4842-2603-8.
- 3) Andreas M. Antonopoulos, *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*, O'Reilly Media, 1st Edition, 2014, ISBN: 978-1-4493-7404-4.

TECHNICAL SEMINAR										
Course Code	24MCA43					CIE Marks		50		
L:T:P:S	0:0:0:2					SEE Marks		50		
Hrs / Week	4					Total Marks		100		
Credits	02					Exam Hours		03		
Course outcomes: At the end of the course, the student will be able to:										
24MCA43.1	Identify the recent trends in computing technologies to address research challenges.									
24MCA43.2	Examine existing literature in the selected field of study to understand research depth and direction.									
24MCA43.3	Analyze case studies, tools, methodologies, techniques, and algorithms relevant to the chosen research area.									
24MCA43.4	Demonstrate effective communication and report writing skills for structured technical presentations.									
24MCA43.5	Derive outcomes and insights from the study to propose directions for future research.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA43.1	3	2	-	2	-	-	-	-	1	2
24MCA43.2	3	2	1	2	-	-	-	-	1	2
24MCA43.3	3	2	-	2	2	-	-	-	1	2
24MCA43.4	1	1	1	-	-	2	1	-	1	2
24MCA43.5	2	1	-	-	-	-	1	-	1	2
Technical Seminar is based on current technological research trends.										
GUIDELINES:										
1. Select any broad area of research or technical topics of interest (E.g. Machine Learning/Data mining, Computer Networks, Cloud Computing, etc.) 2. Select a specific topic of inquiry. (E.g. In Data mining, one can choose cluster analysis or Classification or Association rule mining, consequently a more confined topic like Density based clustering or Grid based clustering etc. can be decided.) 3. Explore for at least 15 to 20 recent research papers (e.g. last 2-5 years in IEEE explore or Science Direct or ACM digital library, etc..) related to the specific topic chosen. From these papers, select best 5 to 8 papers, preferably Journal papers or reputed conferences. 4. Examine these selected papers systematically. Write down a summary of each paper based on their contributions (ideas), Improvements claimed, Parameters used for comparison, Experiments carried out, Tools used. 5. Write a report based on summary highlighting contributions, differences, further ideas to improve those methods, analysis and interpretation.										
Technical Seminar Evaluation:										
Seminar coordinators follow rubrics, which is set by the Department for evaluation of seminar work and report prepared by the students.										
- Seminar reviews will be evaluated by the respective internal guides.										

CIE Assessment Pattern (50 Marks)

Evaluation would be carried out in TWO phases. The evaluation criteria shall be as per the rubrics given below:

Continuous Internal Evaluation	Marks
Review: Phase 1: Selection of topic – Technical Relevance, review of literature, Sustainability and Societal Concerns, presentation of the selected study.	25
Review: Phase 2: Technological developments and analysis, Presentation skills, Report writing.	25

The evaluation will be done by a Senior faculty / Internal Guide from the department and ONE External member from Academia / Industry / Research Organization.

SEE evaluation: (50 Marks)

Rubrics	Marks
Topic	5
Literature Review	10
Technical relevance Sustainability and Societal Concerns	15
Presentation Skills	10
Viva- Voce	10

Suggested Learning Resources:**Web links:**

- <https://www.youtube.com/watch?v=KcLRApb3Pqg>
- <https://www.youtube.com/watch?v=GZRBN-Nz99I>
- https://www.youtube.com/watch?v=lQrj_7xkeNI
- <https://www.youtube.com/watch?v=rz30rRfManE&list=PLdj5pVg1kHiOypKNUm00NKOfvolThAv4N>

INTERNSHIP										
Course Code	24MCA46					CIE Marks	50			
L:T:P:S	0:0:0:10					SEE Marks	50			
Hrs / Week	20					Total Marks	100			
Credits	10					Exam Hours	03			
Course outcomes: At the end of the course, the student will be able to:										
24MCA46.1	Recall key skills and foundational knowledge necessary for working in the software industry.									
24MCA46.2	Explain theoretical and practical knowledge in the context of software development tasks.									
24MCA46.3	Implement code for real-time projects using hands-on experience and applied learning.									
24MCA46.4	Evaluate personal strengths aligned with current software industry demands.									
24MCA46.5	Organize technical content using effective communication skills.									
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:										
	P01	P02	P03	P04	P05	P06	P07	P08	PS01	PS02
24MCA46.1	-	2	-	-	-	1	-	-	3	3
24MCA46.2	2	2	2	-	-	-	-	1	3	3
24MCA46.3	1	-	1	-	1	-	-	1	3	3
24MCA46.4	1	-	-	1	-	-	-	-	3	3
24MCA46.5	-	-	-	-	-	-	-	2	3	3
General Guidelines:										
1. The internship must be carried out individually in an industry or any R&D institution.										
2. The internship shall be carried out for a minimum duration of 90 days.										
3. The internship work may be application-oriented or research-oriented, based on the student's interest. Therefore, the internship reports will vary depending on the type of work undertaken.										
4. The student is expected to submit his/her internship offer letter within one week from the commencement of the internship.										
5. An Internal Guide will be allocated to each student.										
6. The status of the internship progress must be updated with the Internal Guide every week.										
7. Presentations should be given during the subsequent internship reviews.										
8. Internship verification at the place of internship shall be mandatory by the External Guide for the successful completion of the internship.										
9. The CIE of the internship will be evaluated based on the well-defined rubrics during the subsequent internship reviews.										
10. The internship report will be evaluated by both the Internal Guide and the External Guide.										
11. The final presentation of the internship report and the viva-voce will be conducted during the SEE.										
12. If the internship report is not as per the prescribed format or the internship work is not of the expected quality, the external examiners shall have every right to reject the internship report.										

CIE Assessment Pattern (50 Marks)

Semester End Examination	Tests Marks
Internship Report	20
Presentation	20
Question and Answer	10
Total Marks	50

SEE Assessment Pattern (50 Marks)

Semester End Examination	Tests Marks
Internship Report	20
Presentation	20
Question and Answer	10
Total Marks	50

Suggested Learning Resources:**Web links:**

- <https://www.youtube.com/watch?v=tlrGqwd8XSg>
- <https://www.youtube.com/watch?v=N3N9-RLSbvo>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Surveys.
- Contents related activities (Activity-based discussions).
 - For active participation of students, instruct the students to prepare Flowcharts and Handouts
 - Seminar.

APPENDICES

APPENDIX A

Outcome Based Education

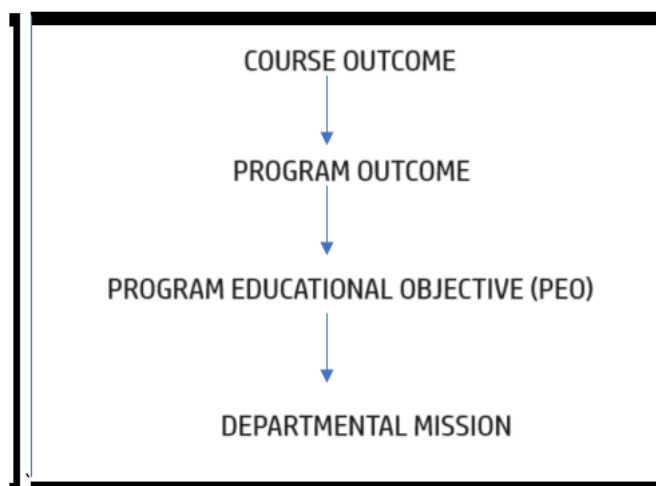
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead, classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational outcomes as defined by the National Board of Accreditation: Program Educational Objectives: The Educational Objectives of the Computer Applications program are the statements that describe the expected achievements of graduate in their career and in particular, what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix B

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes.

Mapping of Outcome:



APPENDIX B

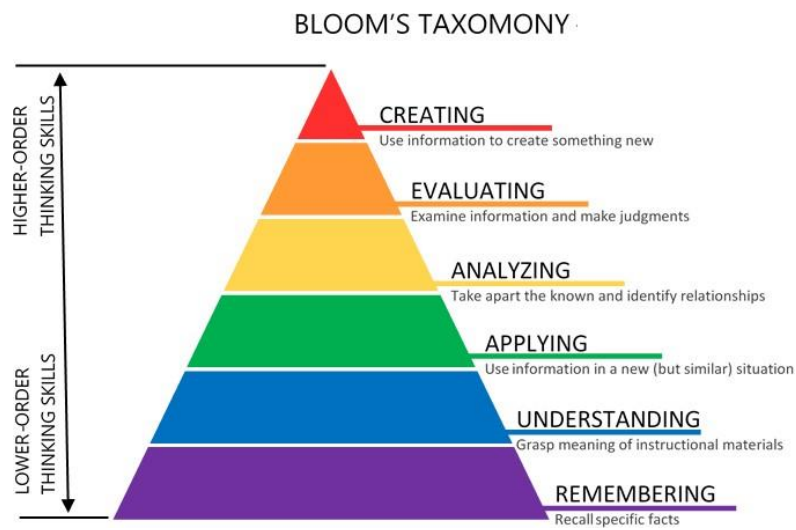
The Graduate Attributes of NBA

- P01 (Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
- P02 (Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.
- P03 (Development of Solutions):** Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.
- P04 (Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
- P05 (Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
- P06 (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.
- P07 (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.
- P08 (Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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