SILVER HORIZONS 25 YEARS OF GLOBAL LEARNING

NEW HORIZON COLLEGE OF ENGINEERING

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

Academic Year 2025-26

MCA

Third & Fourth Semester Scheme & Syllabus

BATCH 2024-26

CREDITS:80

NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
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Department of Master of Computer Applications

Academic Year 2025-26

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Scheme & Syllabus

Batch: 2024-26

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

QUALITY POLICY

To provide services of the highest quality both curricular and co-curricular, so that our students can integrate their skills and serve the industry and society equally well at the global level.

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)

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1

To master skills in computing technologies to analyze, design and develop solutions for industry-oriented real-time computer applications.

PSO2

To inculcate technical communication skills and ethics, with professional practices to strengthen research and enhance career opportunities.

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	3
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	2	3
To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co curricular and extracurricular activities.	3	3	3

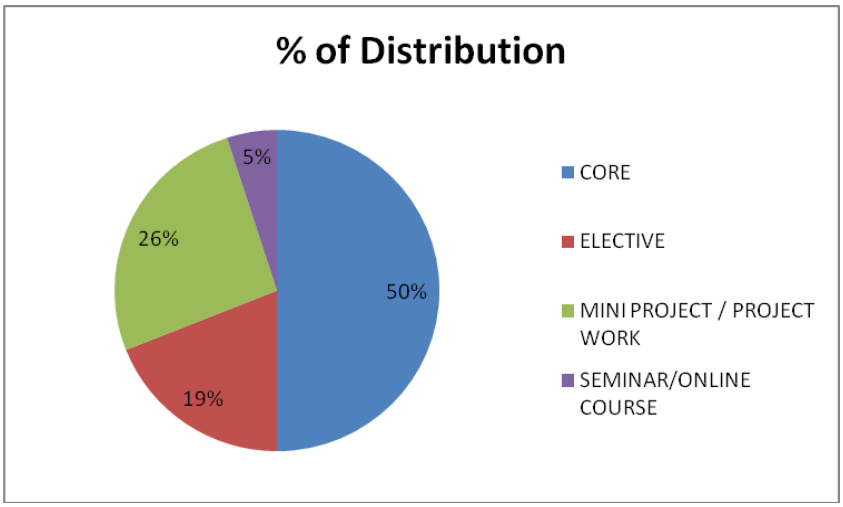
Correlation: 3- High, 2-Medium, 1-Low

Mapping of POs to PEOs

PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
PEO1	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**3**
PEO2	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**3**
PEO3	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**

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

SEMESTER	CORE	ELECTIVE	MINI PROJECT / PROJECT WORK	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	6	10	4	20
TOTAL	40	15	21	4	80
% of Distribution	50%	19%	26%	5%	100%



DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
SCHEME OF THIRD SEMESTER MCA PROGRAM
AY 2025-26

SL NO	BOARD/ COURSE	COURSE CODE	COURSE	BOS	CREDIT DISTRIBUTION				OVERALL CREDITS	CONTACT HOURS WEEKLY (THEORY)	MARKS		
					L	T	P	S			CIE	SEE	TOTAL
1	MCA/IPCC	24MCA31	MACHINE LEARNING	MCA	3	0	1	0	4	6	50	50	100
2	MCA/IPCC	24MCA32	WEB DEVELOPMENT USING FULL STACK	MCA	3	0	1	0	4	6	50	50	100
3	MCA/PEC	24MCA33X	PROFESSIONAL ELECTIVES - 2	MCA	3	0	0	0	3	4	50	50	100
4	MCA/PROJ	24MCA34	PROJECT WORK	MCA	0	0	0	9	9	18	50	50	100
TOTAL					9	0	2	9	20	34	200	200	400

Note: **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** - Self Study

	PROFESSIONAL ELECTIVES – 2							
SL NO	COURSE CODE	COURSE	BOS	CREDIT DISTRIBUTION				TOTAL
				L	T	P	S	
1	24MCA331	DATA SCIENCE	MCA	3	0	0	0	3
2	24MCA332	ETHICAL HACKING	MCA	3	0	0	0	3
3	24MCA333	AUGMENTED REALITY AND VIRTUAL REALITY	MCA	3	0	0	0	3
4	24MCA334	INTERNET OF THINGS	MCA	3	0	0	0	3
5	24MCA335	UI/UX DESIGN	MCA	3	0	0	0	3

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
SCHEME OF FOURTH SEMESTER MCA PROGRAM
AY 2025-26

SL NO	BOARD/ COURSE	COURSE CODE	COURSE	BOS	CREDIT DISTRIBUTION				OVERALL CREDITS	CONTACT HOURS WEEKLY	MARKS		
					L	T	P	S			CIE	SEE	TOTAL
1	MCA/PEC	24MCA41X	PROFESSIONAL ELECTIVES –3	MCA	3	0	0	0	3	3	50	50	100
2	MCA/PEC	24MCA42X	LAB BASED PROFESSIONAL ELECTIVES - 2	MCA	0	1	2	0	3	6	50	50	100
3	MCA/TS	24MCA43	TECHNICAL SEMINAR	MCA	0	0	0	2	2	4	50	50	100
4	AUD/AEC	24AUD44X	ONLINE COURSE		-	-	-	-	2	-	-	-	100
5	AUD/NCMC*	24AUD45	RESEARCH METHODOLOGY AND IPR		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	20	50	50	100
TOTAL					3	1	2	12	20	33	200	200	500

Note: **PEC**– Professional Elective Course, **TS -**Technical Seminar, **INT –** Internship, NCMC-Non Credit Mandatory Course *(Online Course)
AUD/AEC – Audit Course/ Ability Enhancement Course.
L – Lecture, **T**- Tutorial, **P**-Practical, **S** - Self Study

PROFESSIONAL ELECTIVES – 3								
SL NO	COURSE CODE	COURSE	BOS	CREDIT DISTRIBUTION				TOTAL
				L	T	P	S	
1	24MCA411	AI ETHICS	MCA	3	0	0	0	3
2	24MCA412	DIGITAL FORENSICS	MCA	3	0	0	0	3
3	24MCA413	DESIGN THINKING AND INNOVATION	MCA	3	0	0	0	3
4	24MCA414	DIGITAL MARKETING	MCA	3	0	0	0	3
5	24MCA415	AGILE SOFTWARE DEVELOPMENT	MCA	3	0	0	0	3

LAB BASED PROFESSIONAL ELECTIVES -2								
SNO	**COURSE CODE**	**COURSE**	**BOS**	**CREDIT DISTRIBUTION**				**TOTAL**
				L	**T**	**P**	**S**	
1	24MCA421	CLOUD SERVICES MANAGEMENT	MCA	0	1	2	0	3
2	24MCA422	DEVOPS	MCA	0	1	2	0	3
3	24MCA423	BIG DATA ANALYTICS USING HP VERTICA	MCA	0	1	2	0	3
4	24MCA424	SOFTWARE TESTING USING SELENIUM	MCA	0	1	2	0	3
5	24MCA425	BLOCKCHAIN	MCA	0	1	2	0	3

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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 (ML) 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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA31.1	2	-	-	-	-	-	-	-	3	-
24MCA31.2	-	2	2	2	-	-	-	-	3	-
24MCA31.3	-	2	2	2	-	-	-	-	3	-
24MCA31.4	-	2	2	-	-	-	-	-	3	-
24MCA31.5	-	-	3	-	2	-	-	-	3	-

MODULE-1	**INTRODUCTION TO MACHINE LEARNING**	**24MCA31.1**	**7 Hours**

Definition, Origin, Need, Types of Learning, Uses and abuses, Ethical considerations, Abstraction and Knowledge Representation, Generalization, Assessing the Success, Steps to apply 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**	**7 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**	**7 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
Self-study / Case Study / Applications	Case Studies of Machine Learning Applications in Retail, Hospitality, Education and Insurance Sectors

MODULE-4	GENETIC & REINFORCEMENT ALGORITHMS	24MCA31.4	7 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	7 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
Self-study / Case Study / 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)	Assessment	Lab
		25	5	20
L1	Remember	5	2	-
L2	Understand	10	3	-
L3	Apply	5	-	20
L4	Analyze	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) Mathematics and Programming for Machine Learning with R, William B. Claster, CRC Press, Taylor & Francis, 2020, ISBN: 978-1-00-0196979.
2) Machine Learning, Tom M Mitchel, McGraw Hill Education, 2017, ISBN: 978-1-25-909695-2.
3) Machine Learning with R - Third Edition By Brett Lantz, Packt, 2013, ISBN: 978-1-78216-214-8.
4) R for Everyone, Advanced Analytics and Graphics, Jared P Lander, Pearson Publication, 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" Third Edition, O'REILLY, 2022, ISBN : 978-9355421982.
2) 2Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson Education India, 2019, ISBN: 9789353067373.
3) Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Grey scale Indian Edition, O'REILLY, 2016, 978-1449369415.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=jGwO_UgTS7I&list=PLoROMvodv4rMiGQp3WXShtMGgzqpfVfbU
- https://www.youtube.com/watch?v=4b4MUYve_U8&list=PLoROMvodv4rMiGQp3WXShtMGgzqpfVfbU&index=2
- https://www.youtube.com/watch?v=nt63k3bfXS0&list=PLoROMvodv4rMiGQp3WXShtMGgzqpfVfbU&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

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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 AngularJS to develop structured web applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA32.1	1	-	2	-	1	-	-	-	3	-
24MCA32.2	-	1	1	-	1	-	-	-	3	-
24MCA32.3	-	-	1	-	1	-	-	-	3	-
24MCA32.4	-	-	2	-	1	-	-	-	3	-
24MCA32.5	-	-	1	-	1	-	-	-	3	-

MODULE-1	**INTRODUCTION TO WEB PROGRAMMING AND HTML5**	**24MCA32.1**	**7 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.*

Self-study / Case Study / 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**	**7 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	7 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	7 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 / Case Study / Applications	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	7 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)	Qualitative Assessment(s)	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) Programming the world wide web by Sebesta, Robert W. ,Addison-Wesley Professional, 2014, ISBN-13: 9780133775983.
2) Bootstrap by Jake Spurlock, O'ReiIIy Media, 2013, ISBN-13: 9781449343910.
3) Adam Trachtenberg, PHP Cookbook: Solutions and Examples for PHP Programmers, Third edition, O'Reily Media, 2014, ISBN-13: 9781449363758.
4) AngularJS: Up And Running Shyam Seshadri and Brad Green O'Reilly Media, Inc 2018, ISBN-13: 9781491901946.

Reference Books:

1) Mark Meyers, A Smart way to Learn JavaScript, 2013-14 (e-book and Kindle version only), ISBN-13: 9781497408180.
2) Bootstrap 5 From Scratch, Brad Traversy, 2023, ISBN-13: 9781835460559.
3) Ng-book: The complete guide to Angular., by Murray, Nathan, Felipe Coury, Ari Lerner, and Carlo Taborda , CreateSpace Independent Publishing Platform, 2018, ISBN-13: 9781985170285.
4) Bampakos, Aristeidis, and Pablo Deeleman. Learning Angular: A no-nonsense guide to building web applications with Angular 15. Packt Publishing Ltd, 2023, ISBN-13: 9781803240602.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=3Xly2W1Cisc
- https://www.youtube.com/watch?v=OK_JCtrrv-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.

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA331.1	2	2	-	-	-	-	-	-	-	3
24MCA331.2	3	3	-	-	-	-	-	-	-	3
24MCA331.3	3	3	2	2	-	-	-	-	-	3
24MCA331.4	2	1	-	2	-	-	-	-	-	3
24MCA331.5	2	2	-	2	-	-	-	-	-	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.

Self-study / Case Study / Applications	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.			
Self-study / Case Study / Applications	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.			
Self-study/ Case Study/ Applications	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 & AAT2)	AAT3
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	2
L3	Apply	10	5	4
L4	Analyze	5	5	4
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) Python for Data Analysis, Wes McKinney, 3rd Edition, 2022, O'Reilly Media, Inc. ISBN: 9781098104030.
2) Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, Peter Gedeck, O'Reilly Publications, 2nd edition, 2020, ISBN: 8-1492072942.
3) Principles of Data Science, Sinan Ozdemir , Sunil Kakade , Marco Tibaldeschi 2nd Edition, Packt, 2018, ISBN: 9781789804546.
4) Python Data Science Handbook, Jake Vander Plas, O'Reilly, 2016, ISBN: 9781491912058.

Reference Books:

1) Data Science from Scratch, Joel Grus, O'Reilly publishers, 2019, ISBN: 978-9352138326.

2) An Introduction to Data Science, Jeffrey S Saltz, Jeffrey Morgan Stanton, SAGE, 2017, ISBN: 978-1506377537.
3) Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th edition, 2016, Pearson Education, ISBN-13: 9780134115856.

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=GPVsHOlRBBI
- 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.

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA332.1	2	2	-	-	-	-	-	-	2	-
24MCA332.2	2	2	-	2	-	-	-	-	2	-
24MCA332.3	2	2	-	-	-	-	-	-	2	-
24MCA332.4	-	2	2	2	-	-	-	-	2	-
24MCA332.5	-	2	2	-	-	-	-	-	2	-

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 / Case Study / Applications	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 Files ystem, 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.

Self-study / Case Study / Applications	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)	AAT3
		25	15	10
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) Hartman, Shane, Hands-On Ethical Hacking Tactics: Strategies, tools, and techniques for effective cyber defense, 1st Edition, Packt Publishing Ltd., 2024, ISBN: 978-1801810081.
2) Simpson, Michael T, Nicholas Antill, and Rob Wilson, Hands-on ethical hacking and network defense, 1st Edition, Cengage Learning, 2022, ISBN: 978-0357509753.
3) Dafydd Stuttard & Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley, 2011, ISBN: 978-1118026472.
4) Dominic Chell, Tyrone Erasmus, Shaun Colley, Mobile Application Hacker's Handbook, Wiley, 2015, ISBN: 978-1118958506.

Reference Books:

1) R. Baloch, Web Hacking Arsenal: A Practical Guide to Modern Web Pentesting, 1st Edition, CRC Press, 2024, ISBN: 978-1032447179.
2) S. J. Shapiro, Fancy Bear Goes Phishing: The Dark History of the Information Age, in Five Extraordinary Hacks, Picador 2024, ISBN: 978-0374601171.

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

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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	-	-	-	-	-	-	-	-	3
24MCA333.2	-	-	-	2	2	-	-	-	-	3
24MCA333.3	2	1	-	-	2	-	-	-	-	3
24MCA333.4	2	-	-	2	-	-	-	-	-	3
24MCA333.5	1	2	1	-	-	-	-	-	-	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.										
Self-study / Case Study / Applications	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	**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.										
Self-study / Case Study / Applications	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)	AAT3
		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) Virtual Reality, Steven M. LaValle, Cambridge University Press, 2023, ISBN:9781108182874.
2) Virtual Reality Technology, 2nd Edition, Grigore C. Burdea, Philippe Coiffet, November 2017, Wiley-IEEE Press, ISBN: 978-1-119-48572-8.

Reference Books:

1) Augmented Reality: Principles and Practice, Dieter Schmalstieg, Tobias Hollerer, Addison-Wesley, 2016, ISBN: 9780321883575.
2) Creating augmented & virtual realities, Erin Pangillinan, SteveLukas, Vasanth Mohan, O'Reillly Media, Inc.2019, ISBN: 9781492044192.
3) Virtual & Augmented Reality for Dummies, Paul Mealy, 2018, ISBN: 978-1-119-48134-8.
4) Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Steve Aukstakalnis, Addison-Wesley Professional, 2016, ISBN: 9780134094328.

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.

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA334.1	3	2	2	2	-	-	-	-	-	3
24MCA334.2	3	2	1	3	-	-	-	-	-	3
24MCA334.3	3	2	-	2	-	-	-	-	-	3
24MCA334.4	3	1	1	3	-	-	-	-	-	3
24MCA334.5	2	1	-	2	-	-	-	-	-	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 / Case Study / Applications	• 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 / Case Study / Applications	• 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)	AAT3
		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", 1st Edition,Wiley,2021, ISBN-10. 1119285666.
2) David Hanes , Gonzalo Salgueiro , Patrick Grossetete, Robert Barton (Author), Jerome Henry," IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things "1st Edition, Cisco Press,2021, ISBN-13. 978-0134307060.

Reference Books:

1) Qinghao Tang (Author), Fan Du," Internet of Things Security: Principles and Practice", 1st edition,Springer,2021, ISBN-13. 978-0134307060.
2) Chandrasekar Vuppalapati, "Building Enterprise IoT Applications", 1 st Edition, Academic Press, 2019, ISBN-13. 978-0429508691.
3) Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018, ISBN-13. 978-1788397438.
4) Colin Dow, "Internet of Things Programming Projects: Build modern IoT solutions with the Raspberry Pi 3 and Python", 1st edition, Packt Publishing, 2018, ISBN-13. 978-1788397438.

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

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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	PSO1	PSO2
24MCA335.1	2	1	2	-	-	-	-	-	-	3
24MCA335.2	2	1	2	-	-	-	-	-	-	3
24MCA335.3	2	1	2	-	-	-	-	-	-	3
24MCA335.4	2	1	2	-	-	-	-	-	-	3
24MCA335.5	2	1	-	-	-	-	-	-	-	3

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 & AAT2)	AAT3
		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	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources

Text Book:

1) A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012, ISBN: 0321915386.
2) The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011, ISBN: 978-0321683687.
3) The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007, ISBN: 978-0470053423.

Reference Books:

1) Hands-On UX Design for Developers: Design, prototype, and implement compelling user experiences from scratch, Elvis Canziba, 2018, ISBN: 978-1788626699.
2) Wilber O Galitz, "The Essential Guide to User Interface Design- An Introduction to GUI Design, Principles and Techniques", Wiley-Dreamtech India Pvt Ltd, 2015, ISBN: 978-470053423.
3) Eberts: User Interface Design, Prentice Hall, 19944, 978-0131403284.

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.

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PROJECT WORK

Course Code	**24MCA34**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:9**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA34.1	1	2	-	-	-	-	-	1	2	3
24MCA34.2	-	-	3	-	3	-	-	-	2	3
24MCA34.3	-	-	3	-	3	-	-	-	2	3
24MCA34.4	-	-	-	3	-	-	-	-	2	3
24MCA34.5	-	-	-	-	-	-	-	-	2	3

GUIDELINES

1. The student needs to complete the project within the stipulated time with the appropriate development methodology.
2. The project guides and project coordinator follow rubrics set by the department for project evaluation.
3. CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/Co-Guide if any, and a senior faculty of the department.
4. The CIE marks awarded for major project, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and performance in the viva-voce.
5. SEE will be conducted for the project work with viva-voce.
6. It is mandatory for the student to present/publish the work in international conferences or Journals.
7. The evaluation is based on the following:
   (i) Review of Objectives, Methodology and Implementation
   (ii) Design, Implementation and Testing
   (iii) Experimental Result and Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication.
   (iv) Presentation and viva-voce

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

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

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

RBT Levels	Exam Marks Distribution (50)
Remember	-
Understand	-
Apply	10
Analyze	10
Evaluate	10
Create	20

Suggested Learning Resources:
Web links:

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

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Fourth Semester MCA
AY -2025-26

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	-	-	3
24MCA411.2	-	-	-	-	-	-	3	-	-	3
24MCA411.3	-	-	-	-	-	-	3	-	-	3
24MCA411.4	-	-	-	-	-	-	3	-	-	3
24MCA411.5	-	-	-	-	-	-	3	-	-	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.

Self-study/ Case Study/ Applications	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/ Case Study/ Applications	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)	AAT3
		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) AI Ethics: A Textbook, Paula Boddington, Springer Verlag Singapore, 2024, ISBN: 9789811993848.
2) Ethics in Computing, Science and Engineering, Bary G. Bludell, Springer International publishing, 2020, ISBN: 9783030271268.
3) Ethics in Information Technology, George Reynolds, Cengage Learning, 2011, ISBN:9781111534127

References Books:

1) AI Ethics (The MIT Press Essential Knowledge Series), Mark Coeckelbergh, MIT Press, 2020, ISBN: 9780262538190.
2) Ethics in Engineering Practice and Research, Cambridge University Press, 2011, ISBN: 9780521723985.
3) A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet, Sara Baase, 3rd Edition, 2008, ISBN: 9780136008484.

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.

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA412.1	2	1	1	-	-	-	-	-	-	3
24MCA412.2	2	-	2	-	-	-	-	-	-	3
24MCA412.3	-	2	-	-	-	-	-	-	-	3
24MCA412.4	2	3	2	-	-	2	-	-	-	3
24MCA412.5	3	3	3	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 / Case Study / Applications	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
Self-study / Case Study / 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 / Case Study / Applications	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 / Case Study / Applications	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)	AAT3
		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) File System Forensic Analysis, Brian Carrier, 1st Edition, Addison-Wesley, 2005, ISBN: 978-0-321-26817-4.
2) Incident Response and Computer Forensics, Jason Luttgens, Matthew Pepe, Kevin Mandia, *3rd* Edition, McGraw-Hill Education, 2014, ISBN: 978-0-07-179868-6.
3) Practical Malware Analysis, Michael Sikorski and Andrew Honig, 1st Edition, No Starch Press, 2012, ISBN: 978-1-59327-290-6.
4) iPhone and iOS Forensics, Andrew Hoog and Katie Strzempka, 1st Edition, Syngress, 2011, ISBN: 978-1-59749-659-9.
5) Digital Evidence and Computer Crime, Eoghan Casey, 3rd Edition, Academic Press, 2011, ISBN: 978-0-12-374268-1.

Reference Books:

1) Forensic Discovery, Dan Farmer and Wietse Venema, 1st Edition, Addison-Wesley, 2005, ISBN: 978-0-201-63437-2.
2) Computer Forensics and Investigations, Bill Nelson, Amelia Phillips, Christopher Steuart (formerly Enfinger), 6th Edition, Cengage Learning, 2018, ISBN: 978-1-337-60055-1.
3) Software Forensics, Robert M. Slade, 1st Edition, McGraw-Hill, 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.

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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:										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
24MCA413.1	3	2	2	1	-	-	-	-	2	1
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	-	-	2	3
24MCA413.5	1	2	3	-	-	-	3	-	3	2
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 / Case Study / Applications	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.										
Self-study / Case Study / 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.										

Self-study / Case Study / Applications	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)	AAT3
		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 Books:

1) Tim Brown, Change by Design, Harper Collins (2009), ISBN-13: 978-0061766084.
2) Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons, ISBN-13: 9781118620120.

Reference Books:

1) David Lee, Design Thinking in the Classroom, Ulysses Press, ISBN-13: 978-1612438016.
2) Shrutin N Shetty, Design the Future, Norton Press, ISBN-13: 978-1592535873.
3) William Lidwell, Universal Principles of Design, Kritinaholden, Jill Butler, ISBN-13: 978-0760375167.

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.

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA414.1	-	-	-	-	2	-	-	-	-	2
24MCA414.2	-	2	-	-	-	-	-	-	-	2
24MCA414.3	-	-	-	-	2	-	-	-	-	2
24MCA414.4	-	-	-	-	-	-	-	-	-	2
24MCA414.5	-	-	-	-	-	2	-	-	-	2

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.			
Self-study / Case Study / Applications	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.			
Self-study / Case Study / Applications	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)	AAT3
		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, 1st Edition, Mc-Graw Hill, 2017, ISBN: 9387067610, 9789387067615.
2) Puneet Singh Bhatia, Fundamentals of Digital Marketing, Pearson 1st Edition, 2017, ISBN: 978-9332587373.

Reference Books:

1) Ian Dodson: The Art of Digital Marketing, The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns, Wiley, 2016, ISBN: 78-1-119-26570-2.
2) Nitin C. Kamat, Chinmay Nitin Kamat: Digital Social Media Marketing, Himalaya Publishing House Pvt. Ltd. 2018, ISBN: 978-93-5299-115-0.
3) Seema Gupta, Avadhoot Jathar : Marketing Analytics, Wiley India Pvt. Ltd. October 2021, ISBN: 9789354242625.

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

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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	-
24MCA415.2	-	-	2	-	-	3	2	-	2	-
24MCA415.3	-	-	2	-	-	3	-	-	2	-
24MCA415.4	-	-	-	-	1	3	-	-	2	-
24MCA415.5	1	-	3	2	1	3	-	-	2	-

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 / Case Study / Applications	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 / Case Study / Applications	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)	AAT3
		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 Cotterel, Rajib Mall, Software Project Management, 6th Edition, McGraw-Hill, 2018, ISBN: 9789353162346.
2) Ralph Cybulski, PMP PMBOK Study Guide, 7th Edition, Project Management Institute, 2020, ISBN: 9781628256642.
3) Robert C. Martin, Agile Software Development- Principles, Patterns and Practices, 1st Edition Prentice Hall, 2013, ISBN: 9780135974445.
4) Kenneth S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, 1st Edition, Addison Wesley, 2012, ISBN: 9780137043293.
5) Roger S. Pressman, Bruce R. Maxim, Software Engineering-A Practitioner's Approach, 8th Edition, Mc Graw Hill, ISBN: 9780078022128.

Reference Books:

1) Kalpesh Ashar, Project Management Essentials You Always Wanted to Know, 4th edition, Vibrant Publishers, 2021, ISBN: 9781636510090.
2) Jack Marchewka," Information Technology- Project Management", Wiley Student Version, 4th Edition, Wiley India, 2013, ISBN: 9788126556012.
3) Lisa Crispin, Janet Gregory, Agile Testing-A Practical Guide for Testers and Agile Teams, Addison Wesley, 2009, ISBN: 9780321534460.
4) Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", International Edition, Pearson Education, 2002, ISBN: 9780130676344.

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.

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LAB BASED PROFESSIONAL ELECTIVES – 2

CLOUD SERVICES MANAGEMENT			
Course Code	**24MCA421**	**CIE Marks**	**50**
L:T:P:S	**0:1:2:0**	**SEE Marks**	**50**
Hrs / Week	**2+4**	**Total Marks**	**100**
Credits	**03**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA421.1	1	-	-	-	-	-	-	-	2	1
24MCA421.2	3	-	-	-	-	-	-	-	2	1
24MCA421.3	3	2	1	1	-	-	-	-	2	1
24MCA421.4	3	3	3	2	-	-	-	-	2	1
24MCA421.5	3	3	3	2	-	-	-	-	2	1

MODULE-1	**INTRODUCTION TO CLOUD COMPUTING AND PLATFORMS**	**24MCA421.1**	**3 Hours**

Cloud Computing Fundamentals, Characteristics and Benefits of Cloud, Service Models (Iaas, Paas, Saas), Deployment Models (Public, Private, Hybrid), Overview of AWS And Azure Platforms, Global Infrastructure (Regions, Availability Zones), Use Cases Of Cloud Services, Navigating Cloud Consoles.

Laboratory Component: **6 Hours**

1. *Create a cloud platform Free Tier account and log in to the cloud console.*
2. *Explore global infrastructure: list at least 3 regions and key services in each.*
3. *Identify and explore 5 core services (e.g., compute, storage, database, IAM, monitoring).*
4. *View Free Tier usage and billing dashboard: capture current usage and forecasted cost.*
5. *Use the cloud pricing calculator: estimate the cost of running a basic virtual machine.*
6. *Compare the services and pricing between two cloud platforms (e.g., AWS and Azure) for hosting a virtual machine, and summarize your findings in a table.*

Text Book	Text Book 1: Chapter: 1, 2, 3, 4, Text Book 2: Chapter: 1, 2, 3, 4

MODULE-2	**COMPUTE AND STORAGE SERVICES**	**24MCA421.2**	**3 Hours**

Virtual Machines and Instance Types, OS Images and Key Pairs, VM Lifecycle (Start, Stop, Terminate), Remote Access (SSH, RDP), Hosting Applications on Cloud Vms, Types Of Storage (Object, Block, File), S3 and Azure Blob Storage, Creating Buckets and Containers, Uploading/Downloading Files, Setting Access Controls, Versioning and Lifecycle Rules, Hosting Static Websites from Storage.

Laboratory Component: (minimum 3 experiments / programs) **6 Hours**

1. *Launch a t2.micro EC2 Linux instance using Amazon Machine Image (AMI).*
2. *Connect to the EC2 instance via SSH, using the key pair downloaded during setup.*
3. *Install Apache/Nginx on the instance and host a simple "Hello Cloud" web page.*
4. *Create an S3 bucket, upload a file (PDF, image, etc.), and configure it for public access.*
5. *Enable versioning on the S3 bucket and upload a file twice to see version control in action.*
6. *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.*

Text Book	Text Book 1: Chapter: 5, 6, 7, 8, 9

MODULE-3	CLOUD DATABASES	24MCA421.3	3 Hours
Relational Databases in Cloud (Mysql, Postgresql, SQL Server), AWS RDS and Azure SQL Database, SQL Operations (CREATE, SELECT, INSERT, UPDATE, DELETE), Introduction To NoSQL Databases, DynamoDB And Cosmos DB (Key-Value And Document Stores), Use Cases Of NoSQL, Introduction To Graph Databases (Amazon Neptune, Gremlin API), Basics Of Data Warehouses (Amazon Redshift, Azure Synapse), OLTP Vs OLAP.			
Laboratory Component: **6 Hours** 1. *Launch a managed SQL database instance using a free-tier eligible cloud service.* 2. *Connect using a database client tool and create a database and table.* 3. *Perform SQL operations such as creating a student table and inserting 5 sample records.* 4. *Create a NoSQL table with "StudentID" as the primary key and add 3 records.* 5. *Query the NoSQL database using the console's built-in query editor.* 6. *Create a PostgreSQL database using Amazon RDS, connect to it with pgAdmin, create a table, and insert & query sample student records.*			
Self-study / Case Study / Applications	E-commerce Shopping Cart**:** Create a cloud-integrated e-commerce application using cloud database services to store user data, cart contents, and transaction history.		
Text Book	Text Book 1: Chapter: 4, 5, 6		
MODULE-4	**IDENTITY, ACCESS MANAGEMENT AND NETWORKING**	**24MCA421.4**	**3 Hours**
IAM Concepts (Users, Roles, Policies), Creating and Managing IAM Users, Permissions and Access Control, Cloud Networking Basics (VPC, Subnet, IP, Firewall), Security Groups and Network Security Groups (Nsgs), Shared Responsibility Model, Creating Secure Cloud Environments.			
Laboratory Component: **6 Hours** 1. *Create a new IAM user and assign "S3 Read Only" access using pre-defined policies.* 2. *Log in as the new user and verify that they can list S3 buckets but not delete anything.* 3. *Create a security group to allow only HTTP (port 80) and SSH (port 22) access to a VM.* 4. *Attach a custom IAM policy to restrict EC2 termination for a user.* 5. *Test network control: Add and remove inbound/outbound rules and observe connectivity.* 6. *Create a custom VPC with a public subnet, launch an EC2 instance in that subnet, and associate a security group that allows only SSH access.*			
Self-study / Case Study / Applications	Develop a comprehensive online bookstore management system using secure access control and networking practices for efficient data access and protected transactions.		
Text Book	Text Book 1**:** Chapter: 11,12,13 Text Book 2**:** Chapter: 7, 8, 9		
MODULE-5	**MONITORING, COST MANAGEMENT AND PROJECT INTEGRATION**	**24MCA421.5**	**3 Hours**
Cloud Monitoring Tools (Cloudwatch, Azure Monitor), Metrics and Logs, Creating Alarms and Dashboards, Billing and Cost Explorer, Budgets and Alerts, Best Practices for Cost Optimization, Resource Tagging and Cleanup, Planning and Integrating Mini Projects using Compute, Storage, and Databases.			
Laboratory Component: **6 Hours** 1. *Enable detailed monitoring on your EC2 instance and view metrics in CloudWatch.* 2. *Create a CloudWatch alarm to notify when CPU usage exceeds 60%.* 3. *Set up a billing alert to trigger an email if AWS usage exceeds $1.* 4. *Use AWS Tags to tag your S3 bucket, EC2 instance, and RDS database with "Project" = "CloudLab".* 5. *Start a mini project**:** Deploy a student information system using EC2 + RDS + S3 and document the setup.* 6. *Create a custom CloudWatch dashboard that displays at least two EC2 metrics (e.g., CPU utilization, network in/out) in real-time.*			
Text Book	Text Book 1**:** Chapter: 15,16,17,18 Text Book 2: Chapter: 12,13,14		

CIE Assessment Pattern (50 Marks – Hands On)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests(AAT1 & AAT2)	AAT3
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	4
L3	Apply	10	10	4
L4	Analyze	5	-	2
L5	Evaluate		-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Practical)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	15
L3	Apply	15
L4	Analyze	10
L5	Evaluate	-
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Douglas E. Comer**,** *"The Cloud Computing Book: The Future of Computing Explained"*, 1st Edition, Routledge, 2022, ISBN-13: 978-0367706845.
2) Bruce W. Fraser**,** *"Cloud Computing Basics: A Non-Technical Introduction"*, 1st Edition, Springer, 2021, ISBN-13: 978-1484269213.

Reference Books:

1) Michael J. Kavis**,** *"Accelerating Cloud Adoption: Optimizing the Enterprise for Speed and Agility"*, 1st Edition, O'Reilly Media, 2021, ISBN-13: 978-1492093613.
2) 2) Michael Wittig & Andreas Wittig**,** *"Exploring Cloud Computing"*, 1st Edition, Manning Publications, 2021, ISBN-13: 978-1617296984.

Web links and Video Lectures (e-Resources):

- https://www.aws.training/Details/Curriculum?id=20685
- https://www.youtube.com/user/AmazonWebServices
- https://learn.microsoft.com/en-us/training/paths/microsoft-azure-fundamentals-describe-cloud-concepts/
- https://www.youtube.com/watch?v=y1xC5cJ5VzY
- https://www.coursera.org/learn/cloud-computing-foundations

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

- **Project-Based Learning**: Encourage students to build real-world mini-projects using cloud services such as compute instances, object storage, or cloud databases. Example projects include student portals, file-sharing apps, and database-backed websites. This hands-on approach bridges theoretical concepts with practical implementation.
- **Interactive Coding Challenges**: Use platforms like: AWS Cloud Quest, Qwiklabs, Microsoft Azure LabsThese platforms allow students to perform real-time cloud tasks (e.g., launching instances, configuring networks, managing billing) in sandbox environments.

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DEVOPS			
Course Code	**24MCA422**	**CIE Marks**	**50**
L:T:P:S	**0:1:2:0**	**SEE Marks**	**50**
Hrs / Week	**2+4**	**Total Marks**	**100**
Credits	**03**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA422.1	1	-	-	-	-	-	-	-	2	1
24MCA422.2	3	-	-	-	-	-	-	-	2	1
24MCA422.3	3	2	1	1	-	-	-	-	2	1
24MCA422.4	3	3	3	2	-	-	-	-	2	1
24MCA422.5	3	3	3	2	-	-	-	-	2	1

MODULE-1	**INTRODUCTION TO DEVOPS AND CLOUD**	**4MCA422.1**	**3 Hours**

Devops Principles, Devops Lifecycle, Benefits of Devops, Introduction to Cloud Computing, AWS Global Infrastructure Overview, AWS Free Tier Account Setup, Introduction to Key AWS Services (EC2, S3, IAM, VPC).

Laboratory Component: **6 Hours**

1. *Create a free-tier AWS account and launch your first EC2 instance.*
2. *Explore AWS Management Console and list any 5 commonly used services.*
3. *Create an S3 bucket and upload/download a file from it.*
4. *Configure basic IAM roles and attach them to a user.*
5. *Create a VPC with a public subnet and associate it with a route table.*
6. *Demonstrate how DevOps helps in faster software deployment using a simple diagram and explanation.*

Text Book	Text Book 1**:** Chapter: 1, 2, Text Book 2**:** Chapter: 1

MODULE-2	**VERSION CONTROL AND SOURCE CODE MANAGEMENT**	**4MCA422.2**	**3 Hours**

Basics of Git, Git Installation And Setup, Github Repository Creation, Git Commands (Clone, Add, Commit, Push, Pull, Merge), Branching and Pull Requests, Connecting Github with AWS Services.

Laboratory Component: **6 Hours**

1. *Install Git and initialize a local repository.*
2. *Create a GitHub account and push a local project to a remote repository.*
3. *Perform commit, push, and pull operations using Git CLI.*
4. *Create a new branch, make changes, and merge it with the main branch.*
5. *Resolve a basic Git merge conflict manually.*
6. *Integrate GitHub with AWS CodePipeline and test repository trigger*.

Text Book	Text Book 1**:** Chapter: 6, 8 Text Book 2: Chapter: 4

MODULE-3	**CONTINUOUS INTEGRATION AND DEPLOYMENT (CI/CD)**	**24MCA422.3**	**3 Hours**

CI/CD Concepts, Introduction to AWS Code commit, Code build, Code deploy, Code pipeline, Creating and Configuring Pipelines, Automating Application Deployment using AWS CI/CD Tools, Hands-On Project with a Sample Web App.

Laboratory Component: **6 Hours**

1. *Create a CodeCommit repository and push your code into it.*
2. *Configure AWS CodeBuild to build a sample Node.js or Python application.*
3. *Set up AWS CodeDeploy to deploy an app to EC2 using a simple AppSpec file.*
4. *Create a CI/CD pipeline using AWS CodePipeline that builds and deploys an app automatically.*
5. *Add GitHub as a source stage to your CodePipeline.*
6. *Trigger a deployment by modifying code and observe automatic pipeline execution.*

Self-study / Case Study / Applications	Analyze how an online learning platform (like Coursera or Udemy) uses CI/CD pipelines to automate deployment of microservices, manage frequent updates, and ensure zero-downtime delivery. Students can explore pipeline structures, tools used, and benefits of continuous integration in a real-world education tech environment.
Text Book	Text Book 1: Chapter: 5, 9 Text Book 2: Chapter: 5, 6

MODULE-4	**CONTAINERIZATION AND INFRASTRUCTURE AS CODE**	**24MCA422.4**	**3 Hours**

Introduction to Docker, Docker Installation and Commands, Creating Docker files and Docker Compose, AWS ECS (Elastic Container Service) Basics, AWS ECR for Container Image Storage, Introduction to Infrastructure ss Code (Iac), AWS Cloud formation Basics.

Laboratory Component: **6 Hours**

1. *Install Docker and run a "Hello World" container.*
2. *Create a Docker file for a basic web server and build an image.*
3. *Push the Docker image to Amazon ECR (Elastic Container Registry).*
4. *Deploy a Docker container to AWS ECS using the Fargate launch type.*
5. *Write a basic Cloud Formation template to create an EC2 instance.*
6. *Use AWS Cloud Formation to provision an S3 bucket and IAM role.*

Self-study / Case Study / Applications	Study how companies like Netflix or Spotify deploy microservices using container orchestration platforms. Explore the role of Docker, ECS/Kubernetes, and Infrastructure as Code tools in ensuring scalability and manageability of large-scale systems.
Text Book	Text Book 1**:** Chapter: 11, 14 Text Book 2**:** Chapters: 7, 9

MODULE-5	**MONITORING, SECURITY AND FINAL PROJECT**	**24MCA422.5**	**3 Hours**

Monitoring with AWS Cloud watch, Creating Cloud watch Alarms and Dashboards, Basics of AWS IAM (Users, Roles, Policies), Introduction to AWS Secrets Manager, Devops Best Practices, Final Hands-On Project Deploying a Containerized App using CI/CD on AWS.

Laboratory Component: **6 Hours**

1. *Create a CloudWatch dashboard to monitor CPU usage of an EC2 instance.*
2. *Set up an alarm in CloudWatch that sends a notification when CPU exceeds 60%.*
3. *Create an IAM role and attach policies for EC2 access.*
4. *Store a secret (e.g., DB password) in AWS Secrets Manager and retrieve it via CLI.*
5. *Review and explain the security best practices for DevOps pipelines.*
6. *Final Project: Build and deploy a Dockerized web application with CodePipeline, monitor it using CloudWatch, and manage credentials securely with Secrets Manager.*

Text Book	Text Book 1**:** Chapter: 13, 16 Text Book 2: Chapter: 8, 10

CIE Assessment Pattern (50 Marks – Hands On)

RBT Levels		**Marks Distribution**		
		Test (s)	**Alternate Assessment Tests (AAT1 & AAT2)**	**AAT3**
		25	**15**	**10**
L1	**Remember**	5	-	-
L2	**Understand**	5	5	4
L3	**Apply**	10	10	4
L4	**Analyze**	5	-	2
L5	**Evaluate**		-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Practical)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**15**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**-**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1) Gene Kim, Jez Humble, Patrick Debois, John Willis, *"The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations"*, 2nd Edition, IT Revolution Press, 2021, ISBN-13: 978-1950508405.
2) Len Bass, Ingo Weber, Liming Zhu, *"DevOps: A Software Architect's Perspective"*, 1st Edition, Addison-Wesley, 2015, ISBN-13: 978-0134049847.

Reference Books:

1) Jez Humble, David Farley, *"Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation"*, 1st Edition, Addison-Wesley, 2010, ISBN-13: 978-0321601919.
2) Ernest Mueller, James Wickett, Karthik Gaekwad, Peco Karayanev, *"DevOps Engineering on AWS"*, 1st Edition, O'Reilly Media, 2021, ISBN-13: 978-1492079921.

Web links and Video Lectures (e-Resources):

- https://aws.amazon.com/training/learn-about/cloud-practitioner/
- https://learn.microsoft.com/en-us/devops/what-is-devops
- https://docs.aws.amazon.com/codepipeline/latest/userguide/welcome.html
- https://docs.docker.com/get-started/
- https://docs.aws.amazon.com/cloudwatch/
- https://www.youtube.com/playlist?list=PLhr1KZpdzukcOr_6j_zmSrvYnLUtgqsZz

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

- **Project-Based Learning**: Encourage students to build a complete DevOps pipeline for a containerized web application using AWS services. The project includes using GitHub for source code management, configuring CI/CD with AWS CodePipeline, deploying Docker containers using ECS and ECR, managing infrastructure using CloudFormation, and enabling monitoring via CloudWatch. This hands-on mini-project integrates the entire course content into a real-world simulation.
- **Interactive Coding Challenges**: Use platforms like: AWS Cloud Quest, Qwiklabs, Microsoft Azure Labs. These platforms allow students to perform real-time DevOps tasks (e.g., launching EC2 instances, configuring IAM policies, automating deployments, setting up monitoring tools) in sandbox environments using guided labs.

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BIGDATA ANALYTICS USING HP VERTICA

Course Code	**24MCA423**	**CIE Marks**	**50**
L:T:P:S	**0:1:2:0**	**SEE Marks**	**50**
Hrs / Week	**2+4**	**Total Marks**	**100**
Credits	**03**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA423.1	3	2	-	3	-	-	-	-	2	1
24MCA423.2	3	2	-	3	-	-	-	-	2	1
24MCA423.3	3	2	2	3	-	-	-	-	2	1
24MCA423.4	3	2	2	3	-	-	-	-	2	1
24MCA423.5	3	2	2	3	-	-	-	-	2	1

MODULE-1	**INTRODUCTION TO SQL**	**24MCA423.1**	**3 Hours**

Types of SQL, Data Types, Constrains, JOINS, Types of JOINS, Clause, Group by, Having, Order by, Where Clause with Examples, SQL Alias, Views, Union, Union all, Aggregate Functions, Operators.

Laboratory Component: **6 Hours**

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.*
2. *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.*
3. *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.*
4. *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.*

5. *Assume you have a Sales table with columns such as SalesID, Region, and Amount. Using this table, write SQL queries to perform the following tasks using GROUP BY and HAVING commands.*
   - *(i) Calculate the total sales amount for each region.*
   - *(ii) Display the regions where the total sales exceed Rs. 50,000.*
   - *(iii) Find the number of sales transactions recorded in each region and display.*
   - *(iv) Display regions that have fewer than 3 sales transactions.*
6. *Consider a Products table with columns such as ProductID, ProductName, and Price. Write SQL queries to perform the following:*
   - *(i) Displayall products in ascending order of price.*
   - *(ii) Retrieve the second most expensive product and display it.*
   - *(iii) List all products with prices between Rs. 50 and Rs. 100, sorted in descending order of price.*
   - *(iv) Display the least expensive product from the list.*

Text Book	Text Book 1: Chapter: 5,6,7		
MODULE-2	**HPVERTICA-1**	**24MCA423.2**	**3 Hours**

Introduction to HP-Vertica Database, Vertica Analytics Platform, Columnar Orientation, Advanced Compression, High Availability, Automatic Database design, Massively Parallel Processing, Application Integration.

Projections, Query Execution, Vertica Transactions, Types of EPOCHS, Hybrid Data Store – WOS & ROS. Projection Design, Projection Fundamentals, Projection Types, Projection Properties, Replication and Segmentation Database Designer,Comprehensive Mode, Incremental Mode, Sample Data, Sample Queries, DBD Advantages.

Laboratory Component: **6 Hours**

1. *Create a schema named company and within it, create a table called employee with columns emp_id (integer, primary key), emp_name (varchar), dept (varchar), and salary (integer).Insert at least ten employee records into the employee table with appropriate values.*
2. *Write SQL queries to retrieve all employee details, find employees from a specific department (e.g., 'Sales'), and display employees earning more than 50,000.*
3. *Create a manual projection on the Employee table using REPLICATION with a K-SAFETY level of 1and level of 0.*
4. *Create a manual projection on the Employee table using SEGMENTATION with a K-SAFETY level of 1 and level of 0.*
5. *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.*
6. *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.*

Self-study / Case Study / Applications	Write a Vertica-based University Management Systemfor managing and querying academic data using Transactionand EPOCH types.

Text Book	Text Book 2: Chapter 1,2,3,4		
MODULE-3	**HPVERTICA-2**	**24MCA423.3**	**3 Hours**

Loading Data via INSERT-COPY-MERGE, Deleting Data in Vertica-Delete Vector, Design for Delete, Process of Deleting, Truncate, Purge,Update, Partitioning, Tuple Mover-Moveout Parameter, Merge out Parameter, Working with Vertica Management Console.

Laboratory Component: **6 Hours**

1. *Develop a test suite containing minimum 4 test cases using Selenium IDE.*
2. *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.*
3. *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 into the employee table accordingly. After the merge, display the contents of the employee table.*
4. *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.

5. *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.*
6. *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.*

Text Book	Text Book 2: Chapter: 5, 6		
MODULE-4	**BIG DATA ANALYTICS WITH HADOOP**	**24MCA423.4**	**3 Hours**

Big Data Overview, Introduction to Hadoop, Overview of Hadoop Distribution File Systems [HDFS] and Map Reduce Operations, Clustering Types in Hadoop- Standalone Mode, Pseudo Distributed Mode, Fully Distributed Mode.

Laboratory Component: **6 Hours**

1. *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.*
2. *Configure the Java environment variable (JAVA_HOME) required for Hadoop. Verify that the Java path is correctly set and Hadoop can access it.*
3. *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.*
4. *Set up the NameNode by formatting the Hadoop filesystem. Start the NameNode daemon and verify its running status.*
5. *Configure and start the JobTracker daemon in Hadoop. Confirm that it is running and ready to accept MapReduce jobs.*
6. *Access the Hadoop NameNode and JobTracker web UIs using a browser. Note the URLs and verify the status and health of the Hadoop cluster.*

Text Book	Text Book 3: Chapter: 1,2,3		
MODULE-5	**HADOOP ECOSYSTEM**	**24MCA423.5**	**3 Hours**

Introduction to SQOOP, Overview of PIG -Standalone Mode, Cluster Mode, Introduction to PIG Latin, Introduction to HIVE, Introduction to HBASE- Comparison of Hadoop HDFS and HBASE.

Self-study / Case Study / Applications	Demonstrate how to import structured data from MySQL into HDFS using Sqoop for further analysis.
Text Book	Text Book 3: Chapter: 15,16.1, 16.2, 16.3, 16.4,17.4,20.1,20.6

Laboratory Component: **6 Hours**

1. *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.*
2. *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.*
3. *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 files. Provide all commands used during the process.*
4. *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.*
5. *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.*
6. *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.

CIE Assessment Pattern (50 Marks – Hands On)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests (AAT1 & AAT2)	AAT3
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	10	10	5
L4	Analyze	10	-	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Practical)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	5
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Paul N Weinberg, James R Groff, Andrew J Oppel, SQL The Complete Reference, McGrawHill, 3rd Edition, ISBN: 978-0-07-159256-7.
2) Rishabh Agrawal, HP Vertica Essentials, Packt Publishing, 1st Edition, ISBN:978-1782171560.
3) Tom White, Hadoop*: The Definitive Guide,* O'Reilly, 4th Edition, ISBN: 978-1-491-90163-2.

Reference Books:

1) Ben Forta, SQL in 10 Minutes, Sams Teach Yourself, Pearson Education, 4th Edition, ISBN: 9780672336072.
2) Benjamin Bengfort, Data Analytics with Hadoop: An Introduction for Data Scientists 1st Edition,ISBN:978-1491913703.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs92
- https://nptel.ac.in/courses/106104189
- https://www.scribd.com/document/333500102/HP-Vertica-7-1-x-SQL-Reference-Manual

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

- Hands-on experience with real-world ETL operations.
- Provide case scenario Apply concepts to solve real-world problems using projection or partitioning strategy.
- Simulate a performance issue in Vertica, run inefficient queries or create poor projections.

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SOFTWARE TESTING USING SELENIUM

Course Code	**24MCA424**	**CIE Marks**	**50**
L:T:P:S	**0:1:2:0**	**SEE Marks**	**50**
Hrs / Week	**2+4**	**Total Marks**	**100**
Credits	**03**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA424.1	2	-	-	1	-	-	-	-	2	1
24MCA424.2	3	-	2	1	-	-	-	-	2	1
24MCA424.3	3	-	2	1	-	-	-	-	2	1
24MCA424.4	3	3	2	1	-	-	-	-	2	1
24MCA424.5	3	3	2	1	-	-	-	-	2	1

MODULE-1	**INTRODUCTION TO SOFTWARE TESTING**	**24MCA424.1**	**3 Hours**

Testing as an Engineering Activity, Testing as a Process, Basic Definitions, Software Testing Principles, Software Testing Life Cycle, Difference between Test Case, Use Case and Scenario, How to prepare Test Plan, How To Prepare a Test Case Template, Difference Between Error, Bug, Defect and Failure, Verification and Validation, Test Case Design Techniques- Boundary Value Analysis, Equivalence Partitioning, Decision Table.

Laboratory Component: **6 Hours**

1. *Write a Java program to validate if an input integer is within the range 1 to 100. Use boundary value test cases: 0, 1, 2, 99, 100, 101.*
2. *Create a Java program to classify a triangle based on its side lengths. Apply Equivalence Partition to design test cases (valid/invalid/edge inputs).*
3. *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).*
4. *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.*
5. *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.
6. *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
   Any value outside 0–100 → Invalid input. Use Equivalence Partitioning to design and test different input classes (valid and invalid)

Text Book	Text Book 1: Chapter: 1, 2, 10 Text Book 2: Chapter: 1, 2, 4

MODULE-2	LEVELS OF TESTING	24MCA424.2	3 Hours
Difference Between Static and Dynamic Testing, Difference between Functional and Non-Functional Testing, Unit Testing, Designing Unit Tests, Integration Testing, Designing Integration Tests, System Testing and its Types – Alpha Testing, Beta Testing, Acceptance testing and Performance testing, Regression Testing.			
Laboratory Component: **6 Hours** 1. *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).* 2. *Create a calculator program with add() and multiply() methods. Show how integration testing is applied by verifying the combined behavior of both methods.* 3. *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.* 4. *Write a simple program to simulate alpha testing feedback. Include a message indicating this is an internal product test.* 5. *Write a Java program that mimics a beta test by displaying a placeholder message for feedback collected from real users.* 6. *Write a Java program that calculates the execution time for a dummy loop to simulate performance testing.*			
Self-study / Case Study / Applications	Writing a test plan identifying test levels for Library Management System.		
Text Book	Text Book 1: Chapter: 10, 11, 12 Text Book 2: Chapter: 6		
MODULE-3	**INTRODUCTION TO SELENIUM AND SELENIUM IDE**	**24MCA424.3**	**3 Hours**
What is Automation Testing?, Advantages of Automation Testing, Fundamentals of Test Automation, Automation Framework, Introduction to Selenium, Components of Selenium Suite, Advantages and Limitations of Selenium, Selenium IDE Installation , Recording and Running Test Cases using Selenium IDE, Selenium Commands.			
Laboratory Component: **6 Hours** 1. *Develop a test suite containing minimum 4 test cases using Selenium IDE.* 2. *Conduct a test suite for any two web sites using Selenium IDE.* 3. *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.* 4. *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.* 5. *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.* 6. *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.*			
Text Book	Text Book 3: Chapter: 1, 2		
MODULE-4	**WORKING WITH SELENIUM WEBDRIVER**	**24MCA424.4**	**3 Hours**
Introduction to Web Driver, Architecture, Installation of Selenium Web Driver, Locating Web Elements, Handling Multiple elements using find Elements() method, Handling Alerts and Pop-ups, Limitation of Implicit Wait and how Explicit Wait helps.			
Laboratory Component: **6 Hours** 1. *Write a java program to Create a Selenium WebDriver program to locate and interact with web elements using different locator strategies (ID, name, className).* 2. *Write a Selenium WebDriver program using java to find all links on a webpage and print their text using findElements().* 3. *Write a java program using Selenium WebDriver to retrieve and display the content of a list in sorted*			

order.

4. *Write a Java program using Selenium WebDriver to handle a JavaScript alert box. Trigger the alert and accept it.*
5. *Develop a Java program that uses Selenium's implicit wait to handle delayed elements.*
6. *Write a Java program using Selenium WebDriver to use explicit wait to wait for a dynamic element.*

Text Book	Text Book 3: Chapter: 2, 3, 4, 5, 6 Text Book 4: Chapter: 4, 5, 6, 8		
MODULE-5	**TestNG and DATABASE TESTING**	**24MCA424.5**	**3 Hours**

Introduction of Testing Framework, Advantages of TestNG over JUnit, Introduction to TestNG, Installing TestNG in Eclipse, Creating a New TestNG Test File, TestNG Annotation, Database Testing, Steps to Create Java JDBC Connectivity, Example of Database Testing Using Selenium TestNG.

Self-study / Case Study / Applications	Create a users table in MySQL with fields: id, username, email, password and write Java code to connect to the database using JDBC. Use the annotations @BeforeClass, @Test, @AfterClass and assertions to validate the operation's result.
Text Book	Text Book 3: Chapter: 8 Text Book 4: Chapter: 27

Laboratory Component: **6 Hours**

1. *Write a Java program using Selenium WebDriver and TestNG to launch Google and verify the title using @Test and assertions.*
2. *Develop a Selenium WebDriver Java script using TestNG @Parameters annotation to test a login page with different user credentials.*
3. *Write a Java program using TestNG to demonstrate the concept of grouping test cases.*
4. *Create a Selenium WebDriver program in Java that demonstrates parallel execution of test cases on multiple browsers using TestNG.*
5. *Design a data-driven login test in Selenium WebDriver using Java and TestNG.*
6. *Write a Java program to test a database connection using JDBC and TestNG.*

CIE Assessment Pattern (50 Marks – Hands On)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests (AAT1 & AAT2)	AAT3
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	4
L3	Apply	10	10	4
L4	Analyze	10	-	2
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Practical)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	5
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice Hall of India, 2025, ISBN: 978-9388028028.
2) Ilene Burnstein, Practical Software Testing, Springer International Edition, Chennai.
3) Pallavi Sharma, Selenium with Java – A Beginner's Guide, BPB Publications, 2022, ISBN: 978-9391392680.

4) Rahul Shetty, Selenium WebDriver with Java - Basics to Advanced and Frameworks, 2023, Packt Publishing, ISBN: 9781789132908.

Reference Books:

1) Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing: Principles and Practices, Pearson Education India, 2007, ISBN: 978-8177581218.
2) Roger S. Pressman, Bruce R. Maxim, Software Engineering – A Practitioner's Approach, Ninth Edition, McGraw-Hill International Edition, 2023, ISBN: 978-9355325044.

Web links and Video Lectures (e-Resources):

- https://www.selenium.dev/documentation/
- https://www.softwaretestinghelp.com/selenium-tutorial-1/
- https://onlinecourses.nptel.ac.in/noc25_cs66/preview
- https://www.udemy.com/courses/development/software-testing/
- https://www.geeksforgeeks.org/software-testing/database-testing-using-java-selenium-and-testng/

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

- Given a small java snippet with bugs, identify the bugs, classify them as error / defect / failure, and map to the SDLC and STLC stages.
- Given a scenario for ATM PIN validation or mobile number registration, test cases can be created using Boundary Value Analysis, Equivalence Partitioning, and Decision Tables.
- Expert Talk on Industry expectations and career pathways in QA/Testing.

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BLOCKCHAIN

Course Code	**24MCA425**	**CIE Marks**	**50**
L:T:P:S	**0:1:2:0**	**SEE Marks**	**50**
Hrs / Week	**2+4**	**Total Marks**	**100**
Credits	**03**	**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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA425.1	2	-	-	-	-	-	-	-	2	1
24MCA425.2	3	2	-	-	-	-	-	-	2	1
24MCA425.3	3	-	-	-	-	-	-	-	2	1
24MCA425.4	3	-	-	-	-	-	-	-	2	1
24MCA425.5	3	2	3	2	-	-	-	1	2	1

MODULE-1	**FUNDAMENTALS OF BLOCKCHAIN**	**24MCA425.1**	**3 Hours**

History of Blockchain, Distributed Ledgers, Problems with Distributed Ledger, Blockchain Popularity, Pros and Cons of Blockchain, Use Case of Blockchain, Problem of Trust, Trust through Consensus, Consensus Models and Mining, Types of Blockchain Platforms, Cryptocurrencies, P2P Applications, Genesis Block, Blockchain Wallets, Decentralized Applications.

Laboratory Component: **6 Hours**

1. *Write the steps to install MetaMask and create a new Ethereum wallet.*
2. *Write the steps to get free test Ethers using a faucet.*
3. *Write a program or steps to view live Ethereum transactions and mined blocks using blockchain explorer.*
4. *Write a program or steps to find details of a past Ethereum transaction.*
5. *Write a program or use a tool to view block details like block number, miner address, and number of transactions.*
6. *Use an online blockchain demo to create blocks*

Text Book	Text Book 1: Chapter: 1, 2

MODULE-2	**BLOCKCHAIN CRYPTOGRAPHY**	**24MCA425.2**	**3 Hours**

Understanding Digital Signatures, Encryption, Decryption, Types of Encryption, Stream Ciphers, Block Ciphers, Encryption Algorithms, Elliptical Curve Cryptography, Public and Private Keys in Blockchain, Transaction Signing, Hashing, Merkle Trees.

Laboratory Component: **6 Hours**

1. *Write a program to input a message and generate its MD5 hash. Display the original message and the hashed value.*
2. *Write a program to input a message and generate its SHA-256 hash. Display the message and the hash.*
3. *Write a program to encrypt and decrypt a message using the Caesar cipher with a fixed key.*
4. *Write a program to generate a public and private key pair using RSA algorithm and display both keys.*
5. *Write a program for implementing Elliptic Curve Cryptography (ECC) Signing.*
6. *Write a program to encrypt a message using the public key and decrypt it using the private key. Display original, encrypted, and decrypted messages.*

Text Book	Text Book 1: Chapter: 3, 4

MODULE-3	FUNDAMENTALS OF ETHEREUM	24MCA425.3	3 Hours
Fundamentals Of Ethereum: History of Ethereum, Ethereum Concepts and Terminology, Ethereum Virtual Machine, Ethereum Releases, Ethereum Networks, Ethereum Wallets, Ethereum Currency and Units (Ether, Gwei, Wei), Gas, Types of Ethereum Accounts, Ethereum Block Chain Explorers, Ether Faucets, Ethereum Clients.			
Laboratory Component: **6 Hours** 1. *Write the steps to create multiple Ethereum accounts using MetaMask. Display the addresses of at least two accounts.* 2. *Write a program to start a Private Ethereum Network by Initializing the Genesis Block Using Geth* 3. *Write a program to check the Ether balance of an Ethereum account on a test network.* 4. *Write the steps or program to send Ether from one Ethereum account to another using MetaMask on a test network.* 5. *Write a program or use Etherscan to view details of a recent transaction such as sender, receiver, gas used, and status.* 6. *Write the steps to monitor real-time Ethereum transactions and identify a recently mined block using a blockchain explorer.*			
Text Book	Text Book 1: Chapter: 10, 11		
MODULE-4	**SMART CONTRACT PROGRAMMING WITH SOLIDITY**	**24MCA425.4**	**3 Hours**
Smart Contract, Lifecycle of Smart Contract, Need of Smart Contracts, Smart Contracts in B2C Applications (Business To Consumer), Smart Contracts in B2B Applications (Business To Business), Solidity Programming: Solidity - Introduction, Need and Features, Language: Types, Structures, Control Flow and Smart Contract Structure.			
Laboratory Component: **6 Hours** 1. *Write a program to demonstrate the Lifecycle of a Smart Contract.* 2. *Write a Solidity smart contract named HelloWorld that stores and returns message string.* 3. *Write the steps to compile a basic Solidity smart contract using the Remix IDE. Identify and fix any compilation errors.* 4. *Write the steps to deploy a smart contract on the Remix JavaScript VM. Display the deployed contract address.* 5. *Write a program or use Remix to call functions from a deployed smart contract.* 6. *Develop a Solidity Smart Contract demonstrating the use of Control Flow Statements (if-else, for, while).*			
Self-study / Case Study / Applications	Explore the lifecycle and real-world applications of smart contracts in B2C and B2B scenarios using Solidity.		
Text Book	Text Book 2: Chapter: 7, 8		
MODULE-5	**ETHEREUM INFRASTRUCTURE DEVELOPMENT AND TESTING**	**24MCA425.5**	**3 Hours**
Introduction to Geth Client, Interacting with Ethereum Network using Geth, Ethereum Development Tools, Setting Up Development Environment.			
Laboratory Component: **6 Hours** 1. *Write the steps to install the Ethereum client Geth on your system.* 2. *Write the steps to initialize a private Ethereum blockchain using Geth and start the node.* 3. *Write commands to unlock an account, check account balance, and attach to the running Geth console.* 4. *Write a program to track Smart Contract Events Using Remix IDE.* 5. *Write a Simple Solidity Contract Using Structs and Mappings.* 6. *Write a program to create a Time-Locked Smart Contract.*			
Self-study / Case Study / Applications	Explore how the Geth client facilitates private Ethereum blockchain setup, account management, mining, and smart contract testing using development tools like Truffle and Hardhat.		
Text Book	Text Book 2: Chapter: 13, 14, 15		

CIE Assessment Pattern(50 Marks – Hands On)

RBT Levels		Marks Distribution		
		Test (s)	Alternate Assessment Tests (AAT1 & AAT2)	AAT3
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	4
L3	Apply	10	10	4
L4	Analyze	10	-	2
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern(50 Marks – Practical)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	5
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Book:

1) Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, 2017, ISBN 978-1-78712-544-5.
2) Laursen, G.H. and Thorlund, J., 2016. Business analytics for managers: Taking business intelligence beyond reporting. John Wiley & Sons, ISBN: 9781119295850.

Reference Books:

1) Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016, ISBN-10. 0691171696.
2) Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017, ISBN-13. 978-1484226032.
3) Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014, ISBN-10. 1449374042.

Web links and Video Lectures (e-Resources):

- https://ethereum.org/en/developers/docs/
- https://docs.soliditylang.org/
- https://trufflesuite.com/docs/
- https://geth.ethereum.org/docs/

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

- Brainstorm on selecting appropriate blockchain platforms or techniques (public vs private blockchain, smart contracts, consensus mechanisms) for various real-time scenarios.
- Perform a comprehensive analysis of an Ethereum blockchain dataset (e.g., from Kaggle or Google BigQuery).

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA43.1	3	2	-	2	-	-	-	-	-	3
24MCA43.2	3	2	1	2	-	-	-	-	-	3
24MCA43.3	3	2	-	2	2	-	-	-	-	3
24MCA43.4	1	1	1	-	-	2	1	-	-	3
24MCA43.5	2	1	-	-	-	-	1	-	-	3

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=PLdj5pVg1kHiOypKNUmO0NKOfvoIThAv4N

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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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
24MCA46.1	-	2	-	-	-	1	-	-	-	3
24MCA46.2	2	2	2	-	-	-	-	1	-	3
24MCA46.3	1	-	1	-	1	-	-	1	-	3
24MCA46.4	1	-	-	1	-	-	-	-	-	3
24MCA46.5	-	-	-	-	-	-	-	2	-	3

General Guidelines:

1. The project work must be done individually in a software firm or any R & D Institution.
2. The project should be high quality simulated application project work, for a total duration of 6 weeks (which should either be taken after the completion of second semester and before the beginning of the third semester / completion of the third semester and before beginning the fourth semester.
3. Project work may be application-oriented or research-oriented as per student interest. Therefore, the project reports will vary depending on the type of project undertaken.
4. The student is expected to submit his/her synopsis within a week of time from the commencement of the internship.
5. An Internal guide will be allocated for each student.
6. The status of project progress must be updated with the internal guide every week.
7. Presentations should be given during subsequent project reviews.
8. Project verification at the place of project work must be mandatory by the external guide, for completion of the work.
9. Project report must be checked for plagiarism, similarity index must be less than or equal to 10%.
10. The CIE of the project work will be evaluated based on the well-defined rubrics during subsequent project reviews.
11. The project report will be evaluated by both internal and external guide assigned by the COE.
12. Final presentation of the project report and viva-voce will be from the SEE.
13. If the project report is not as per the format and not a high quality simulated application project, external examiners will have every right to reject the project.

CIE Assessment Pattern (50 Marks)

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

SEE Assessment Pattern (50 Marks)

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

Suggested Learning Resources:
Web links:

- https://www.youtube.com/watch?v=tIrGqwd8XSg
- 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.

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APPENDICES

APPENDIX A

Outcome Based Education

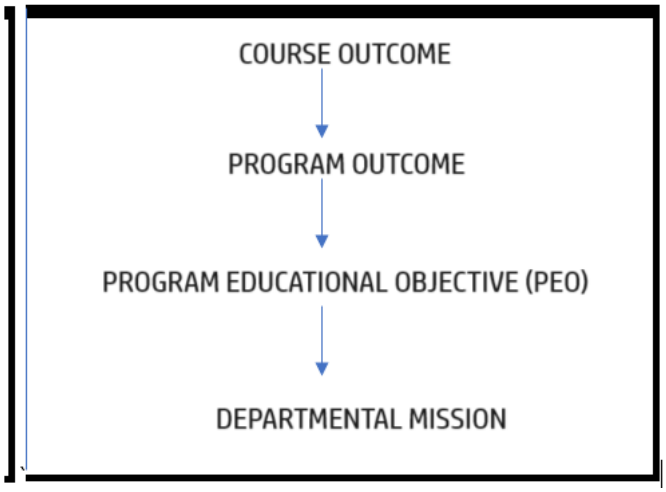
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead, classes, opportunities,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

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

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

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

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

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

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

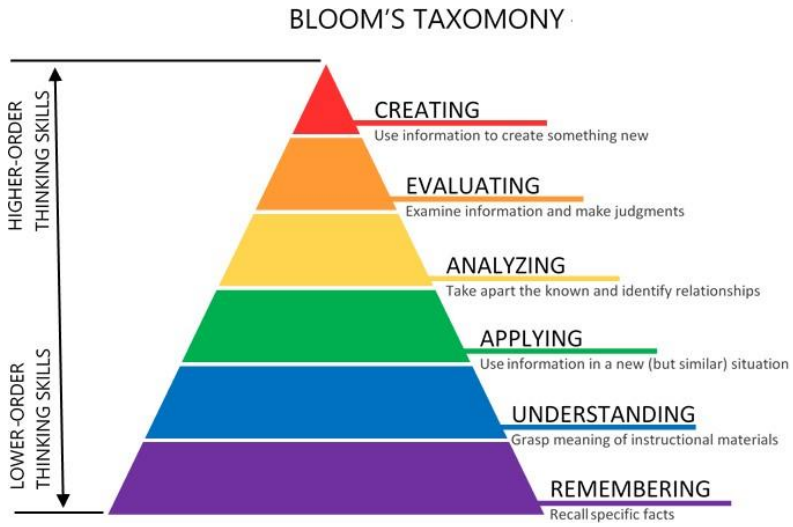
PO7 **(Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.

PO8 **(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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