KISHKINDA UNIVERSITY

ಕಿಷ್ಕಿಂದ ವಿಶ್ವವಿದ್ಯಾಲಯ

(A State Private University Established by the Karnataka Act No. 20 of 2023)

Advancing Knowledge Transforming Lives

SCHEME & SYLLABUS OF I and IV SEMESTER

THE DEGREE OF MASTER OF COMPUTER APPLICATION (MCA)
Under Outcome Based Education (OBE) & Choice-Based Credit System (CBCS) Scheme
Effective from the academic year 2023 -24

2023

MASTER OF COMPUTER APPLICATIONS (MCA)

DEPARTMENT VISION

"We aim to produce globally competent, innovative researchers, intellectual professionals, and entrepreneurs in the field of computing, with the objective to prosper and provide value to the knowledge-based economy and society".

DEPARTMENT MISSION

1. To provide excellent, morally-driven post-graduate and doctoral programs in computer applications.
2. To use tasks that need hands-on, multidisciplinary, and experience with technology-intensive knowledge.
3. To bridge gap between industry and academia by designing curriculum and syllabi around the demands of industries and society as a whole.

PROGRAM EDUCATIONAL OUTCOMES (PEOs)

PEO1: To effectively advance their careers in Software Industry, IT consulting, government, technology-enabled services, research, education, and entrepreneurship.

PEO2: To excel in diverse and inter-disciplinary organizations by embracing professionalism and ethics, both individually and as a team, and by communicating adequately.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Students will be competent to demonstrate proficiency in understanding and implementing various AI/ML algorithms in solving complex real-world problems in diverse domains such as health care, finance, natural language processing.

PSO2: Students are expected to use data and integrate data science solutions into business intelligence frameworks to support decision-making processes in organizations.

PSO3: Student will use DevOps to implement Continuous Integration and Continuous Deployment (CI/CD) pipelines to automate software development, testing, and deployment processes.

PSO4: Student are expected to demonstrate advanced problem-solving abilities using Python, and R programming, analyzing difficult computer issues maintenance of software solutions across a variety of platforms.

Key ethics:

Creative thinking, Teamwork, Dedication, Truthfulness, and Excellence.

Pattern of matrix for two years Master of Computer Applications (MCA)

Distribution of Courses/Papers for Master of Computer Applications (MCA) I to IV Semester as per Choice Based Credit System (CBCS)

I-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				CIE	SEE	Total Marks	L	T	P		
FIRST	BS	23MCA11	Mathematical Foundation for Computer Applications	50	50	100	3	-	-	3	3
	PC	23MCA12	Data Structures & Applications	50	50	100	4	-	-	4	3
	PC	23MCA13	Data Communication	50	50	100	4	-	-	4	3
	PC	23MCA14	Web Stack Developments	50	50	100	4	-	-	4	3
	PC	23MCA15	Unix Operating System & Shell Programming (IPCC)	50	50	100	3	-	2	4	3
	PC	23MCA16P	Data Structures Laboratory	50	50	100	-	-	4	2	3
	PC	23MCA17P	Web Technologies Laboratory	50	50	100	-	-	4	2	3
	SEC	23MCA18	Soft Skill & Aptitude (*MNCC)	MNCC - Conducted during the intervening vacation of I and II semesters							
	BC	23MCA19	Problem Solving using C	**Bridge Course:** This Subject will be taught at the beginning of the first semester for 2 weeks							
Total Marks and Credits for I Semester				**350**	**350**	**700**	**18**	**-**	**10**	**23**	**-**

Note: BS-Basic Science, PC: Professional core, PE-Professional Electives, OE-Open Elective, IPCC-Integrated Professional Core Courses, SEC – Skill Enhancement Course, and BC- Bridge Course.

Pattern of matrix for two years Master of Computer Applications (MCA)

Distribution of Courses/Papers for Master of Computer Applications (MCA) I to IV Semester as per Choice Based Credit System (CBCS)

II-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				CIE	SEE	Total Marks	L	T	P		
SECOND	PC	23MCA21	Database Management System	50	50	100	4	-	-	4	3
	PC	23MCA22	Object Oriented Programming with JAVA	50	50	100	4	-	-	4	3
	PC	23MCA23	Software Engineering & Project Management (IPCC)	50	50	100	3	-	2	4	3
	PC	23MCA24	Introduction to Python (IPCC)	50	50	100	3	-	2	4	3
	PC	23MCA25P	DBMS Lab	50	50	100	-	-	4	2	3
	PC	23MCA26P	JAVA Programming Lab	50	50	100	-	-	4	2	3
	PE	23MCA27X	PROFESSIONAL Elective-1	50	50	100	3	-	-	3	3
	PE	23MBAO28X	OPEN ELECTIVE	50	50	100	3	-	-	3	3
	SEC	-	Advanced Python Programming (*MNCC)	MNCC - Conducted during the intervening vacation of II and III semesters							
Total Marks and Credits for II Semester				**400**	**400**	**800**	**20**	**-**	**12**	**26**	**-**

Note: PC: Professional core, PE-Professional Electives, OE-Open Elective, IPCC-Integrated Professional Core Courses, & SEC – Skill Enhancement Course.

PROFESSIONAL ELECTIVES-1		OPEN ELECTIVE	
Course Code	**Course Title**	**Course Code**	**Course Title**
23MCA271	R Programming	23MBAO2XX	Financial Management & Investment
23MCA272	Data Visualization using Python	23MBAO2XX	Supply Chain Management
23MCA273	Introduction to Cloud Computing	23MBAO2XX	Entrepreneurship Development

Pattern of matrix for two years Master of Computer Applications (MCA)

Distribution of Courses/Papers for Master of Computer Applications (MCA) I to IV Semester as per Choice Based Credit System (CBCS)

III-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				CIE	SEE	Total Marks	L	T	P		
THIRD	PC	23MCA31	Design and Analysis of Algorithm	50	50	100	4	-	-	4	3
	PC	23MCA32	Data Mining	50	50	100	4	-	-	4	3
	PC	23MCA33	Machine Learning	50	50	100	3	-	-	3	3
	PC	23MCA34	Computer Graphics with Open GL (IPCC)	50	50	100	3	-	2	4	3
	PC	23MCA35	DAA Lab	50	50	100	-	-	4	2	3
	PC	23MCA36	Data Mining Lab	50	50	100	-	-	4	2	3
	PE	23MCA37X	PROFESSIONAL Elective-2	50	50	100	3	-	-	3	3
	PE	23MCA38X	PROFESSIONAL Elective-3	50	50	100	3	-	-	3	3
	PC	23MCA39	Research Methodology	25	25	50	2	-	-	2	2
Total Marks and Credits for III Semester				**425**	**425**	**850**	**22**	**-**	**10**	**27**	**-**

Note: PC: Professional core, PE-Professional Electives, IPCC-Integrated Professional Core Courses, and SEC – Skill Enhancement Course.
SEC : Internship:MNCC - Conducted during the intervening vacation of III and IV semesters

PROFESSIONAL ELECTIVES-2		PROFESSIONAL ELECTIVES-3	
Course Code	**Course Title**	**Course Code**	**Course Title**
23MCA371	Artificial Intelligence	23MCA381	Distributed Computing System
23MCA372	Foundations of Data Science	23MCA382	Big Data
23MCA373	Cyber Security	23MCA383	IoT (Internet of Things)

Pattern of matrix for two years Master of Computer Applications (MCA)

Distribution of Courses/Papers for Master of Computer Applications (MCA) I to IV Semester as per Choice Based Credit System (CBCS)

IV-SEMESTER

Semester No.	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				CIE	SEE	Total Marks	L	T	P		
FOURTH	PW	23MCA41	Software Testing and Practices	50	50	100	4	-	-	4	3
	PE	23MCA42X	PROFESSIONAL Elective-4	50	50	100	3	-	-	3	3
	PE	23MCA43X	PROFESSIONAL Elective-5	50	50	100	3	-	-	3	3
	PW	23MCA44	PROJECT WORK	100	100	200	-	-	20	10	3
	INT	23MCA45	INTERNSHIP	50	50	100	-	-	4	4	3
Total Marks and Credits for IV Semester				**300**	**300**	**600**	**10**	**-**	**-**	**24**	**-**

Note: PE – Professional Elective, PW – Project Work, INT- Internship

PROFESSIONAL ELECTIVES-4		PROFESSIONAL ELECTIVES-5	
Course Code	**Course Title**	**Course Code**	**Course Title**
23MCA441	Deep Learning	23MCA451	Advanced Computer Networks
23MCA442	Natural Language Processing	23MCA452	Storage Area Network
23MCA443	DevOps	23MCA453	Block Chain Technology

The Common guidelines for all the Professional Course, Professional Electives (Rubric for CIE and SEE):

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Assignments/Seminar/Presentation/Demonstration/Case Studies (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels
(Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 50 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 10 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9	20

				or 10	
Total		**50**	**Total**		**100**

Title of Subject: PROBLEM SOLVING USING C & C++

BRIDGE COURSE: This subject will be taught before the commencement of the MCA course for about ONE week.

COURSE CODE: 23MCA19 | **Max Hours: 40**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the comprehensive knowledge of C programming.
2. Implement the programs using control statements, looping, arrays, and also functions.
3. Implement some applications of heterogeneous data member using structure and union and create files.
4. Gain the knowledge on features of OOPs, basic concepts of C++.
5. Design and apply appropriate OOPs concepts for solving computing problems.

MODULE – I: Introduction to C Programming | **08 Hours**

Algorithm, Flowchart, pseudo code, Introduction, history of C, developing a program, Structure of C Program, Character Set, Tokens, Variables and Constants, Keywords, Typecasting, Scope, Data types, Operators, Instructions, I/O statements.

MODULE – II: Control and Looping Structures | **08 Hours**

Decision control structures, looping, switch case. Arrays, types of arrays, and strings, string handling functions. Functions, types of functions, parameter passing mechanism, recursion.

MODULE – III: Structure, Pointer, Files | **08 Hours**

Typedef, enumerated data types, structure, union, array of structures, Pointers. I/O functions, data file, text and binary files.

MODULE – IV: Introduction to OOP | **08 Hours**

Features of OOPs, Classes and Objects, access specifiers, member functions, member data, constructors, Destructors, Inline member functions, friend functions, static member function, arrays of objects, pointer and their uses.

MODULE – V: Inheritance, Polymorphism, Exception handling | **08 Hours**

Inheritance, types, Operator overloading, function overloading, virtual function, templates, exception handling mechanism, try, throw, & catch block.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Gilberg, F Richard & Forouzan, A Behrouz	Data Structures A Pseudocode approach with C	2nd Edition	Cengage
Yashavant Kanetkar	Data Structures Through C	3rd Edition	BPB Publications
Balaguruswamy	Programming in ANSI C	4th Edition	McGraw Hill Education
Yedidyah Langsam, Moshe J. Augenstein, Aaron M Tenenbaum	Data Structures Using C and C++	2nd Edition	Pearson Education Asia

Title of Subject: Mathematical Foundation for Computer Applications		
COURSE CODE: 23MCA11	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Apply numerical techniques to solve system of linear equations.
2. Apply the predicate calculus in judging validity of an argument.
3. Solve recurrence relation using generating functions.
4. Apply binomial and poison distribution in determining the probability of success in scientific applications.
5. Apply the techniques of graph theory in sorting, shortest path algorithms etc.

MODULE – I: Linear Algebra — **08 Hours**

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-Elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Rayleigh's power method to find the dominant Eigen value and the corresponding Eigenvector. Problems

MODULE – II: Mathematical Logic — **08 Hours**

Propositional Logic, Applications of Propositional Logic, Propositional Equivalences Predicates and Quantifiers, Nested Quantifiers, Rules of Inference Introduction to Proofs.

MODULE – III: Recurrence Relations — **08 Hours**

Introduction to Recurrence Relations, The method of Characteristic Roots, Solution of Non-homogeneous Recurrence Relations, Generating Functions of Sequences, Solving Recurrence Relations by Substitution and Generating Functions.

MODULE – IV: Random Variable and Probability Distribution — **08 Hours**

Concept of random variable, discrete and continuous probability distributions, Binomial, Poison's, and normal distribution. Mean and variance.

MODULE – V: Graph Theory — **08 Hours**

Definition of graph, different types of graphs, directed graph, representation of graph as matrix, connected graph, sub-graphs, Bi-graphs, paths and cycles, graph Isomorphism, Euler and Hamilton paths, planar graphs.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Richard A Johnson and C.B Gupta	Probability and Statistics for Engineers	2010	Pearson Education
J.K Sharma	Discrete Mathematics	3rd edition	Mac Millian Publishers India
Narsingh Deo	Graph Theory: With Application to Engineering and CS	16th Edition	Prentice Hall of India

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 50 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 10 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses					
RUBRIC for CIE			***RUBRIC for SEE***		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: DATA STRUCTURES & APPLICATIONS		
COURSE CODE: 23MCA12	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	**Total Hours: 50**
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Demonstrate different data structures, its operations using C programming.
2. Design code involving applications arrays, structures, Pointer, stacks, queues, trees, and graphs
3. Implement some applications of data structures in a high-level language such as C/C++
4. Design and apply appropriate data structures for solving computing problems.
5. Implement an appropriate data structure to solve real world problems

MODULE – I: Introduction	**10 Hours**

Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations. Memory management functions. Recursion: Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Polynomial and sparse matrix.

MODULE – II: Stack and Queue	**10 Hours**

Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion. Queue: Definition, Representation, Queue Variants: Circular Queue, Priority Queue, Double Ended Queue; Applications of Queues. Programming Examples.

MODULE – III: Linked List	**10 Hours**

Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation,. Definition, Representation, Operations: getnode() and Freenode() operations, Types: Singly Linked List. Linked list as a data Structure, Inserting and removing nodes from a list, Linked implementations of stacks, Header nodes, Array implementation of lists.

MODULE – IV: Trees	**10 Hours**

Definition of Trees, Basic Terminology of Trees, Binary Tree, Binary Tree Representation as An Array & Linked List, Application of Trees, Binary Tree Traversal: In-Order, Pre-Order, Post-Order - Threaded Binary Tree, Height Balance Tree, B-Trees, Binary Search Trees, Construction of BST Operations- Searching, Insertion and Deletion, AVL Trees, Height of an AVL Tree, Operations – Insertion, Deletion and Searching.

MODULE – V: Graphs	**10 Hours**

Basic Terminology of Graphs, Implementation of Graphs as An Arrays& Linked List, Operation on Graphs, Graphs Traversals: Breadth First Search, Depth First Search –Topological Sort – Minimum Spanning Tree: Prims and Kruskals.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Gilberg, F Richard & Forouzan, A Behrouz	Data Structures A Pseudocode approach with C	2nd Edition	Cengage

Yashavant Kanetkar	Data Structures Through C	3rd Edition, 2019	BPB Publications
Balaguruswamy	Programming in ANSI C	17th edition, 2020	McGraw Hill Education
Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenanbanum	Data Structures Using C and C++	2nd Edition	Pearson Education Asia

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3	20

				or 4	
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: DATA COMMUNICATION		
COURSE CODE: 23MCA13	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the basic data communication principles.
2. Apply different transmission methods, modes of transmissions
3. Describe transmission errors, compression techniques, and encryption methods.
4. List the transmission media, network topologies, switching and routing, functionalities of OSI model
5. Explain the different techniques to ensure the reliable and secured communication in wireless communication

MODULE – I: Introduction	**10 Hours**
Fundamental concepts, Data Communications, protocols, standards, standard organizations, Signal Propagation, Analog & Digital signals, Bandwidth of a Signal, and a Medium, Fourier Analysis, The Concepts of Bandwidth of a Signal, Data Transmission rate and Bandwidth.	
MODULE – II: Analog and Digital Transmission Methods	**10 Hours**
Analog Signal, Analog Transmission, Digital Signal, Digital Transmission, Digital Signal, Analog Transmission, Baud Rate, Bits per second. Modes of Transmission: Parallel and Serial Communication, Simplex, Half-Duplex, & Full Duplex Communication, Multiplexing, & Demultiplexing, Types of Multiplexing.	
MODULE – III: Transmission Media, Network Topologies, OSI Model	**10 Hours**
Guided & Unguided Media, Topology & its types, Basics of Switching, Router & Routing, OSI Model, LAN(Ethernet, VLAN, FDDI, Token Ring), MAN (DQDB,SMDS), & WAN, Pure ALOHA and Slotted ALOHA.	
MODULE – IV: Transmission Errors, Compression, Encryption	**10 Hours**
Error Classification, Types of Errors, Simple Coding Scheme, Cryptography, Symmetric and Asymmetric Key Encryption, Digital Certificates, Digital Signatures, Secure Socket Layer (SSL) / Transport Layer Security (TLS).	
MODULE – V: Wireless Communication	**10 Hours**
Overview of Wireless Networks, IEEE Standards for LAN, MAN, WAN – 802.1, 802.2, 802.3, 802.4, 802.5, 802.11, Infrared Communication, Bluetooth, 802.11 Wireless LAN, IPV4, IPV6.	
Text Books:	

Author Names	Name of the Text Books	Edition	Publisher
Behrouz A. Forouzan	Data Communications and Networking	5th Edition	McGraw Hill Forouzan Networking Series
James F Kurose and Keith W Ross	Computer Networking, A Top-Down Approach	6th Edition 2017	Pearson Education
Larry L Peterson and Bruce S Davie	Computer Networks	6th Edition	ELSEVIER

Andrew S Tanenbaum	Computer Networks	5th Edition	Pearson Education
Mayank Dave	Computer Networks	5th Edition	Cengage Learning
Larry L Peterson and Bruce S Davie	Computer Networks A Systems Approach	5th Edition	MKP
Alberto Leon-Garcia, Indra Widjaja	Communication Networks Fundamental Concepts and Key Architectures	2nd Edition	McGraw Hill

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will	30	5 & 6	MODULE 3:Question 5 or 6	20

	be considered for the Final Marks)		7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: WEB STACK DEVELOPMENTS		
COURSE CODE: 23MCA14	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Create Small Web Page using different tags of HTML & also using XHTML.
2. Create Dynamic Web Pages using Java Script and CSS.
3. Design websites using appropriate security principles, focusing specifically on the vulnerabilities inherent in common web implementations.
4. Define and understand the basic concepts of PHP.
5. Implement responsive web Sites using PHP by connecting to the My-SQL database.

MODULE – I: Introduction to Web Concepts — **10 Hours**

Internet – Client/Server Model, Web browsers, web servers, MIME, URL, HTTP Introduction to HTML & XHTML5 tags, Basic syntax and structure, text markups, images, lists, tables, progress, Media tags-audio and video ,forms, frames.

MODULE – II: Scripting Language — **10 Hours**

Introduction to scripting Language, Memory concepts, Arithmetic Decision making. Java Script Control Structures, Java Script Functions, Program units in Java Script, Functions, Scope Rules, Recursion Java Script global functions. Java Script Arrays, array declaring and allocating memory, passing arrays to functions, multiple subscripted arrays, Java Script Objects-Introduction, Math, String, Data, Boolean and Number Objects.

MODULE – III: Introduction to CSS — **10 Hours**

Inline Styles, Creating Style Sheets with the style element, conflicting Styles, Linking External Style Sheets, Positioning Elements, Backgrounds, Element Dimensions, and the CSS Box Model, User Style Sheets, Filter and Transitions, HTML DOM, Browser BOM. Introduction to Event model, Event ON CLICK, Event ON LOAD – Error Handling with ON Error, Tracking the Mouse with Event, More DHTML.

MODULE – IV: Introduction to PHP — **10 Hours**

Overview of PHP Capabilities, PHP HTML embedding tags, & Syntax, Simple Script Examples, PHP & HTTP Environment Variables. PHP Language Core- Variables, Constants, Data Types, PHP: Operators, Flow Control & Loops. Arrays, Strings Functions Include & Require Statements, Simple File & Directory Access Operations, Error Handling.

MODULE – V: Web Server Architecture — **10 Hours**

Processing HTML form using GET, POST, REQUEST, SESSION, COOKIE variables, Sending E-mail, Database Operations with PHP, Connecting to My-SQL (or any other database), Selecting a db, Building & Sending Query, Retrieving, Updating, 7 Inserting Data, CMS: WordPress. NOTE: XAMMP is used for PHP, WordPress: Introduction & Installations.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
DT Editorial Services	HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)	2nd Edition 2016	Dreamtech Press

Frank Zammetti	Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker	1st Edition 2020	APRES
Chris Bates	Web Programming	3rd Edition 2007	Wiley Publications
Kogent Learning Solutions Inc	HTML5 Black Book	2nd Edition	Dreamtech
Chris Northwood	The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer	1st edition 2018	Apress Publications
Laura Lemay, Rafe Colburn & Jennifer Kyrnin	Mastering HTML, CSS & Javascript Web Publishing	1st Edition 2016	BPB Publications

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses					
RUBRIC for CIE			***RUBRIC for SEE***		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
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2	Experiential Learning –	10	1 & 2	MODULE 1:Question 1	20

	EL1 & EL2			or 2	
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: UNIX OPERATING SYSTEMS & SHELL PROGRAMMING		
COURSE CODE: 23MCA15	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-0-2	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Analyse the basic Operating System Structure and concept of Process Management
2. Analyse the given Synchronization/ Deadlock problem to solve and arrive at valid conclusions.
3. Understand the Unix basics, file system management, and practical skills in working with directories and file managers..
4. Develop proficiency in Unix shells, mastering their features for efficient command-line operations and becoming adept at using various text editors
5. Understand and configure startup files for different Unix shells, and acquire practical skills in shell scripting using awk and Perl for text processing and automation.

MODULE – I: Basic Concepts — **10 Hours**

Necessity of an Operating System, Operating System Structure, Evolution of Operating System (Multiprogramming Systems, Batch Systems, Time Sharing System, Distributed Systems, and Real Time System), Operating System Components and Services, System Calls, System Programs, Virtual Machines.

MODULE – II: Process Management, Process Synchronization and Deadlocks — **10 Hours**

Process Concept, Process Scheduling, Cooperating processes, Threads, Inter-Process communication, CPU Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real Time Scheduling and Algorithm Evaluation. The Critical Section Problem, Synchronization hardware semaphores, Classical Problems of Synchronization, Critical Regions, Monitors, Deadlocks-systems model, Characterization, Deadlock Prevention, Avoidance and Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

MODULE – III: Introduction to UNIX — **10 Hours**

Unix, your Unix account, getting started with Unix, the Unix file system, working with files, working with directories, using file manager.

MODULE – IV: UNIX Shells — **10 Hours**

Unix Shells, working with shell, using additional features, text editors, editing with Vi, editing with emacs, editing with pico, editing with Text editor.

MODULE – V: Startup Files & Scripting Languages — **10 Hours**

Startup files, using sh & ksh startup files, using csh, tcsh startup files, using bash startup files. Shell scripting, scripting with awk, scripting with Perl.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Paul K. Andersen	Just Enough UNIX	5th Edition	McGraw Hill
Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	Operating Systems Principles	8th Edition	Wiley – India
Kenneth Roson et al	UNIX: The Complete Reference	2000	Osborne/McGraw Hill

Steve Montsugu	Using UNIX	2nd Edition	Prentice Hall India
Behrouz A Forouzan and Richard F Gilberg	N/A (Information not provided)	5th Edition	N/A
Harvey M Deital	Operating Systems	3rd Edition 1990	Addison Wesley

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

<table>
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<tr><th colspan="3">RUBRIC for CIE</th><th colspan="3">RUBRIC for SEE</th></tr>
<tr><th>SL.NO.</th><th>Contents</th><th>Marks</th><th>SL.NO.</th><th>Contents</th><th>Marks</th></tr>
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<tr><td>3 & 4</td><td>MODULE 2:Question 3 or 4</td><td>20</td></tr>
</table>

3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: DATA STRUCTURES LABORATORY		
COURSE CODE: 23MCA16P	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	
Contact Hours: (L:T:P): 0-0-4	**Credit: 02**	**Duration of Exam: 03**

Recognize the functional requirements, then formulate and implement effective solutions for issues pertaining to the data structure.

1. Implementation of Dynamic Memory Management functions.
2. Implementation of Recursive Functions.
3. Implementation of Stack operations.
4. Implementation of Infix to Post fix conversion.
5. Implementation of Queue operations.
6. Implementation of Circular Queue operations.
7. Implementation of Singly Linked list.
8. Implementation of Doubly Linked list.
9. Implementation of Tree Traversals.
10. Implementation of Graph to find Minimum Spanning Tree.

Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50

Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.

Scheme of Semester End Examination (SEE) Laboratory for 50 marks :

SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks

Title of Subject: Web Technologies Laboratory		
COURSE CODE: 23MCA17P	**CIE Marks: 50**	
SEMESTER: I	**SEE Marks: 50**	
Contact Hours: (L:T:P): 0-0-4	**Credit: 02**	**Duration of Exam: 03**

1. Design a static web portal using HTML5 semantic elements, style using CSS
2. Design a web page to demonstrate, customization of Bootstrap classes using CSS
3. Develop an event countdown timer using HTML5, CSS/Bootstrap and JavaScript
4. Design a JS program to show the stack implementation using Arrays
5. Write a JS program to demonstrate any 4 methods of
   a. String object
   b. Date object
   c. Number Object
6. Write a JS program to illustrate the following concepts considering appropriate scenario
   a. Different ways of creating objects and nested objects
   b. Different kinds of DOM events
7. a. Install and configure PHP, web server, MYSQL
   b. Write a program to print "Welcome to PHP"
   c. Write a simple PHP program using expressions and operators.
8. Write a PHP program to demonstrate the use of Decision making control structures, & Looping structures using-
   a. If statement
   b. If-else statement
   c. Switch statement
   d. While statement
   e. Do-while statement
   f. For statement
   g. For each statement
9. Design a web page using following form controls:
   a. Text box, b. Radio button, c. Check box, d. Buttons, e. List box, f. Combo box,
   g. Hidden field box
10. Develop a simple application to -
    a) Enter data into database
    b) Retrieve and present data from database

Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50

Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.

Scheme of Semester End Examination (SEE) Laboratory for 50 marks :

SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks.

Title of Subject: DATABASE MANAGEMENT SYSTEM		
COURSE CODE: 23MCA21	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Comprehend fundamental database principles, including Database approach, Data Models, Schemas, Instances, DBMS architecture.
2. Demonstrate proficiency in Relational Data Model concepts, Relational Algebra operations, Relational Calculus.
3. Acquire skills in Function Dependencies, Normalization techniques (INF, 2NF, 3NF, BCNF), informal design guidelines.
4. Understand transaction basics, implement atomicity and durability, grasp concurrent executions, serializability, recovery techniques, failure classification, storage structure, and recovery methods.
5. Insights into Distributed databases, Multimedia databases, Object-oriented database management systems

MODULE – I: Basic concepts	**10 Hours**

Database & Database Users, Characteristics of the Database Approach, advantages of using DBMS. Data Models, Schemas & Instances. DBMS Architecture & Data Independence. System Architecture for DBMS and Data Dictionary, Database Users Data Base languages & Interfaces. Data Modeling using the Entity-Relationship Model -Entity types, Entity Sets, Attributes and Keys, Relationship, Relationship Types, Week Entity Types, Structural Constraints, Enhanced ER Model- Specialization Generalization, Constraints on Specialization Generalization.

MODULE – II: Relational Model, Languages & Systems	**10 Hours**

Relational Data Model Concepts and Constraints. Relational Algebra - select, project, set theoretic, join operations. Overview of Relational Calculus. SQL - A Relational Database Language. Data Definition commands, View and Queries, transaction commands, Specifying Constraints & Indexes in SQL.

MODULE – III: Relational Data Base Design	**10 Hours**

Function Dependencies & Normalization for Relational Databases. Informal design guidelines for relation schemas, Functional Dependencies. Normal forms based on primary keys (INF, 2NF, 3NF& BCNF). Lossless join & Dependency preserving decomposition. Multivalued dependencies, join dependencies (4NF & 5NF), Denormalization.

MODULE – IV: Transactions, Concurrency Control, Recovery Techniques	**10 Hours**

Basic concept; ACID properties; transaction state; implementation of atomicity and durability; concurrent executions; basic idea of serializability; view and conflict serializability Recovery Techniques Failure Classification , Storage Structure, Recovery and Atomicity Log Based Recovery, Shadow Paging ,stable storage implementation, data access; recovery and atomicity - log based recovery, deferred database modification, immediate database modification, checkpoints. Feature engineering and transformation to meet analysis requirements, Handling

missing data in datasets.

MODULE – V: Emerging fields in DBMS	**10 Hours**

Distributed databases; Basic idea; distributed data storage; data replication; data fragmentation horizontal, vertical and mixed fragmentation. Concepts of Multimedia databases, Object oriented data base management systems. Data Warehousing & mining.

Text Books:

Author Names	Name of the Textbook	Edition	Publisher
Elmsari and Navathe	Fundamental of Database System	7th Edition	Addison Wesley, New York
H. Korth & A. Silberschatz	DATABASE SYSTEM CONCEPTS	6th Edition	Tata McGraw-Hill (TMH)
Date. CJ	An Introduction to Database System	8th Edition	Narosa Publishing House, New Delhi
Ullman. J.D	Principles of Database Systems	3rd Edition	Galgotia Publications, New Delhi

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

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			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: OBJECT ORIENTED PROGRAMMING WITH JAVA		
COURSE CODE: 23MCA22	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand Object Oriented Design concepts, Identify the Objects, patterns and services in/ for real-time applications.
2. Demonstrate the implementation of inheritance (multilevel, hierarchical and multiple) by using extend and implement keywords.
3. Describe and demonstrate the implementation of Generics, Lambda, and the collection framework.
4. Use JDBC to develop application programs and GUI based programming.
5. Demonstrate the implementation of Servlets and JSP

MODULE – I: Introduction to Object Oriented Programming (OOP)	**10 Hours**

Object-Oriented Programming (OOP) Principles- Class Fundamentals - Declaring Objects - Introducing Methods - Overloading methods − Constructors - Parameterized Constructors - this Keyword. Garbage Collection - the finalize () Method - Introducing Access Control – Understanding static - Introducing nested and inner classes - String class - String Buffer Class – Command Line Arguments.

MODULE – II: Inheritance, Interfaces & Packages and Multithreading in Java	**10 Hours**

Inheritance Basics - Multilevel Hierarchy- Using super - Method overriding – Dynamic Method Dispatch- Abstract keyword- Using final with inheritance - The Object Class. Inheritance in java with Interfaces − Defining Interfaces - Implementing Interfaces - Extending Interfaces- Creating Packages - CLASSPATH variable - Access protection - Importing Packages - Interfaces in a Package. Thread Model - Life cycle of a Thread - Java Thread Priorities - Runnable interface and Thread Class- Thread Synchronization − Inter Thread Communication.

MODULE – III: Generics, Lambda and The Collections Framework	**10 Hours**

Generics Concept - General Form of a Generic Class − Bounded Types − Generic Class Hierarchy - Generic Interfaces − Restrictions in Generics. Introduction to Lambda expression- Block Lambda Expressions - Generic Functional Interfaces. Passing lambda expressions as arguments - Lambda expressions and exceptions-Lambda expressions and variable capture. The Collections Overview − Collection Interface − List Interface − Set Interface − SortedSet Interface − Queue Interface - ArrayList Class − LinkedList Class − HashSet Class − Using an Iterator − The For Each Statement. Working with maps − The map interfaces, the map classes. Comparators- the collection algorithms.

MODULE – IV: Java Beans and JDBC	**10 Hours**

Introduction to JDBC- Connecting to the database- Basic JDBC Operations − Essential JDBC Classes − JDBC Drivers − JDBC-ODBC Bridge − Connecting to a database with drivermanager − JDBC database URL.Quoting, Redirection: The Three Standard Files, Two Special Files: /dev/null and /dev/tty, pipes, tee: Creating a Tee, Command Substitution. Java beans - Advantages of Beans − Introspection- Bound and Constrained Properties − Persistence − Customizers.

MODULE – V: Java Servlets & JSP	10 Hours
Servlets Basics – Life Cycle of a Servlet –A Simple Servlet - The Servlet API – Servlet Interfaces – Generic Servlet Class- HttpServletRequest Interface – HttpServeltResponse. The JSP development model – component of jsp page – Page directive – Action – scriptlet – JSP expression, JSP Syntax and semantics, JSP in XML.	

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Schildt Herbert	Java: The Complete Reference	11th Edition	Tata McGraw-Hill
Phil Hanna	The Complete Reference JSP 2.0	2nd Edition	Tata McGraw-Hill
Cay S Horstmann	Core Java Volume 1 Fundamentals	11th Edition	Prentice Hall
Matt Weisfeld	Object-Oriented Thought Process	5th Edition	Addison-Wesley Professional
Ian F. Darwin	Java Cookbook	4th Edition	O'Reilly Media, Inc.
Mohanram Balachandar Bogu	RESTful Java Web Services	3rd Edition	Packt Publishing
Bruno R Preiss	Data Structures and Algorithms with Object Oriented Design Patterns in JAVA	1st Edition	Wiley

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

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Scheme of Semester End Examination (SEE) for 100 marks:

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	Total	**50**		**Total**	**100**

Title of Subject: SOFTWARE ENGINEERING		
COURSE CODE: 23MCA23	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Summarize software engineering principles and activities involved in the development of software projects along with requirement engineering process.
2. Discuss the fundamentals of object-oriented concepts, system models, and UML diagrams.
3. Summarize various types of Testing.
4. Explain the fundamental concepts of agile software engineering.
5. Demonstrates the need to apply the principles of XP life cycle.

MODULE – I: Introduction to Software Engineering	**10 Hours**

Introduction to Software Engineering: Need for Software Engineering, Software Engineering Ethics. Software Process Models: Waterfall Model, Incremental Model, and Spiral Model. Rational Unified Process (RUP). Requirements Engineering Process: Requirements Elicitation and Analysis. Functional and Non-Functional Requirements. Software Requirements Document. Requirements Specification. Requirements Validation.

Laboratory Component: Identify the Problem statement and gather the requirements.

MODULE – II: System Model and Object-oriented Design	**10 Hours**

System Model: Context Models, Interaction Models, Structural Models, Behavioral Models. Object-oriented design: OO Themes, Three Models: Class Modelling, Object and Class, Link and associations, Generalization and Inheritance, Object Oriented Design Process, Use Case, Sequence and State Diagrams.

Laboratory Component: Design Object Oriented System using UML diagrams.

MODULE – III: Software Testing and Maintenance	**10 Hours**

Software Testing and Maintenance: Development Testing, Test-Driven Development, Release Testing User Testing, Test Automation, Test Scripts Evolution Process: Program Evolution Dynamics, Software Maintenance, Legacy System Management.

Laboratory Component: Design Test cases to test the program.

MODULE – IV: Agile Technology	**10 Hours**

Agile: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, Agile methods, Don't Make Your Own Method, The Road to Mastery, find a Mentor. Mastering Agility: Values and principles: Commonalities, About values, Principles, and Practices.

Laboratory component: Develop an Agile project plan for a given scenario.

MODULE – V: Understanding XP	**10 Hours**

The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us, Go!, Assess Your Agility.

Laboratory component: Develop software units using extreme programming concepts.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Ian Somerville	Software Engineering	10th Edition	Pearson Education
James Shore, Chromatic	The Art of agile Development	2nd Edition	O'Reilly
Pankaj Jalote	An Integrated Approach to Software Engineering	3rd Edition	Wiley Publications
Robert C. Martin	Agile Software Development, principles, Patterns, and Practices	1st Edition	Prentice Hall
Craig Larman	Agile and Iterative Development: A Manger's Guide	1st Edition	Pearson Education

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

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			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: Introduction to Python		
COURSE CODE: 23MCA24	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-2-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Acquire a strong foundational understanding of Python programming.
2. Implement simple for loops, including those using ranges, and leverage while loops effectively and manipulate through the use of pass, continue, and break statements.
3. Demonstrate proficiency in crafting solutions using functions, creating modular code with units, and leveraging external packages for enhanced functionality in Python projects.
4. Explore list, tuples, and dictionaries in understanding the concept of references and their role in data structures.
5. Acquire the skills to read and write files in Python

MODULE – I: Introduction and Data Types	**10 Hours**

Installation and Working with Python, Understanding Python variables, Operators, Understanding python blocks, Declaring and using Numeric data types: int, float, complex. String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program.

MODULE – II: Program Flow Control	**10 Hours**

Conditional blocks using if, else and elif. Simple for loops in python, For loop using ranges. Use of while loops in python. Loop manipulation using pass, continue, and break. Programming examples using Python conditional and loops block.

MODULE – III: Functions, Units And Packages	**10 Hours**

def Statements with parameters and return values. Local and global scope, The global statement, exception handling. Organizing python projects into units. Importing own unit as well as external units. Understanding Packages. Powerful Lamda function in python. Programming using functions, units and external packages

MODULE – IV: List and Dictionary Manipulations	**10 Hours**

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List. List-like Types: Strings and Tuples, References. Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things.

MODULE – V: Pattern Matching with Regular Expressions and File Operation	**10 Hours**

Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re

.DOTALL, and re .VERBOSE. Reading and Writing Files: Files and File Paths, The os.path unit, The File Reading/Writing Process, Saving Variables with the shelve unit, Saving Variables with the pprint.pformat() Function. Organizing Files: The shutil unit, Walking a Directory Tree, Compressing Files with the zipfile unit.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Al Sweigart	Automate the Boring Stuff with Python	2nd Edition	William Pollock
Allen B. Downey	Think Python: How to Think Like a Computer Scientist	2nd Edition	Green Tea Press
Charles Dierbach	Introduction to Computer Science Using Python	1st Edition	Wiley India Pvt Ltd.
Reema Thareja	Python Programming using problem-solving approach	2nd Edition	Oxford University Press India

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses					
RUBRIC for CIE			***RUBRIC for SEE***		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: DBMS Laboratory		
COURSE CODE: 23MCA25P	CIE Marks: 50	
SEMESTER: I	SEE Marks: 50	
Contact Hours: (L:T:P): 0-0-4	Credit: 02	Duration of Exam: 03

1. Implementation of DDL commands of SQL with suitable examples
   a) Create table
   b) Alter table
   c) Drop table
2. Implementation of DML commands of SQL with suitable examples
   a) Insert
   b) Update
   c) Delete
3. Implementation of different types of function with suitable examples
   a) Number function
   b) Aggregate Function
   c) Character Function
   d) Conversion Function
   e) Date Function
4. Implementation of different types of operators in SQL
   a) Arithmetic Operators
   b) Logical Operators
   c) Comparison Operator
   d) Special Operator
   e) Set Operation
5. Implementation of different types of Joins
   a) Inner Join
   b) Outer Join
   c) Natural Join
6. Study and Implementation of
   a) Group By & having clause
   b) Order by clause
   c) Indexing
7. Study & Implementation of
   a) Sub queries
   b) Views
8. Study & Implementation of Database Backup & Recovery commands.
   Study & Implementation of Rollback, Commit, Savepoint.
9. Creating Database /Table Space

Managing Users: Create User, Delete User Managing roles:-Grant, Revoke. 10. Study & Implementation of PL/SQL.
Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50 Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.
Scheme of Semester End Examination (SEE) Laboratory for 50 marks : SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks

Title of Subject: JAVA LABORATORY		
COURSE CODE: 23MCA26P	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 0-0-4	**Credit: 02**	**Duration of Exam: 03**

1. Implement the concept of class, data members, member functions and access specifiers.
2. Implement the concept of function overloading & Constructor overloading.
3. Implement the concept of inheritance, super, abstract and final keywords.
4. Implement the concept of package and interface.
5. Implement the concept of Generics.
6. Implement the concept of the lambda expression.
7. Implement the concept of a collection framework.
8. Implement the concept of JDBC.
9. Implement the concept of java beans.
10. Implement the concept of java servlets

Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50

Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.

Scheme of Semester End Examination (SEE) Laboratory for 50 marks :

SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks

PROFESSIONAL ELECTIVE – 1

Title of Subject: Generative Artificial Intelligence		
COURSE CODE: 23MCA271	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand how problems can be solved by AI technique.
2. Comprehensive understanding of search algorithms, enabling them to approach problem-solving in AI with a well-informed and strategic perspective.
3. Analyze and design knowledge based system.
4. Equipped with the skills and knowledge necessary to address uncertainty in AI applications.
5. Excel in expert systems, mastering features, organization, and tool application like MYCIN for effective knowledge representation in diverse problem-solving scenarios.

MODULE – I: Introduction and Intelligent Agents	**08 Hours**

AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

MODULE – II: Search Strategies	**08 Hours**

Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A*, AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm.

MODULE – III: Knowledge Representation	**08 Hours**

Knowledge Based Agents, Logic, Propositional Logic, Inference, Equivalence, Validity and Satisfiability, Resolution, Forward and Backward Chaining, DPLL algorithm, Local search algorithms, First Order Logic, Models for first order logic, Symbols and Interpretations, Terms, Atomic sentences, complex sentences, Quantifiers, Inference in FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

MODULE – IV: Uncertain Knowledge & Reasoning	**08 Hours**

Acting under Uncertainty, Basic Probability notation, The Axioms of Probability, Bayes' Rule and its Use, Where do Probabilities come from? Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.

MODULE – V: Introduction to Generative AI	**08 Hours**

Definition and scope of Generative AI, Overview of generative models and their applications Importance of Generative AI in various domains, Brief discussion on ethical considerations and challenges.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Russel and Norvig	Artificial Intelligence: A Modern Approach	2nd Edition	Pearson Education

Patterson	Artificial Intelligence – A Practical Approach	3rd Edition	Tata McGraw Hill
E. Rich, K. Knight & S. B. Nair	Artificial Intelligence	3rd Edition	McGraw Hill
G. Luger	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	4th Edition	Pearson Education
Dan W. Patterson	Introduction to Artificial Intelligence and Expert Systems	1st Edition	Prentice Hall of India

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will	30	5 & 6	MODULE 3:Question 5 or 6	20

	be considered for the Final Marks)		7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 1

Title of Subject: FOUNDATIONS OF DATA SCIENCE		
COURSE CODE: 23MCA272	CIE Marks: 50	
SEMESTER: II	SEE Marks: 50	
Contact Hours: (L:T:P): 3-0-0	Credit: 03	Duration of Exam: 03

Course Outcomes: At the end of the course, the student will be able to

1. Develop a strong understanding of data science principles, terminology, and its applications across various industries.
2. Compute and interpret descriptive statistics, and conditional probability for effective data analysis and decision-making.
3. Apply statistical sampling methods, analyze sampling distributions, and understand hypothesis testing errors to draw meaningful conclusions.
4. Demonstrate the ability to source, clean, and preprocess datasets for effective analysis.
5. Implement advanced data analysis techniques, including dimensionality reduction, anomaly detection, and text mining.

MODULE – I: Introduction to Data Science	08 Hours

Definition of Data Science and its applications, Historical evolution and significance of Data Science, Key concepts: Big Data, Data Analytics, Ethical considerations in Data Science, Role of Data Scientists in decision-making processes.

MODULE – II: Fundamentals of Statistics and Probability	08 Hours

Descriptive Statistics: Mean, Median, Mode, Variance, and Standard Deviation.

Probability: Probability Axioms, addition and multiplication theorems of probability, Conditional Probability.

MODULE – III: Inferential statistics	08 Hours

Sampling, sampling distributions, testing of hypothesis: Type-1 and Type-2 errors, expectation, confidence interval, t-distribution and chi-square.

MODULE – IV: Data Management and Preprocessing	08 Hours

Data preprocessing: Techniques for cleaning and transforming raw data, Strategies for handling outliers and anomalies. Feature engineering and transformation to meet analysis requirements, Handling missing data in datasets.

MODULE – V: Advanced Topics in Data Science	08 Hours

Dimensionality reduction techniques: Overview of techniques such as PCA (Principal Component Analysis), Anomaly detection and outlier analysis, Text mining, and Time series analysis

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani	An Introduction to Statistical Learning	1st Edition	Springer

Joel Grus	Data Science from Scratch	2nd Edition	O'Reilly Media
Wes McKinney	Python for Data Analysis	3rd Edition	O'Reilly Media
Wade Briggs	Data Science with Python	1st Edition	Pearson

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

<table>
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<tr><th>SL.NO.</th><th>Contents</th><th>Marks</th><th>SL.NO.</th><th>Contents</th><th>Marks</th></tr>
<tr><td>1</td><td>QUIZZES – Q1 & Q2
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</table>

	Marks)			or 8	
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 1

Title of Subject: INTRODUCTION TO DevOps		
COURSE CODE: 23MCA273	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand of Docker basics, installation and learn to work with containers.
2. Use containers and move applications across environments with continuous integration and Delivery.
3. Leverage Docker to perform automated builds and make Kubernetes to work on container Images.
4. Explore the Kubernetes architecture to set up and use entire lifecycle-based clusters and pods.
5. Understand pod and implement pods using YAML or JSON descriptors.

MODULE – I: Docker Fundamentals	**08 Hours**
Discovering Docker, The what and why of Docker, Building a Docker application. Understanding Docker - Docker's architecture, The Docker daemon, The Docker client, Docker registries, The Docker Hub.	
MODULE – II: Docker and Development	**08 Hours**
Using Docker as a lightweight virtual machine - From VM to container, Saving and restoring your work, Environments as processes, Building images, Running containers.	
MODULE – III: Docker and DevOps	**08 Hours**
Continuous integration - Docker Hub automated builds, Containerizing your CI process. Continuous delivery - Interacting with other teams in the CD pipeline.	
MODULE – IV: First steps with Docker and Kubernetes	**08 Hours**
Creating, running, and sharing a container image, Setting up a Kubernetes cluster, Running the first app on Kubernetes.	
MODULE – V: Pods:	**08 Hours**
Introducing Pods, Creating pods from YAML or JSON descriptors, Organizing pods with labels, Listing subsets of pods through label selectors, Annotating pods, Using namespaces to group resources, Stopping and removing pods.	

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Ian Miell, Aidan Hobson Sayers	Docker in Practice	2nd Edition	Manning Publications
Marko Lukša	Kubernetes in Action	2nd Edition	Manning Publications
James Turnbull	The Docker Book	2nd Edition	Turnbull Press

Brendan Burns, Joe Beda, Kelsey Hightower	Kubernetes: Up and Running	2nd Edition	O'Reilly

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 2

Title of Subject: R PROGRAMMING		
COURSE CODE: 23MCA281	CIE Marks: 50	
SEMESTER: II	SEE Marks: 50	
Contact Hours: (L:T:P): 3-0-0	Credit: 03	Duration of Exam: 03

Course Outcomes: At the end of the course, the student will be able to

1. To understand the process of Software Engineering and Project Management.
2. To conceptualize the Software Development Life Cycle (SDLC) models.
3. To familiarize the Project Management framework and tools.
4. Apply use of knowledge of Software Life Cycle to successfully implement the projects in the corporate world.
5. Identify the Inputs, Tools and Techniques to Implement Project Management Processes to successfully complete project in IT industry.

MODULE – I: Introduction to R	08 Hours
Basic calculation - Getting Help - Installing Packages - Data and programming: Data Types, Data Structures, programming Basics.	
MODULE – II: Descriptive Statistics	**08 Hours**
Introduction to Statistics and Data, Types of Data -Quantitative Data, Qualitative Data, Data, Multivariate Data etc. Features of Data distributions - Center, Spread, Shape, Symmetry, Skewness and Kurtosis, Stem and Leaf Diagrams, Frequency Distributions and Histogram, Measures of Center - Mean, Median, Mode, Measures of Spread - Range, Variance, Standard Deviation, Interquartile range, Measures of Relative Position: Quartiles, Percentiles. Plotting - Histogram, Bar plot, Box plot, Scatter Plot, Pie chart.	
MODULE – III: Inferential Statistics	**08 Hours**
Hypothesis Tests in R - One sample t-Test Review and example, Two sample t-Test Review - and example - Simulation, Simple Linear Regression - Modeling, Least square approach, The lm function - Maximum likelihood Estimation(MLE) Approach, Simulating SLR, Analysis of Varience - One-Way ANOVA, Two-Way ANOVA.	
MODULE – IV: Probability	**08 Hours**
Sample Spaces - Events - Model Assignments - Properties of Probability - Counting Methods - Conditional probability - Independent Events - Bayes' Rule - Random Variables.	
MODULE – V: Case Study	**08 Hours**
Healthcare - Finance - Digital Marketing- Environment-Sports	

Text Books:

Author Names	Name of the Text Books	Edition (Auto-filled)	Publisher
Siva Athreya, V. S. Sunder	Measure and Probability	1st Edition	CRC Press
G. Jay Kerns	Introduction to Probability and Statistics Using R	1st Edition	Lulu.com
Torsten Hothorn, Brian S. EverittScherber	A Handbook of Statistical Analyses using R	3rd Edition	CRC Press

Justin C. Touchon	Applied Statistics with R- A Practical Guide for the Life Sciences	1st Edition	Oxford University Press

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 2

Title of Subject: DATA VISUALIZATION USING PYTHON		
COURSE CODE: 23MCA282	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Demonstrate the use of IDLE or PyCharm IDE to create different plots.
2. Implementation of Matplotlib for drawing different Plots
3. Comprehensive understanding of advanced visualization, to create maps
4. Demonstrate working with Seaborn, Bokeh.
5. Working with Plotly for 3D, Time Series and Maps

MODULE – I: Introduction to Data Visualization	**08 Hours**

Introduction to data visualization, Importance of data visualization, types of data visualization, tools for data visualization. Area plots, Histograms, Bar charts, Pie chart, Box plots, Scatter plots, bubble plots.

MODULE – II: Matplotlib	**08 Hours**

Introduction to matplotlib, creating basic plots with matplotlib, customizing plots with matplotlib, advanced matplotlib features.

MODULE – III: Advanced Visualization plots, Creating maps, & Visualizing Geospatial Data	**08 Hours**

Waffle charts, Word clouds, Introduction to Seaborn, creating statistical plots with seaborn, Customizing plots with seaborn, advanced seaborn features, and regression. Introduction to Folium, Maps with markers, Choropleth Maps.

MODULE – IV: Bokeh	**08 Hours**

Introduction to Bokeh, Creating interactive plots with Bokeh, Customizing plots with Bokeh, Advanced Bokeh features.

MODULE – V: Plotly and Dash	**08 Hours**

Introduction to plotly, creating interactive plots with plotly, customizing plots with plotly, advanced plotly features, Introducton to Dash, creating dashboards with dash, customizing dashboards with dash.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Ben Root	Python Plotting with Matplotlib	1st Edition	CreateSpace Independent Publishing Platform
Hasnain Raz	Data Visualization with Matplotlib and Seaborn	1st Edition	Packt Publishing
Jake VanderPlas	Python Data Science Handbook	1st Edition	O'Reilly Media

Ostwal Pratap	Interactive Data Visualization with Python and Bokeh	1st Edition	Apress

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
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			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 2

Title of Subject: INTRODUCTION TO CLOUD COMPUTING		
COURSE CODE: 23MCA283	**CIE Marks: 50**	
SEMESTER: II	**SEE Marks: 50**	
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Articulate the main concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
2. Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models.
3. Analyze the core issues of cloud computing such as security, privacy, and interoperability.
4. Identify problems, analyze, and evaluate various cloud computing solutions.
5. Analyze appropriate cloud computing solutions and recommendations according to the applications used.

MODULE – I: Introduction to Cloud Computing Fundamentals	**08 Hours**
Essential characteristics, architectural Influences, Technological Influences, and Operational Influences.	
MODULE – II: Cloud Computing Architecture	**08 Hours**
Cloud Delivery models, The SPI framework, cloud software as a service (SaaS), Cloud platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud deployment models, public clouds, community clouds, hybrid clouds, alternative deployment models, expected benefits.	
MODULE – III: Cloud Computing Software Security fundaments	**08 Hours**
Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.	
MODULE – IV: Cloud Computing Risk Issues & Security Challenges	**08 Hours**
The CIA Traid, Privacy and Compliance Risks, Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Service Provider Risks. Security Policy Implementation, Policy Types, and Computer Security Incident Response Team (CSIRT).	
MODULE – V: Cloud Computing Security Architecture	**08 Hours**
Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution environments and Communications, Micro architectures, Identity Management and Access Control, Autonomic Security.	

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
John W. Itinghouse, James F. Ransome	Cloud Computing Implementation, Management and Security	1st Edition	CRC Press
Borko Furht, Armando Escalante	Handbook of Cloud Computing	2010th Edition	Springer
Anthony T. Velte, Toby J. Velte, Robert Elsenpeter	Cloud Computing: A Practical Approach	2010	TATA McGraw-Hill, New Delhi
Michael Miller	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online	2008	Que
Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper	Cloud Computing For Dummies	2010	Wiley Publishing, Inc.
Rajkumar Buyya, James Broberg, Andrzej Goscinski	Cloud Computing (Principles and Paradigms)	2011	John Wiley & Sons, Inc.

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 20 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses					
RUBRIC for CIE			***RUBRIC for SEE***		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

Title of Subject: DESIGN AND ANALYSIS OF ALGORITHM		
COURSE CODE: 23MCA31	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 50**
Contact Hours: (L:T:P): 4-0-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Provide understanding of fundamental algorithmic concepts and analysis techniques, including time and space complexity, and asymptotic notations.
2. Introduction to the greedy algorithmic technique and its applications in optimization problems like job sequencing, knapsack, minimum spanning trees, and shortest path problems.
3. Dynamic programming methodology for solving optimization problems such as matrix chain multiplication, knapsack, shortest path, and travelling salesperson problems.
4. Implement backtracking and branch and bound algorithms to solve combinatorial optimization problems like n-queens, sum of subsets, graph colouring, and Hamiltonian cycles.
5. Computational complexity theory by introducing NP-hard and NP-complete problems, non-deterministic algorithms, and approximation algorithms for effective problem-solving.

MODULE – I: Introduction — **10 Hours**

Algorithm, analysis, time complexity and space complexity, O-notation, Omega notation and Theta notation. Mathematical Analysis of Recursive and Non-recursive methods.
Divide and Conquer: General Strategy, Binary Search, Quick Sort and Merge Sort

MODULE – II: Greedy method — **10 Hours**

General method, applications - Job sequencing with deadlines, knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

MODULE – III: Dynamic Programming — **10 Hours**

General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.

MODULE – IV: Backtracking — **10 Hours**

General method, applications-n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles. Branch and Bound: General method, applications - Travelling sales person problem,0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.

MODULE – V: NP-Hard and NP-Complete problems — **10 Hours**

Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Ellis Horowitz, Satraj Sahni, Rajasekharam	Fundamentals of Computer Algorithms	-	Galgotia Publications Pvt.

			Ltd.
A. Levitin	Introduction to the Design and Analysis of Algorithms	-	Pearson Education
P. H. Dave, H. B. Dave	Design and Analysis of Algorithms	2008	Pearson Education
M. T. Goodrich, R. Tomassia	Algorithm Design: Foundations, Analysis and Internet examples	-	John Wiley and Sons
P. H. Dave, H. B. Dave	Design and Analysis of Algorithms	2008	Pearson Education

Title of Subject: DATA MINING		
COURSE CODE: 23MCA32	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 50**
Contact Hours: (L:T:P): 4-0-0	**Credit: 04**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Comprehensive Understanding: Attain a comprehensive understanding of data mining concepts, techniques, and algorithms.
2. Practical Application: Apply data mining techniques to real-world datasets for classification, clustering, and association rule mining.
3. Evaluation Proficiency: Evaluate and compare the performance of data mining models using appropriate metrics and validation techniques.
4. Advanced Topics Mastery: Master advanced topics in data mining such as text mining, web mining, and big data analytics.
5. Project Implementation: Successfully design, implement, and present a data mining project demonstrating acquired knowledge and skills.

MODULE – I: Introduction to Data Mining	**10 Hours**

Overview of Data Mining: Definition, importance, and applications, Data mining process: preprocessing, mining, post processing. Data preprocessing: Data cleaning: handling missing values, outliers, Data integration, transformation, and reduction. Data Mining Techniques: Classification, clustering, association rule mining, Anomaly detection, regression analysis. Evaluation of Data Mining Models: Performance measures: accuracy, precision, recall, F1-score, Cross-validation, training and testing datasets.

MODULE – II: Classification and Prediction	**10 Hours**

Classification Techniques: Decision trees: ID3, C4.5, CART, Bayesian classification, Rule-based classification. Evaluation of Classification Models: Confusion matrix, ROC curve. Ensemble methods: bagging, boosting, random forests. Regression Analysis: Linear regression, Logistic regression, Evaluation metrics for regression models. Feature Selection and Dimensionality Reduction: Filter and wrapper methods, Principal Component Analysis (PCA), Singular Value Decomposition (SVD).

MODULE – III: Clustering and Association Rule Mining	**10 Hours**

Clustering Algorithms: K-means clustering, Hierarchical clustering, Density-based clustering (DBSCAN). Evaluation of Clustering Models: Internal and external clustering validation measures, Cluster analysis visualization techniques. Association Rule Mining: Apriori algorithm, FP-Growth algorithm, Evaluation metrics for association rules. Sequential Pattern Mining: Sequential pattern mining algorithms, Applications in time-series data analysis.

MODULE – IV: Advanced Topics in Data Mining	**10 Hours**

Text Mining: Basics of text preprocessing, Text classification and clustering. Web Mining: Mining structure and content of web pages, Web usage mining. Social Media Mining: Mining social networks, Sentiment analysis. Big Data Analytics: Introduction to big data and distributed computing frameworks, Data mining on big data platforms like Hadoop, Spark.

MODULE – V: Applications and Project Work	**10 Hours**

Applications of Data Mining: Industry-specific applications: healthcare, finance, marketing, Case studies and real-world examples. Project Formulation: Identifying a data mining problem,

Data collection and preprocessing for the project. Project Implementation: Applying appropriate data mining techniques to the project. Experimentation, evaluation, and analysis of results. Project Presentation: Presenting the project findings, insights, and conclusions.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Pang-Ning Tan, Michael Steinbach, Vipin Kumar	Introduction to Data Mining	1st Edition	Pearson Education
Jiawei Han, Micheline Kamber, Jian Pei	Data Mining: Concepts and Techniques	3rd Edition	Morgan Kaufmann
David J. Hand, Heikki Mannila, Padhraic Smyth	Principles of Data Mining	2nd Edition	The MIT Press
Gordon S. Linoff, Michael J. A. Berry	Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management	2nd Edition	Wiley
Ian H. Witten, Eibe Frank, Mark A. Hall	Data Mining: Practical Machine Learning Tools and Techniques	4th Edition	Morgan Kaufmann

Title of Subject: MACHINE LEARNING		
COURSE CODE: 23MCA33	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand fundamental concepts and techniques in machine learning, including well-posed learning problems and designing learning systems with consideration of perspectives and issues.
2. Apply regression and classification techniques including linear regression, decision trees, support vector machines, and naive Bayes to solve real-world problems.
3. Implement clustering and instance-based learning algorithms such as k-means clustering, neural networks, and reinforcement learning, along with understanding their applications.
4. Analyze probabilistic graphical models including undirected and directed graphical models, Bayesian networks, and hidden Markov models for inference, learning, and generalization.
5. Design and conduct machine learning experiments, including cross-validation, measuring and assessing performance, hypothesis testing, and comparison of algorithms using various datasets through case studies.

MODULE – I: Introduction	**08 Hours**

Introduction: Definition-Examples of machine learning applications –Well posed learning problems- Designing a learning system- Perspectives and issues Concept learning and general to specific ordering: Inductive learning hypothesis- Concept learning as search – candidate elimination algorithm-inductive bias.

MODULE – II: Regression and classification	**08 Hours**

Regression: Linear Regression-Simple-Multiple Decision Tree-Pruning: Introduction – Representation-Algorithm issues Classification: Support Vector machine – Naïve Bayes-Applications

MODULE – III: Clustering and Learning	**08 Hours**

Clustering: k-Means clustering– adaptive Hierarchical clustering –Applications- Neural network : Perceptron, multilayer network- back propagation- introduction to deep neural network Instance based learning :k-NN– Radial basis functions Case based reasoning-Reinforcement learning -Applications.

MODULE – IV: Probabilistic graphical models	**08 Hours**

Graphical Models: Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – Learning Generalization - Hidden Markov Models - Conditional random fields(CRFs)

MODULE – V: Machine learning experiments	**08 Hours**

Design-Cross validation - Measuring Performance -Hypothesis testing- Assessing Performance - Comparison of algorithms, Datasets-Case study.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Christopher M. Bishop	Pattern Recognition and Machine Learning	1st Edition	Springer
Kevin P. Murphy	Machine Learning: A Probabilistic Perspective	1st Edition	MIT Press
Ethem Alpaydin	Introduction to Machine Learning	3rd Edition	MIT Press
Jiawei Han, Micheline Kamber, Jian Pei	Data Mining: Concepts and Techniques	3rd Edition	Morgan Kaufmann
Richard S. Sutton, Andrew G. Barto	Reinforcement Learning: An Introduction	2nd Edition	The MIT Press

Title of Subject: COMPUTER GRAPHICS WITH OPENGL		
COURSE CODE: 23MCA34	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 50**
Contact Hours: (L:T:P): 3-0-2	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understanding of Computer Graphics Fundamentals: By the end of the course, students should demonstrate a solid understanding of fundamental concepts in computer graphics, including graphics pipeline, OpenGL architecture, primitives, and coordinate systems.
2. Proficiency in OpenGL Programming: Students should be proficient in using OpenGL for 2D and 3D graphics rendering, including basic functions like drawing shapes, applying transformations, and managing viewing perspectives.
3. Application of Lighting and Shading Techniques: Upon completion of the course, students should be able to apply various lighting models and shading techniques in OpenGL to create realistic illumination effects in their graphical scenes.
4. Implementation of Advanced Rendering Techniques: Students should be capable of implementing advanced rendering techniques such as texture mapping, environment mapping, and shadow mapping using OpenGL to enhance the visual quality of their graphics.
5. Interactive Graphics Development: By the end of the course, students should be able to develop interactive graphics applications with user interaction features using OpenGL, including handling input events, implementing animations, and incorporating 3D models.

MODULE – I: Introduction to Computer Graphics and OpenGL Basics	**10 Hours**

Overview of Computer Graphics, Definition, importance, applications, Graphics pipeline overview. Introduction to OpenGL**,** History and evolution, OpenGL architecture, Setting up OpenGL environment. Points, lines, and polygons, 2D and 3D coordinate systems, Viewing transformations, Initialization and setup, Drawing basic shapes, Color and shading.

MODULE – II: OpenGL Transformations and Viewing	**10 Hours**

Translation, rotation, scaling, Matrix transformations, Hierarchical transformations, Viewing transformations: translation, rotation, Orthographic and perspective projections, Viewing volumes and frustum, Model-view-projection transformations, Viewing transformations in action, Camera simulation, Clipping algorithms, Implementing clipping in OpenGL, Understanding transformation functions.

MODULE – III: Lighting and Shading in OpenGL	**10 Hours**

Basics of illumination models, Types of light sources, Phong reflection model, Light properties and parameters, Specular, diffuse, and ambient lighting, Material properties, Flat shading vs. smooth shading, Gouraud shading, Phong shading, Texture coordinates and mapping, Texture filtering and wrapping, Applying textures in OpenGL.

MODULE – IV: Advanced OpenGL Techniques	**10 Hours**

Framebuffer objects (FBOs), Multisampling and antialiasing, Shadow mapping. OpenGL Buffers and Buffer Management: Introduction to buffers: vertex, pixel, frame buffers, Buffer

management functions in OpenGL, Vertex arrays and buffer objects, Shader programming: Vertex and fragment shaders, Introduction to GLSL, Environment mapping, Particle systems, Advanced blending techniques.

MODULE – V: OpenGL and Interaction | **10 Hours**

Handling mouse and keyboard events, User interface design in OpenGL, Interaction techniques, Basics of animation, Keyframe animation, Interpolation techniques, Basics of 3D modeling, Mesh representation, Model loading in OpenGL.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Donald Hearn, M. Pauline Baker	Computer Graphics with OpenGL	4th Edition	Pearson Education
Edward Angel, Dave Shreiner	Interactive Computer Graphics: A Top-Down Approach with OpenGL	7th Edition	Addison-Wesley Professional
Sumanta Guha	Computer Graphics Through OpenGL: From Theory to Experiments	1st Edition	CRC Press
F.S. Hill Jr.	Computer Graphics: Using OpenGL	2nd Edition	Prentice Hall
Mark J. Kilgard	OpenGL Programming for the X Window System	1st Edition	Addison-Wesley Professional

Title of Subject: DAA LAB		
COURSE CODE: 23MCA35	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	
Contact Hours: (L:T:P): 0-0-4	**Credit: 02**	**Duration of Exam: 03**

Programs offer hands-on experience with various design and analysis of algorithms and techniques.

1. Develop a program to perform binary search on a sorted array and evaluate its time complexity.
2. Create functions to implement quicksort algorithms and compare their efficiency on different datasets.
3. Create functions to implement merge sort algorithms and compare their efficiency on different datasets.
4. Solve the job sequencing problem with deadlines using a greedy approach.
5. Implement algorithms to find minimum cost spanning trees.
6. Implement algorithms to find single-source shortest paths in a graph.
7. Develop dynamic programming solutions for 0/1 knapsack problem.
8. Solve the travelling salesperson problem using dynamic programming.
9. Implement backtracking algorithms to solve the n-queen problem.
10. Implement Hamiltonian Cycles in a connected undirected Graph G of n vertices using the backtracking principle.

Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50

Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.

Scheme of Semester End Examination (SEE) Laboratory for 50 marks:

SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks

Title of Subject: DATA MINING LABORATORY		
COURSE CODE: 23MCA36	CIE Marks: 50	
SEMESTER: III	SEE Marks: 50	
Contact Hours: (L:T:P): 0-0-4	Credit: 02	Duration of Exam: 03

Programs offer hands-on experience with various data mining algorithms and techniques, utilizing dynamic memory management for efficient handling of large datasets

1. Develop a program to implement the K-Means clustering algorithm from scratch.
2. Create a program to perform association rule mining using the Apriori algorithm.
3. Develop a program to construct a decision tree from a given dataset.
4. Write a program to mine sequential patterns using the PrefixSpan algorithm.
5. Create a program to build a linear regression model from a given dataset.
6. Develop a program to perform PCA for dimensionality reduction.
7. Write a program to classify text documents using the Naive Bayes algorithm.
8. Create a program to perform density-based clustering using the DBSCAN algorithm.
9. Develop a program to build an SVM classifier for binary classification tasks.
10. Write a program to perform hierarchical clustering using agglomerative or divisive approaches.

Scheme of Continuous Internal Evaluation Laboratory (CIE): 25 + 25 = 50

Conduction of laboratory exercises, Lab report & observation & analysis, Lab Test: TWO LAB tests will be conducted. Each LAB test will be evaluated for 25 Marks.

Scheme of Semester End Examination (SEE) Laboratory for 50 marks:

SEE for practical will be jointly conducted and evaluated by two examiners. The duration of practical examination is 3 hours and is evaluated for 50 marks. The break up for conduction of practical examination is (i) Procedure and Write up : 20% of max marks, (ii) Conducting the practical: 60% of max marks, (iii) Viva Voce: 20% of max marks

PROFESSIONAL ELECTIVE – 2

Title of Subject: ARTIFICIAL INTELLIGENCE		
COURSE CODE: 23MCA371	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand AI's key concepts, various applications, and ethical considerations.
2. Formulate and solve problems, apply search algorithms (uninformed and informed), and grasp adversarial search techniques.
3. Apply propositional and first-order logic, differentiate procedural and declarative knowledge, and implement ontology-based representations.
4. Grasp probability basics, utilize Bayes' Rule, represent uncertain knowledge using belief networks, and reason effectively under uncertainty.
5. Recognize features of expert systems, understand knowledge representation techniques, and utilize expert system tools like MYCIN and EMYCIN for problem-solving.

MODULE – I: Foundations of Artificial Intelligence	**08 Hours**

Definition and Evolution of Artificial Intelligence, Key Concepts: Agents, Environments, and Rationality, Applications of AI in Various Domains, Ethical Considerations in AI.

MODULE – II: Problem Solving and Search Algorithms	**08 Hours**

Problem Formulation and State Space Search, Uninformed Search Algorithms (e.g., Breadth-First, Depth-First), Informed Search Algorithms (e.g., A*, Heuristic Search), Adversarial Search: Minimax Algorithm.

MODULE – III: Knowledge Representation	**08 Hours**

Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic Representing Knowledge using Rules: Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning, Semantic Knowledge, Ontology Based representation.

MODULE – IV: Uncertain Knowledge & Reasoning	**08 Hours**

Acting under Uncertainty, Basic Probability notation, The Axioms of Probability, Bayes' Rule and its Use, Where do Probabilities come from?, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.

MODULE – V: Expert Systems	**08 Hours**

Definition, Features of an Expert System, Organization, Characteristics, Prospector, Knowledge Representation in Expert Systems, Expert System tools – MYCIN, EMYCIN.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Stuart Russell, Peter Norvig	Artificial Intelligence - A Modern Approach	Third Edition	Pearson
Elaine Rich, Kevin Knight,	Artificial Intelligence	Third	McGraw-Hill

Shivashankar B Nair		Edition	Education
Dan W. Patterson	Introduction to Artificial Intelligence and Expert Systems		Pearson

Scheme of Continuous Internal Evaluation (CIE): 10 + 10 + 30 = 50

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar/presentation/demonstration (10) adding up to 20 marks. Final EL marks will be reduced to 10 Marks.

TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 30 Marks.

Scheme of Semester End Examination (SEE) for 50 marks:

The question paper will have FIVE full questions with internal choice from each MODULE. Each question will carry 10 marks. Student will have to answer one full question from each MODULE.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			*RUBRIC for SEE*		
SL.NO.	**Contents**	**Marks**	**SL.NO.**	**Contents**	**Marks**
1	QUIZZES – Q1 & Q2 (Average of TWO Quizzes)	10	Every MODULE consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each MODULE [MODULE 1 to 5]		
2	Experiential Learning – EL1 & EL2	10	1 & 2	MODULE 1:Question 1 or 2	20
			3 & 4	MODULE 2:Question 3 or 4	20
3	TESTS – T1,T2, & T3 (Average of Best Two will be considered for the Final Marks)	30	5 & 6	MODULE 3:Question 5 or 6	20
			7 & 8	MODULE 4:Question 7 or 8	20
			9 & 10	MODULE 5:Question 9 or 10	20
	Total	**50**		**Total**	**100**

PROFESSIONAL ELECTIVE – 2

Title of Subject: FOUNDATIONS OF DATA SCIENCE		
COURSE CODE: 23MCA372	CIE Marks: 50	
SEMESTER: III	SEE Marks: 50	Total Hours: 40
Contact Hours: (L:T:P): 3-0-0	Credit: 03	Duration of Exam: 03

Course Outcomes: At the end of the course, the student will be able to

1. Develop a strong understanding of data science principles, terminology, and its applications across various industries.
2. Compute and interpret descriptive statistics, and conditional probability for effective data analysis and decision-making.
3. Apply statistical sampling methods, analyze sampling distributions, and understand hypothesis testing errors to draw meaningful conclusions.
4. Demonstrate the ability to source, clean, and preprocess datasets for effective analysis.
5. Implement advanced data analysis techniques, including dimensionality reduction, anomaly detection, and text mining.

MODULE – I: Introduction to Data Science	08 Hours

Definition of Data Science and its applications, Historical evolution and significance of Data Science, Key concepts: Big Data, Data Analytics, Ethical considerations in Data Science, Role of Data Scientists in decision-making processes.

MODULE – II: Fundamentals of Statistics and Probability	08 Hours

Descriptive Statistics: Mean, Median, Mode, Variance, and Standard Deviation.

Probability: Probability Axioms, addition and multiplication theorems of probability, Conditional Probability.

MODULE – III: Inferential statistics	08 Hours

Sampling, sampling distributions, testing of hypothesis: Type-1 and Type-2 errors, expectation, confidence interval, t-distribution and chi-square.

MODULE – IV: Data Management and Preprocessing	08 Hours

Data preprocessing: Techniques for cleaning and transforming raw data, Strategies for handling outliers and anomalies. Feature engineering and transformation to meet analysis requirements, Handling missing data in datasets.

MODULE – V: Advanced Topics in Data Science	08 Hours

Dimensionality reduction techniques: Overview of techniques such as PCA (Principal Component Analysis), Anomaly detection and outlier analysis, Text mining, and Time series analysis

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani	An Introduction to Statistical Learning	1st Edition	Springer

Joel Grus	Data Science from Scratch	2nd Edition	O'Reilly Media
Wes McKinney	Python for Data Analysis	3rd Edition	O'Reilly Media
Wade Briggs	Data Science with Python	1st Edition	Pearson

PROFESSIONAL ELECTIVE – 2

Title of Subject: CYBER SECURITY		
COURSE CODE: 23MCA373	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental principles and concepts of cyber security, including common threats, attack vectors, and ethical considerations.
2. Develop proficiency in implementing security mechanisms such as cryptography, firewalls, and intrusion detection systems to protect networks and data.
3. Acquire knowledge of risk assessment methodologies, compliance frameworks, and incident response procedures to effectively manage cyber security incidents.
4. Gain practical experience in conducting vulnerability assessments, forensic analysis, and developing security policies and procedures.
5. Explore emerging trends and technologies in cyber security, including artificial intelligence, blockchain, and the Internet of Things (IoT), and their implications for securing digital environments.

MODULE – I: Introduction to Cyber Security	**08 Hours**

Introduction to Cyber Security: Scope, importance, and ethics. Overview of cyber threats and attack vectors. Laboratory Component: Analyzing cyber security incidents and requirements.

MODULE – II: Network Security	**08 Hours**

Fundamentals of networking and common protocols. Network security mechanisms: firewalls, IDS/IPS, and VPNs. Laboratory Component: Configuring network security devices and conducting vulnerability assessments.

MODULE – III: Cryptography and Data Protection	**08 Hours**

Basics of cryptography and encryption techniques. Cryptographic protocols and secure communication. Laboratory Component: Implementing encryption algorithms and digital signatures.

MODULE – IV: Cyber Threat Detection and Incident Response	**08 Hours**

Threat detection techniques and incident response planning. Forensic analysis and investigation methodologies. Laboratory Component: Deploying SIEM and conducting incident response exercises.

MODULE – V: Cyber Security Governance and Risk Management	**08 Hours**

Cyber security governance frameworks and risk assessment methodologies. Security controls, compliance, and business continuity planning. Laboratory Component: Developing risk management strategies and continuity plans.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
William Stallings	Cryptography and Network Security: Principles and Practice	8th Edition	Pearson
Bruce Schneier	Applied Cryptography: Protocols,	2nd	Wiley

	Algorithms, and Source Code in C	Edition	
Michael T. Goodrich, Roberto Tamassia, David M. Mount	Introduction to Computer Security	1st Edition	Pearson
Eric Conrad, Joshua Feldman, Seth Misenar	CISSP Study Guide	3rd Edition	Sybex
Peter Gregory, Philip Craig	CISSP For Dummies	6th Edition	For Dummies
William Stallings	Cryptography and Network Security: Principles and Practice	8th Edition	Pearson

PROFESSIONAL ELECTIVE – 3

Title of Subject: DISTRIBUTED COMPUTING SYSTEM		
COURSE CODE: 23MCA381	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental principles and challenges of distributed computing systems.
2. Apply distributed algorithms and synchronization techniques in real-world scenarios.
3. Manage resources effectively in a distributed environment, ensuring fault tolerance and consistency.
4. Implement security measures to protect distributed systems from threats and vulnerabilities.
5. Explore advanced topics and emerging trends in distributed computing through case studies and practical applications.

MODULE – I: Introduction to Distributed Computing Systems	**08 Hours**

Introduction to Distributed Systems: Definition and goals, Types of distributed systems, Evolution and examples. Architectural Models: Client-server, Peer-to-peer, and Middleware architecture, Communication paradigms. Fundamental Concepts: Transparency, Scalability, Openness, and Heterogeneity, Challenges in distributed computing. Communication in Distributed Systems: Synchronous and asynchronous communication, Remote Procedure Call (RPC), Remote Method Invocation (RMI), Message-oriented communication.

MODULE – II: Distributed Algorithms and Synchronization	**08 Hours**

Distributed Algorithms: Classification and characteristics, Leader election algorithms, Mutual exclusion algorithms. Clock Synchronization: Logical clocks, Lamport timestamps, Vector clocks, Clock synchronization algorithms. Consensus and Agreement: Consensus in synchronous and asynchronous systems, Paxos algorithm. Replication and Consistency: Data replication, Consistency models, Consistency protocols.

MODULE – III: Distributed Resource Management	**08 Hours**

Resource Allocation: Load balancing, Load sharing algorithms, Distributed scheduling. Distributed File Systems: Architecture and design, Naming and transparency, Case studies: NFS, AFS. Distributed Databases: Distributed database architecture, Concurrency control, Distributed transactions, Two-phase commit protocol. Fault Tolerance: Basics of fault tolerance, Failure models, Recovery techniques, Checkpointing and rollback recovery.

MODULE – IV: Security in Distributed Systems	**08 Hours**

Security Fundamentals: Threats and vulnerabilities, Security requirements in distributed systems. Cryptographic Techniques: Symmetric and asymmetric encryption, Digital signatures, Public key infrastructure (PKI). Authentication and Access Control: Authentication protocols, Kerberos, Access control mechanisms. Security in Practice: Secure communication protocols (SSL/TLS), Distributed denial of service (DDoS) attacks, Security in distributed middleware.

MODULE – V: Advanced Topics and Case Studies	**08 Hours**

Distributed Web-Based Systems: Web services, Service-oriented architecture (SOA), Microservices architecture. Cloud Computing: Cloud architecture and service models, Resource

management in cloud, Case studies of cloud platforms. Internet of Things (IoT): IoT architecture, Data management in IoT, Security challenges in IoT. Case Studies and Future Directions: Case studies of real-world distributed systems, Future trends in distributed computing.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Andrew S. Tanenbaum, Maarten Van Steen	"Distributed Systems: Principles and Paradigms"	2nd Edition	Pearson
George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair	"Distributed Systems: Concepts and Design"	5th Edition	Pearson
Ajay D. Kshemkalyani, Mukesh Singhal	"Distributed Computing: Principles, Algorithms, and Systems"	1st Edition	Cambridge University Press

PROFESSIONAL ELECTIVE – 3

Title of Subject: BIG DATA		
COURSE CODE: 23MCA382	**CIE Marks: 50**	
SEMESTER: III	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand big data concepts, challenges, analytics classifications, and terminologies, emphasizing the importance of big data analytics over traditional business intelligence.
2. Gain knowledge about NoSQL databases, Hadoop ecosystem components, and distributed computing challenges.
3. Learn MongoDB basics, including data types and query language, and master MapReduce programming concepts for data processing.
4. Comprehend Hive architecture, query language statements, and implementation details such as user-defined functions and file formats.
5. Acquire proficiency in Pig features, execution modes, and Pig Latin language, enabling effective data processing and analysis.

MODULE – I: Introduction to Big Data and Analytics	**08 Hours**

Classification of Digital Data, Structured and Unstructured Data – Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Data Science - Data Scientist - Terminologies used in Big Data Environments - Basically Available Soft State Eventual Consistency - Top Analytics Tools.

MODULE – II: Introduction to Technology Landscape	**08 Hours**

NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.

MODULE – III: Introduction to Mongodb and Mapreduce Programming	**08 Hours**

MongoDB: Why Mongo DB - Terms used in RDBMS and Mongo DB - Data Types - MongoDB Query Language MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

MODULE – IV: Hive	**08 Hours**

Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having – RCFile - Implementation - Hive User Defined Function - Serialization and Deserialization.

MODULE – V: Pig	**08 Hours**

Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having – RCFile - Implementation - Hive User Defined Function - Serialization and Deserialization.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Seema Acharya, Subhashini Chellappan	Big Data and Analytics	1st Edition	Wiley Publications
Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman	Big Data for Dummies	1st Edition	John Wiley & Sons, Inc.
Tom White	Hadoop: The Definitive Guide	4th Edition	O'Reilly Publications
Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnky, Bruce Brown, Rafael Coss	Hadoop For Dummies	1st Edition	Wiley Publications
Robert D. Schneider	Hadoop For Dummies	1st Edition	John Wiley & Sons, Inc.

PROFESSIONAL ELECTIVE – 3

Title of Subject: IOT (INTERNET OF THINGS)		
COURSE CODE: 23MCA383	CIE Marks: 50	
SEMESTER: III	SEE Marks: 50	Total Hours: 40
Contact Hours: (L:T:P): 3-0-0	Credit: 04	Duration of Exam: 03

Course Outcomes: At the end of the course, the student will be able to

1. Explain the definition and usage of the term 'the internet of things' in different contexts
2. Learn IoT/M2M system layers, standardizations, communication technologies, and device management for efficient device design.
3. Comprehend web communication protocols and principles for effective data exchange in connected devices.
4. Master data acquisition, organization, processing, and analytics in IoT/M2M systems, with insights into business models and applications.
5. Gain proficiency in data collection, storage, and computing using cloud platforms, with an understanding of IoT cloud-based services and sensor technologies.

MODULE – I: Internet of Things: An Overview	08 Hours

An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

MODULE – II: Design Principles for Connected Devices	08 Hours

IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

MODULE – III: Design Principles for the Web Connectivity	08 Hours

Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

MODULE – IV: Data Acquiring, Organising, Processing and Analytics	08 Hours

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

MODULE – V: Data Collection, Storage and Computing Using a Cloud Platform	08 Hours

Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology ,Sensing the World.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Rajkamal	Internet of Things: Architecture, Design Principles And Applications	1st ed	McGraw Hill Higher Education
A. Bahgya, V. Madisetti	Internet of Things	1st ed	University Press
Adrian McEwen, Hakim Cassimally	Designing the Internet of Things	1st ed	Wiley
Cuno Pfister	Getting Started with the Internet of Things	1st ed	O'Reilly
Rajkamal	Internet of Things: Architecture, Design Principles And Applications	1st ed	McGraw Hill Higher Education

Title of Subject: RESEARCH METHODOLOGY		
COURSE CODE: 23MCA39	**CIE Marks: 25**	
SEMESTER: III	**SEE Marks: 25**	**Total Hours: 30**
Contact Hours: (L:T:P): 2-0-0	**Credit: 02**	**Duration of Exam: 02**

Course Outcomes: At the end of the course, the student will be able to

1. Develop a robust understanding of research methodology, encompassing the various types of research, research approaches, and the significance of research methods versus methodology.
2. Acquire the skills necessary to define research problems effectively, select appropriate research problems, and understand the importance of problem definition in research.
3. Master the techniques and importance of literature review in research, including its role in bringing clarity and focus to research problems, improving methodology, and developing theoretical frameworks.
4. Gain proficiency in research design principles, including recognizing the need for research design, understanding its features, and comprehending different research designs and experimental principles.
5. Demonstrate competence in data collection methods, interpretation techniques, and report writing practices essential for effective communication of research findings.

MODULE – I: Introduction	**06 Hours**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India

MODULE – II: Defining the Research Problem	**06 Hours**

Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings.

MODULE – III: Literature review	**06 Hours**

Place of the literature review in research How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

MODULE – IV: Research Design	**06 Hours**

Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

MODULE – V: Data Collection & Interpretation and Report Writing	**06 Hours**

Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, and Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
C.R. Kothari, Gaurav Garg	Research Methodology: Methods and Techniques	4th Edition, 2018	New Age International
Ranjit Kumar	ResearchMethodologyastep-by-stepguideforbeginners. (For the topic Reviewing the literature under module 2)	3rd Edition, 2011	SAGE PublicationsLtd
Trochim	Research Methods: the concise knowledge Base	2005	Atomic Dog Publishing
Fink A	Conducting Research Literature Reviews: From the Internet to Paper	2009	SAGE Publications

IV-SEMESTER

Title of Subject: SOFTWARE TESTING AND PRACTICES		
COURSE CODE: 23MCA41	CIE Marks: 50	
SEMESTER: IV	SEE Marks: 50	Total Hours: 50
Contact Hours: (L:T:P): 4-0-0	Credit: 04	Duration of Exam: 03

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental principles and techniques of software testing, including black-box and white-box testing methodologies.
2. Develop proficiency in test planning, documentation, and execution, encompassing static and dynamic testing approaches.
3. Apply advanced testing concepts such as model-based testing, exploratory testing, and security testing to ensure comprehensive test coverage.
4. Gain practical experience in Agile testing principles and practices, including test-driven development (TDD) and behavior-driven development (BDD).
5. Acquire skills in software quality assurance processes, metrics, and test process improvement models for continuous enhancement of testing practices.

MODULE – I: Introduction to Software Testing and Practices	10 Hours

Introduction to Software Testing: Fundamentals, SDLC phases, and objectives. Testing principles and techniques: black-box and white-box testing. Test planning, documentation, and execution.

MODULE – II: Software Testing Techniques and Dynamic Testing	10 Hours

Static and dynamic testing techniques: static code analysis, functional and non-functional testing. Test automation and continuous integration. Introduction to model-based testing.

MODULE – III: Advanced Testing Concepts and Quality Assurance	10 Hours

Model-based testing, exploratory testing, security and usability testing. Introduction to Agile testing principles and practices. Software quality assurance processes and metrics.

MODULE – IV: Testing in Agile and DevOps Environments	10 Hours

Agile testing principles, test-driven development (TDD), and behavior-driven development (BDD). Testing in DevOps: continuous testing, test automation, and infrastructure as code.

MODULE – V: Software Quality Assurance and Test Process Improvement	10 Hours

Key software testing metrics and measurement. Test process improvement models: TMM, TPI Next, and TMMi. Risk-based testing strategies and prioritization techniques.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Srinivasan Desikan, Gopalaswamy Ramesh	Software Testing: Principles and Practices	1st Edition	Pearson
Paul Ammann, Jeff Offutt	Introduction to Software Testing	1st Edition	Cambridge University Press
Lisa Crispin, Janet Gregory	Agile Testing: A Practical	1st Edition	Addison-Wesley

	Guide for Testers and Agile Teams		
Cem Kaner, Jack Falk, Hung Q. Nguyen	Testing Computer Software	2nd Edition	Wiley
Paul M. Duvall, Steve Matyas, Andrew Glover	Continuous Integration: Improving Software Quality and Reducing Risk	1st Edition	Addison-Wesley

PROFESSIONAL ELECTIVE – 4

Title of Subject: DEEP LEARNING		
COURSE CODE: 23MCA421	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts of neural networks and deep learning architectures, including convolutional, recurrent, and generative models.
2. Develop proficiency in implementing deep learning algorithms using popular libraries such as TensorFlow and Keras for tasks like image classification, object detection, and sequence modeling.
3. Acquire knowledge of advanced deep learning topics such as attention mechanisms, reinforcement learning, and autoencoders, along with their applications in various domains.
4. Gain practical experience in training and fine-tuning deep learning models, including CNNs, RNNs, and GANs, through hands-on exercises and projects.
5. Explore ethical considerations and biases in deep learning applications, and understand the societal impact of deploying deep learning systems in real-world scenarios.

MODULE – I: Introduction to Deep Learning	**08 Hours**
Introduction to Deep Learning: Fundamentals, neural network architecture, and libraries. Laboratory Component: Setting up deep learning environments.	
MODULE – II: Convolutional Neural Networks	**08 Hours**
CNNs: Architecture, layers, and popular models. Image classification and object detection with CNNs. Laboratory Component: Implementing CNN architectures.	
MODULE – III: Recurrent Neural Networks (RNNs) and LSTM Networks	**08 Hours**
RNNs and LSTMs: Architecture, sequence modeling, and applications in NLP. Laboratory Component: Developing RNN and LSTM models.	
MODULE – IV: Generative Adversarial Networks (GANs)	**08 Hours**
GANs: Architecture, training process, and variants. GAN applications in image generation and style transfer. Laboratory Component: Implementing GAN architectures.	
MODULE – V: Advanced Topics in Deep Learning	**08 Hours**
Advanced Topics: Attention mechanisms, reinforcement learning, autoencoders, and deep learning ethics. Final Project and Presentation.	

Text Books:

Author Names	Name of the Text Books	Edition (Auto-filled)	Publisher
Ian Goodfellow, Yoshua Bengio, Aaron Courville	Deep Learning	1st Edition	The MIT Press
Aurélien Géron	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	2nd Edition	O'Reilly Media

Charu C. Aggarwal	Neural Networks and Deep Learning: A Textbook	1st Edition	Springer
Rajalingappaa Shanmugamani	Deep Learning for Computer Vision	1st Edition	Packt Publishing
David Foster	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play	1st Edition	O'Reilly Media

PROFESSIONAL ELECTIVE – 4

Title of Subject: NATURAL LANGUAGE PROCESSING		
COURSE CODE: 23MCA422	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts and techniques of natural language processing (NLP), including text processing, syntactic analysis, and semantic representation.
2. Develop proficiency in implementing NLP algorithms and models using programming languages such as Python and libraries like NLTK and spaCy.
3. Acquire knowledge of advanced NLP topics such as machine translation, sentiment analysis, and discourse processing, along with their practical applications.
4. Gain hands-on experience in building NLP systems through laboratory exercises and projects, including tasks like part-of-speech tagging, parsing, and sentiment classification.
5. Explore emerging trends and future directions in NLP, including deep learning techniques, ethical considerations, and applications in various domains such as healthcare and social media analysis.

MODULE – I: Introduction to Natural Language Processing	**08 Hours**
Introduction to NLP: Scope, history, and applications. Basic text processing techniques. Laboratory Component: Implementing basic text processing tasks.	
MODULE – II: Syntax and Parsing	**08 Hours**
Syntax Analysis: CFGs, dependency parsing. Syntactic features: POS tagging, chunking. Laboratory Component: Implementing parsing algorithms.	
MODULE – III: Semantic Analysis and Discourse Processing	**08 Hours**
Semantic Representation: Frame semantics, distributional semantics. Discourse Analysis: Coreference resolution, coherence. Laboratory Component: Semantic analysis algorithms.	
MODULE – IV: Advanced NLP Techniques	**08 Hours**
Machine Translation: Statistical and neural machine translation. Sentiment Analysis: Classification, opinion mining. Laboratory Component: Implementing advanced NLP techniques.	
MODULE – V: Applications and Future Trends in NLP	**08 Hours**
NLP Applications: Chatbots, social media analysis. NLP in Healthcare: Clinical NLP, biomedical text processing. Laboratory Component: Exploring NLP applications and trends.	

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Daniel Jurafsky, James H. Martin	Speech and Language Processing	3rd Edition	Pearson
Steven Bird, Ewan Klein, Edward Loper	Natural Language Processing with Python	1st Edition	O'Reilly Media
Christopher D. Manning, Hinrich	Foundations of Statistical Natural Language	1st Edition	The MIT Press

Schütze	Processing		
Palash Goyal, Sumit Pandey, Karan Jain	Deep Learning for Natural Language Processing	1st Edition	Apress
Nitin Indurkhya, Fred J. Damerau	Handbook of Natural Language Processing	1st Edition	CRC Press

PROFESSIONAL ELECTIVE – 4

Title of Subject: DevOps		
COURSE CODE: 23MCA423	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the principles and benefits of DevOps and cloud computing models (IaaS, PaaS, SaaS), and set up and manage AWS infrastructure services such as EC2, S3, and RDS.
2. Comprehend the architecture and components of Docker, and effectively build, manage, and run Docker applications and containers.
3. Implement continuous integration and delivery processes using Docker and Kubernetes, setting up Kubernetes clusters, managing pods, and containerizing CI/CD pipelines.
4. Apply Infrastructure as Code (IaC) principles using AWS CloudFormation, creating and managing templates and stacks for efficient infrastructure provisioning.
5. Set up and manage CI/CD pipelines with AWS CodePipeline and CodeDeploy, deploying applications to EC2 and AWS Lambda, and monitoring deployments with CloudWatch.

MODULE – I: Introduction to DevOps and Cloud Computing	**08 Hours**

Overview of DevOps: Concepts and benefits, Overview of Cloud Computing: IaaS, PaaS, SaaS, Introduction to AWS: Services (EC2, S3, RDS, Lambda, etc.), AWS Infrastructure Setup: Creating an AWS account, setting up AWS CLI, Basics of AWS Identity and Access Management (IAM), AWS Compute Services: Introduction to Amazon EC2, instance types, AMIs, security groups, Auto Scaling and Elastic Load Balancing (ELB).

MODULE – II: Docker Fundamentals	**08 Hours**

Discovering Docker: The what and why of Docker, Understanding Docker: Docker's architecture, the Docker daemon, the Docker client, Docker registries, the Docker Hub, Building Docker Applications: Creating and managing Docker images, Using Docker as a Lightweight Virtual Machine: From VM to container, environments as processes, Building and Running Docker Containers: Saving, restoring work, creating images.

MODULE – III: Docker and DevOps Integration, Docker and Kubernetes Integration	**08 Hours**

Continuous Integration with Docker: Docker Hub automated builds, containerizing CI processes, Continuous Delivery with Docker: Interacting with other teams in the CD pipeline, First Steps with Docker and Kubernetes: Setting up a Kubernetes cluster, running apps, Creating, Running, and Sharing a Container Image, Managing Kubernetes Pods: Creating pods from YAML or JSON descriptors, organizing pods with labels, listing subsets of pods through label selectors, annotating pods, using namespaces to group resources, stopping and removing pods.

MODULE – IV: Infrastructure as Code (IaC) with AWS CloudFormation	**08 Hours**

Benefits and Principles of IaC: Best practices, Overview of AWS CloudFormation: Syntax, structure, writing templates, Managing Stacks: Creating, updating, deleting stacks, policies, drift detection, nested stacks, cross-stack references, Using AWS Serverless Application Model (SAM) with CloudFormation.

MODULE – V: Continuous Integration and Continuous Deployment (CI/CD) with AWS	**08 Hours**
Overview of CI/CD Pipelines: Setting up AWS CodePipeline for automated builds, Introduction to AWS CodeDeploy: Deploying to EC2 instances and Lambda, Integration: CodePipeline with CodeDeploy and other AWS services, pipeline execution, automation triggers, Monitoring: CloudWatch alarms and notifications.	

Text Books:

Author Names	Name of the Text Books	Edition (Auto-filled)	Publisher
Jez Humble, David Farley	"Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation"	1st Edition	Addison-Wesley
Gene Kim, Patrick Debois, John Willis, Jez Humble	"The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations"	1st Edition	IT Revolution Press
Karl Matthias, Sean P. Kane	"Docker: Up & Running: Shipping Reliable Containers in Production"	2nd Edition	O'Reilly Media
Kelsey Hightower, Brendan Burns, Joe Beda	"Kubernetes: Up and Running: Dive into the Future of Infrastructure"	2nd Edition	O'Reilly Media
Paul Duvall, Steve Matyas, Andrew Glover	"Continuous Integration: Improving Software Quality and Reducing Risk"	1st Edition	Addison-Wesley

PROFESSIONAL ELECTIVE – 5

Title of Subject: ADVANCED COMPUTER NETWORKS		
COURSE CODE: 23MCA431	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Comprehensive Understanding: Attain a comprehensive understanding of advanced computer network concepts, including network security, wireless communication, quality of service, and emerging technologies.
2. Practical Application: Apply theoretical knowledge to design, implement, and manage secure and efficient computer networks, incorporating principles of cryptography, network performance optimization, and IoT integration.
3. Proficiency with Network Protocols: Gain proficiency in analyzing, configuring, and troubleshooting network protocols and technologies, including TCP/IP, wireless LANs, mobile IP, and cloud networking.
4. Security Expertise: Acquire expertise in network security principles, cryptographic algorithms, and security mechanisms, enabling the design and implementation of robust security solutions to protect network infrastructure and data.
5. Awareness of Emerging Trends: Stay updated with emerging trends and technologies in computer networks, such as 5G networks, blockchain, IoT, and edge computing, fostering adaptability to future advancements in the field.

MODULE – I: Network Security	**08 Hours**
Introduction to Network Security: Overview of network security objectives, threats, and vulnerabilities. Security services: authentication, access control, confidentiality, integrity, and availability.	
MODULE – II: Cryptography	**08 Hours**
Cryptography Basics: Fundamentals of encryption, decryption, and cryptographic algorithms. Symmetric and asymmetric key cryptography. Public Key Infrastructure (PKI): Principles of PKI, digital certificates, and certificate authorities. HTTPS protocol and SSL/TLS encryption. Network Attacks and Defense Mechanisms: Common network attacks: eavesdropping, man-in-the-middle, denial of service (DoS), and distributed DoS (DDoS). Intrusion detection and prevention systems (IDS/IPS), firewalls, and secure protocols.	
MODULE – III: Network Performance and Quality of Service (QoS)	**08 Hours**
Network Performance Metrics: Latency, throughput, jitter, and packet loss. Tools for measuring and monitoring network performance. Quality of Service (QoS): QoS requirements and mechanisms for different types of traffic. Traffic shaping, prioritization, and scheduling algorithms. Traffic Engineering and Load Balancing: Techniques for optimizing network resource utilization. Load balancing algorithms: Round Robin, Weighted Round Robin, and Least Connections. Network Virtualization: Virtual LANs (VLANs), Virtual Private Networks (VPNs), and Virtualization technologies. Software-defined networking (SDN) principles and architectures.	
MODULE – IV: Internet of Things (IoT)	**08 Hours**
Introduction to IoT: IoT architecture, devices, and communication protocols. IoT applications in	

smart homes, healthcare, and industrial automation. IoT Communication Technologies: Wireless sensor networks (WSN), Zigbee, Bluetooth Low Energy (BLE), and LoRaWAN. MQTT and CoAP protocols for IoT communication.

MODULE – V: Cloud Networking | **08 Hours**

Cloud Computing Fundamentals: Cloud service models: IaaS, PaaS, and SaaS. Cloud deployment models: public, private, and hybrid clouds. Cloud Networking and Virtualization: Network virtualization in cloud environments. Software-defined networking (SDN) and Network Function Virtualization (NFV) concepts.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
James F. Kurose, Keith W. Ross	Computer Networking: A Top-Down Approach	7th Edition	Pearson Education
William Stallings	Cryptography and Network Security: Principles and Practice	7th Edition	Pearson Education
William Stallings	Wireless Communications and Networks	2nd Edition	Pearson Education
Larry L. Peterson, Bruce S. Davie	Computer Networks: A Systems Approach	5th Edition	Morgan Kaufmann
Raj Kamal	Internet of Things (IoT): Architectures, Protocols, and Applications	2nd Edition	McGraw-Hill Education

PROFESSIONAL ELECTIVE – 5

Title of Subject: STORAGE AREA NETWORK		
COURSE CODE: 23MCA432	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts of storage technology and SAN architectures.
2. Design and implement effective SAN solutions based on industry best practices.
3. Manage and administer SAN environments, including provisioning, monitoring, and troubleshooting.
4. Apply advanced SAN technologies and optimize performance in real-world scenarios.
5. Analyze and present SAN case studies, including emerging trends and future directions in storage networking.

MODULE – I: Introduction to Storage Area Networks	**08 Hours**

Introduction to Storage Technology: Overview of data storage evolution, Storage architectures: DAS, NAS, and SAN, Storage virtualization and cloud storage concepts. Storage Networking Fundamentals: Components of SAN: Host, connectivity, and storage, Benefits of SAN over other storage architectures, SAN topologies: Point-to-point, arbitrated loop, and switched fabric. SAN Protocols and Standards: Fibre Channel Protocol (FCP), iSCSI, and FCoE, Overview of SAN standards and organizations.

MODULE – II: SAN Design and Implementation	**08 Hours**

SAN Design Considerations: Needs assessment and requirements gathering, Designing SAN architecture: Scalability, performance, and availability, Best practices in SAN design. SAN Implementation and Deployment: Steps in SAN implementation: Planning, installation, and configuration, Integrating SAN with existing infrastructure, Testing and validation of SAN setup. SAN Management Tools: Overview of SAN management software, Key functionalities: Monitoring, reporting, and troubleshooting.

MODULE – III: SAN Administration and Management	**08 Hours**

SAN Administration: Daily administrative tasks: Provisioning, monitoring, and maintenance, Storage provisioning and LUN masking, Managing SAN performance and capacity. SAN Security: Security challenges in SAN environments, Implementing SAN security measures: Zoning, LUN masking, and encryption, Best practices for SAN security management. Backup and Recovery in SAN: SAN backup strategies and technologies, Data replication and disaster recovery solutions, Ensuring data integrity and availability.

MODULE – IV: Advanced SAN Technologies	**08 Hours**

Advanced SAN Features: Thin provisioning and data deduplication, Automated tiering and storage pooling, SAN and virtualization integration. Performance Optimization: Techniques for optimizing SAN performance, Troubleshooting SAN performance issues. Emerging Trends in SAN: Cloud-based SAN solutions, Converged and hyper-converged infrastructures, Software-defined storage and SAN.

MODULE – V: Case Studies and Future Directions	**08 Hours**

SAN Case Studies: Real-world SAN implementations in various industries, Lessons learned

and best practices. Future Directions in Storage Networking: Emerging technologies and trends in storage networking, The role of artificial intelligence and machine learning in SAN management. SAN Project: Planning and executing a SAN project from design to deployment, Presenting and evaluating project outcomes.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Robert Spalding	"Storage Networks: The Complete Reference"	1st Edition	McGraw-Hill
Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt	"Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE"	2nd Edition	Wiley
Richard Barker, Paul Massiglia	"Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs"	1st Edition	Wiley
EMC Education Services	"Information Storage and Management: Storing, Managing, and Protecting Digital Information"	2nd Edition	Wiley
Meeta Gupta	"Storage Area Network Fundamentals"	1st Edition	Cisco Press

PROFESSIONAL ELECTIVE – 5

Title of Subject: BLOCK CHAIN TECHNOLOGY		
COURSE CODE: 23MCA433	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	**Total Hours: 40**
Contact Hours: (L:T:P): 3-0-0	**Credit: 03**	**Duration of Exam: 03**

Course Outcomes: At the end of the course, the student will be able to

1. Understand the fundamental concepts of blockchain technology, including its architecture, data structure, and consensus mechanisms.
2. Develop proficiency in smart contract development and decentralized application (DApp) deployment on blockchain platforms like Ethereum.
3. Acquire knowledge of blockchain security and privacy principles, including identity management, cryptography, and secure development practices.
4. Analyze real-world blockchain use cases in various industries such as finance, supply chain, healthcare, and real estate.
5. Explore emerging trends in blockchain scalability, interoperability, governance, and sustainability, and assess their impact on future blockchain applications.

MODULE – I: Introduction to Blockchain Technology	**08 Hours**

Introduction to Blockchain: Characteristics, evolution, and architecture. Blockchain data structure and platforms overview. Laboratory Component: Setting up a local blockchain environment.

MODULE – II: Smart Contracts and Decentralized Applications	**08 Hours**

Smart Contracts: Programming languages, Ethereum Virtual Machine. Decentralized Applications (DApps): Architecture, use cases, and tokenization. Laboratory Component: Writing and deploying smart contracts.

MODULE – III: Blockchain Security and Privacy	**08 Hours**

Blockchain Security: Threats, consensus algorithms, and identity management. Privacy: Techniques and best practices. Laboratory Component: Auditing smart contracts for security vulnerabilities.

MODULE – IV: Blockchain Use Cases and Applications	**08 Hours**

Use Cases: Supply chain management, finance, healthcare, real estate. Case studies and implementation examples. Laboratory Component: Developing blockchain solutions for specific use cases.

MODULE – V: Scalability, Interoperability, and Future Trends	**08 Hours**

Scalability Challenges: Solutions and scalability techniques. Interoperability: Standards and protocols. Emerging Trends: Governance, sustainability, and future prospects. Final Project and Presentation.

Text Books:

Author Names	Name of the Text Books	Edition	Publisher
Imran Bashir	Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications	2nd Edition	Packt Publishing

Henning Diedrich	Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations	1st Edition	O'Reilly Media
Daniel Drescher	Blockchain Basics: A Non-Technical Introduction in 25 Steps	1st Edition	Apress
Arshdeep Bahga, Vijay Madisetti	Blockchain Applications: A Hands-On Approach	1st Edition	VPT
Elad Elrom	The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects	1st Edition	Apress

Title of Subject: PROJECT WORK – PW PHASE-II		
COURSE CODE: 23MCA44	**CIE Marks: 100**	
SEMESTER: IV	**SEE Marks: 100**	
Contact Hours: (L:T:P): 0-0-20	**Credit: 10**	**Duration of Exam: 03**

The students enrolled for MCA course have to undergo a PROJECT WORK.

Project Work Guidelines

Preliminary Requirements and Literature Survey

- **Selection and Preparation**:
  - Students shall select their project topic in consultation with their guide/co-guide.
  - Conduct a literature survey and complete preliminary project requirements.
  - Prepare an introductory project document and present a seminar.
- **Continuous Internal Evaluation (CIE)**:
  - CIE marks shall be awarded by a committee comprising:
    - Head of Department (HoD) as Chairman
    - Guide/co-guide, if any
    - A senior faculty member of the department
  - Evaluation Criteria:
    - Project Report: 50%
    - Project Presentation Skill: 25%
    - Question and Answer Session: 25%
- **University Examination (SEE)**:
  - Conducted as per University norms.

Project Work and Evaluation

- **Project Work Completion**:
  - Students must complete their project work, ensuring the report is subjected to a plagiarism check.
  - Prepare a comprehensive project report.
- **Continuous Internal Evaluation (CIE)**:
  - CIE marks for project shall be awarded by the committee.
  - Evaluation Criteria:
    - Project Report (subjected to plagiarism check): 50%
    - Project Presentation Skill: 25%
    - Question and Answer Session: 25%
- **University Examination (SEE)**:
  - Conducted at the end of IV semester.
  - Project work evaluation and Viva-Voce examination will be conducted after satisfying the plagiarism check, following University norms.

Title of Subject: INTERNSHIP		
COURSE CODE: 23MCA45	**CIE Marks: 50**	
SEMESTER: IV	**SEE Marks: 50**	
Contact Hours: (L:T:P): 0-0-4	**Credit: 04**	**Duration of Exam: 03**

The students enrolled for MCA course have to undergo an Industrial Training/Internship for a minimum of 04 weeks duration in Software Industry and/or R&D Sector.

Overview:

- **Duration**: 6 weeks
- **Timing**: During the vacation of II and III semesters and/or III and IV semesters
- **Evaluation**: University examination during IV semester

Requirements:

- **Mandatory Participation**: All students must undergo the internship.
- **Credit Allocation**: The internship is credit-bearing and will be counted towards the IV semester.
- **Head of Passing**: Internship is a compulsory component for passing and the award of the degree.

Failure to Complete:

- **Consequences**: Students who do not complete the internship will be declared as failed in the internship course.
- **Re-examination**: Those who fail must complete the internship requirements before the next university examination to be eligible for passing.

Notes:

- Students must satisfy all internship requirements to be eligible for evaluation.
- The completion of the internship is crucial for progressing in the degree program and ultimately for the award of the degree.