GOVERNMENT ARTS COLLEGE (AUTONOMOUS), COIMBATORE – 641 018.

(Affiliated to Bharathiar University) Reaccredited by NAAC with 'A' Grade

MASTER OF COMPUTER APPLICATIONS (MCA)

SYLLABUS

Effective from the Academic year of 2023-2024 Onwards

GOVERNMENT ARTS COLLEGE (*AUTONOMOUS*),
COIMBATORE – 641 018.

(Affiliated to Bharathiar University) Reaccredited by NAAC with 'A' Grade

ELIGIBILITY FOR ADMISSION:

The Eligibility for Candidates admitted to the first-year course in Master of Computer Applications (M.C.A) is as per TANCET.

DURATION OF THE COURSE:

The course shall be offered on a full-time basis for two years. The course will consist of four semesters of course work and laboratory work and the fourth semester includes a project work.

REQUIREMENTS FOR EXAMINATION AND ATTENDANCE:

A candidate will be permitted to appear for the semester examinations if, he/she secures not less than 75% of attendance in the number of working days during the semester and that the candidates' character has been satisfactory. If a candidate fails to secure 75% attendance and conduct has been satisfactory it shall be open to the Principal or any authority delegated such powers to grant exemption to a candidate for valid reasons subject to conditions.

EXAMINATIONS:

The final Examinations shall be conducted at the end of each semester for the subjects of study undergone in that semester.

Practical Examinations will be conducted with one Internal Examiner and one External Examiner. The question paper for practical examination will be jointly prepared by Internal and External Examiners. Record marks will be assigned by Internal examiner.

SESSIONAL MARKS:

Sessional marks will be awarded to the candidates for both theory and practical. For theory it will be based on two class tests, assignments and seminar. For practical it will be based on continuous lab assessments. During the sixth semester the students have to report the progress of their Project work on scheduled dates, to the department committee based on which marks shall be awarded by the project supervisor.

PASSING REQUIREMENTS:

1) Single valuation (External examiner) system is followed for correcting final theory examinations.
2) A candidate shall be declared to have passed the examinations in a subject if he/she secures not less than 50% of the total prescribed marks for the subject in Sessional and final examinations put together, subject to his/her getting a minimum of 50% of the marks in the semester examination.
3) A candidate who successfully completes the course and passes the examinations prescribed in all the subjects of study and practical examinations shall be declared to have been qualified for the degree.
4) If a candidate does not complete the course successfully within a period of 6 years (12 semesters) from the date of his/her joining, he/she will be disqualified from the course.
5) Candidates who have passed with 75% and more aggregate and have cleared all the papers in the first attempt be classified as First class with distinction.

CLASSIFICATION OF SUCCESSFUL CANDIDATES:

1) All candidates securing not less than 60% of the aggregate marks including sessional shall be declared to have passed the Degree in FIRST CLASS provided they have passed the examination in every subject including Practical, Project work and Viva-Voce within three years of joining the course.
2) Other successful candidates shall be declared to have passed the examinations in SECOND CLASS.

Program Learning Outcomes (PLOs)	
On successful completion of the M.C.A Programme, students will be able to	
PLO 1	Apply knowledge of mathematics, statistics, science and computing appropriately to model the software applications.
PLO 2	Assimilate and use state of the art computing technologies, tools and techniques necessary for computing practices.
PLO 3	Design a system, component, or process to meet desired need within realistic constraints such as economic, environmental, social and ethical contexts
PLO 4	Have an ability to design, implement and evaluate sustainable computational solutions for various complex problems as per needs and specifications.
PLO 5	Communicate effectively with the computing community, and with society, about complex computing activities by being able to comprehend and write effective reports, design documentation, and make effective presentations.
PLO 6	Manage projects and function effectively as an individual and as a member or leader in diverse terms, and in multidisciplinary setting.
PLO 7	Recognize the need for and prepare themselves to engage in independent and life -long learning for continual development as a computing professional for the betterment of individuals and organizations.
PLO 8	Apply ethical principles and commit to professional responsibilities in research for better environment.
PLO 9	Utilize the education necessary to understand the impact of computing solutions in a global and societal context
PLO 10	Acquire professional ethics, innovation skills and team work towards the wellness of the society.

GOVERNMENT ARTS COLLEGE (*Autonomous*), COIMBATORE – 641 018.
DEPARTMENT OF COMPUTER APPLICATIONS

MCA – SCHEME OF EXAMINATIONS: CBCS PATTERN

(For the students admitted from Academic year 2023-2024)

Subject Code	Title of the Paper	Hrs. (Wk.)	Max. Internal Marks	Max. External Marks	Total Marks	External Marks for pass	Total Pass Marks	Credits
Semester – I								
23MCA11C	Object Oriented Programming with C++	4	25	75	100	38	50	3
23MCA12C	Relational Database Management System	4	25	75	100	38	50	3
23MCA13C	Computer Organization and Architecture	4	25	75	100	38	50	3
23MCA14C	Data Structures and Algorithms	4	25	75	100	38	50	3
23MCA15C	Operating Systems	4	25	75	100	38	50	3
23MCA16P	Practical – I: C++ Programming Lab	5	40	60	100	30	50	4
23MCA17P	Practical – II: RDBMS Lab	5	40	60	100	30	50	4
		30			700			23
Semester –II								
23MCA21C	Python Programming	4	25	75	100	38	50	3
23MCA22C	Java Programming	4	25	75	100	38	50	3
23MCA23C	Computer Networks	4	25	75	100	38	50	3
23MCA24C	Digital Image Processing	4	25	75	100	38	50	3
23MCA25C	Probability and Statistics	4	25	75	100	38	50	3
23MCA26P	Practical – III: Python Programming Lab	5	40	60	100	30	50	4
23MCA27P	Practical – IV: Java Programming Lab	5	40	60	100	30	50	3
		30			700			22

Semester- III								
23MCA31C	Big Data Analytics and R Programming	5	25	75	100	38	50	3
23MCA32C	Mobile Applications Development	5	25	75	100	38	50	3
23MCA33C	Cryptography and Network Security	5	25	75	100	38	50	3
23MCA34E	Elective 1:	5	25	75	100	38	50	4
23MCA35P	Practical – V: R Programming Lab	5	40	60	100	30	50	5
23MCA36P	Practical – VI: Mobile Applications Development Lab	5	40	60	100	30	50	5
		30			600			23
Semester-IV								
23MCA41E	Elective 2	4	25	75	100	38	50	4
23MCA42E	Elective 3	4	25	75	100	38	50	4
23MCA43P	Practical – VII: Software Development and Testing Lab	5	40	60	100	30	50	5
23MCA44V	Project and Viva Voce	17	40	160	200	80	100	9
		30			500			22
Total / Credit					2500			90

GOVERNMENT ARTS COLLEGE (*Autonomous*), COIMBATORE – 641 018.

DEPARTMENT OF COMPUTER APPLICATIONS

ELECTIVES – FOR SEMESTER III and IV

Elective – I:	
1.1	IoT ARCHITECTURE AND PROTOCOLS
1.2	MULTIMEDIA AND ITS APPLICATIONS
1.3	SOFTWARE ENGINEERING CONCEPTS
Elective – II:	
2.1	OPEN-SOURCE TECHNOLOGY (PHP/MYSQL)
2.2	WEB PROGRAMMING ESSENTIALS
2.3	INFORMATION RETRIEVAL TECHNIQUES
Elective – III:	
3.1	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
3.2	MACHINE LEARNING
3.3	CLOUD COMPUTING

BRIDGE COURSE FOR MCA
(FOR STUDENTS ADMITTED FROM 2023-2024 ONWARDS)

TOTAL: 60 HOURS

The objective of bridge course is to provide the fundamental concepts and Practical knowledge about Computer Science and its Applications for students admitted from Non – Computer streams [with Mathematics at UG level or +2.].

Sub Code	Subject Name	Theory Hrs.	Practical Hrs.
BR1	C Programming	10	20
BR2	Computer Graphics and Multimedia	10	20
	Total hours	20	40

SUB CODE: BR1
C PROGRAMMING (THEORY) (10 HOURS)

- History and the importance of C as System programming and application programming -Variables, datatypes, operators and built- in functions.
- Input / Output statements, Control, escape sequences - Control structures - IF then else, Else if Ladder, Switch case statements.
- Iteration- Loops – For loop, while, do while.
- Arrays, Structures, Union, Files.

C PROGRAMMING LAB (PRACTICALS) (20 HOURS)

1) Develop a program in C for generating Fibonacci Series.
2) Develop a program in C for printing n Prime numbers.
3) Develop a program in C for generating Palindrome number.
4) Develop a program in C for finding Factorial of a number.
5) Develop a program in C to find Sum of Digits.
6) Develop a program in C to Reverse a Number.
7) Develop a program in C to find the factorial of a number using recursion.
8) Develop a C program to sort the given list of numbers in an array.
9) Develop a C Program to implement file operations

SUB CODE: BR2
COMPUTER GRAPHICS AND MULTIMEDIA (10 HOURS)

- Output Primitives - Attributes of output Primitives - 2D Transformations
- Multimedia- Text – Audio – Video

COMPUTER GRAPHICS AND MULTIMEDIA LAB (20 HOURS)

1) Develop a program to implement 2D Transformations such as Translation, Rotation and Scaling.
2) Develop a program to Draw Lines using DDA.
3) Create and move an object with sound effects.
4) Create an object and animate it using Photoshop.
5) Create a web page using Photoshop.

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA11C	OBJECT ORIENTED PROGRAMMING WITH C++	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe the basic concepts of Object-Oriented programming
2	Identify the classes, objects, members of a class and the relationships among them to solve a specific problem
3	Illustrate the concept of constructors and destructors and describe the mechanism of overloading the operators.
4	Examine the concept of data encapsulation, inheritance and function templates as used in C++ programming language.
5	Discover the commonly used operations in the files.

Unit - I

Principles of Object-Oriented Programming: Software Crisis – Software Evolution – Procedure Oriented Programming – Object Oriented Programming Paradigm – Basic concepts and benefits of OOP – Object Oriented Language – Application of OOP – Structure of C++ – Applications of C++. Tokens, Expressions and Control Structures: Operators in C++ – Manipulators.

Unit - II

Functions in C++: Function Prototyping – Call by Reference – Return by Reference – Inline Functions – Default, Const arguments – Function Overloading – Friend and Virtual Functions. Classes and Objects: – Member Functions – Nesting of Member Functions – Private Member Functions – Memory Allocation for Objects – Static Data Members – Static Member Functions – Array of Objects – Objects as Function Arguments – Friendly Functions – Returning Objects – Const Member Functions – Pointer to Members.

Unit – III

Constructors: Parameterized Constructors – Multiple Constructors in a Class – Constructors with Default Arguments – Dynamic Initialization of Objects – Copy and Dynamic Constructors – Destructors. Operator Overloading: Overloading Unary and Binary Operators – Overloading Binary Operators using Friend Functions – Overloading the Extraction and the Insertion Operators.

Unit – IV

Inheritance: Defining Derived Classes – Single Inheritance – Making a Private Member Inheritable – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Virtual Base Classes– Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

Unit - V

Streams: String I/O – Character I/O – Object I/O – I/O with Multiple Objects – File pointers – Disk I/O with member functions. Exception Handling – Templates – Redirection – Command Line Arguments.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

• Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1.	E. Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Galgotia, Publications Pvt. Ltd., 2000.
2.	Herbert Schildt, "C++: The Complete Reference", McGraw Hill Inc., 1997.
3.	Stanley B. Lippman, "Inside the C++ Object Model", Addison Wesley, 1996.
FURTHER READING:	
1	C++ programming : From Problem Analysis to Program Design / C plus plus programming. : Malik, D S. Course Technology, Boston, MA : 2009. Fourth Edition.
2	C++ programming cookbook Herb Schildt's C++ programming cookbook / C++ (Computer program language) , Schildt, Herbert. McGraw-Hill, New York: c2008.
3	C++ common knowledge : essential intermediate programming/ C++ (Computer program language) , Dewhurst, Stephen C. Addison-Wesley, Upper Saddle River, N. J.: 2005.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.learncpp.com/
2	https://www.toptal.com/c/the-ultimate-list-of-resources-to-learn-c-and-c-plus-plus
3	https://www.programiz.com/cpp-programming
4	https://www.edx.org/learn/c-plus-plus

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓			✓
	PLO-9	✓	✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA12C	RELATIONAL DATABASE MANAGEMENT SYSTEM	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the basic concepts of DBMS.
2	Employ the conceptual and relational models to design large database systems
3	Understand and analyse of E-R model and design
4	Apply normalization steps in database design and removal of data anomalies
5	Understand the architecture associated with DBMS

Unit - I

Introduction - Database system applications - purpose of database system - View of data - Database Languages - Relational Databases - Database Design - Data Storage and Querying - Transaction Management - Database Architecture - Database Users and Administrators.

Unit - II

Relational Databases - Relational Model - Structure of Relational Databases - Fundamental Relational Algebra Operations - Additional Relational Algebra Operations. SQL - Background - Data Definition - Basic Structure of SQL Queries - Set Operations - Aggregate Functions - Null values - Nested Sub queries - Views - Modification of the Database.

Unit – III

Database design: Database Design and the E - R Model - Design Phases - Design Alternatives - The Entity Relationship Model - Constraints - Entity Relationship Diagrams - Extended E - R features - Specialization - Generalization - Aggregation - Reduction to Relational Schemas.

Unit – IV

Relational Database Design - Features of Good Relational Designs - Atomic Domains and First Normal Form - Decomposition using Functional Dependencies - Keys and Functional Dependencies – Boyce Codd Normal Form - BCNF and Dependency Preservation - Third Normal Form - Functional Dependency Theory - Lossless Decomposition - Dependency Preservation - BCNF Decomposition Algorithm - 3NF Decomposition - Multivalued Dependencies - Fourth Normal Form - 4NF Decomposition.

Unit - V

Database System Architectures - Centralized and Client / Server Architectures - Centralized Systems - Client / Server Systems - Server System Architectures - Parallel Systems - Distributed Systems - Network Systems.

PEDAGOGY STRATEGIES

- Lecturing

• Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Database System Concepts" by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Fifth
2	"An Introduction to Database Systems "by Bipin c. Desai, West Publishing Company, 1990.
3	"Database Management Systems" by Elmasri and Navathe.
FURTHER READING:	
1	Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
2	Fundamentals of Database System By Elmasari &Navathe- Pearson Education
3	Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, 4thEdition, 2005, Elsevier India Publications, New Delhi
4	Fundamentals of Database Management System – Gillenson, Wiley India
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/projects/introduction-to-relational-database-and-sql
2	https://www.edx.org/learn/relational-databases
3	https://www.udemy.com/course/sql-and-rdbms/
4	https://www.classcentral.com/course/swayam-data-base-management-system-9914

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8					✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA13C	COMPUTER ORGANIZATION AND ARCHITECTURE	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe basic organization of computer
2	Understand the combination logic and sequential logic
3	Demonstrate and perform computer arithmetic operations and Logic Operations
4	Identify and compare different methods for computer I/O mechanisms
5	Categorize memory organization and explain the function of each element of a memory hierarchy

Unit - I

Binary Systems: Digital Computers and Digital systems – Binary Numbers – Number Base Conversions – Octal and Hexadecimal number – Complements – Binary codes. **Boolean Algebra and Logic Gates:** Basic Definition – Axiomatic Definition of Boolean Algebra – Basic Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard forms – Other Logic Operations – Digital Logic Gates – Simplifications of Boolean Function.

*(**Book 1**| Chapter 1, 2)*

Unit - II

Combinational Logic: Introduction – Design Procedure – Adders – Subtractors – Code Conversions – Multiplexer – Demultiplexer – Encoder – Decoder. **Sequential Logic:** Introduction – FlipFlops: Triggering Flip-flop. – Excitation Tables. **Registers and Counters:** Registers – Shift Registers- Ripple Counters – Synchronous Counters – Timing Sequences.

*(**Book 1**| Chapter 4 ,5, 6)*

Unit – III

Register Transfer Logic: Introduction – Arithmetic, Logic and Shift Micro-operations – Fixed Point Binary data – Arithmetic Shifts – Instruction Codes. **Micro Computer System Design:** Introduction – Instructions and Addressing modes – Stack, Subroutines and Interrupt – Input-Output interface – Direct Memory Access.

*(**Book 2**| Chapter 4, 2)*

Unit – IV

CPU Organization: General Register Organization – Types of Interrupts – RISC. **Pipeline and Vector Processing:** Parallel Processing – Pipelining – Array Processors – Performance of a processor. **InputOutput Organization:** Peripheral Devices – Asynchronous Data Transfer (Strobe & Handshaking Method) – Modes of Transfer – Priority Interrupt – IOP.

*(**Book 2**| Chapter 8, 9, 11).*

Unit - V

Memory Organization: Types of Memory – Memory Hierarchy – Main Memory – Memory interface to CPU – Associative Memory – Cache Memory: Cache mapping schemes – Virtual

Memory. *(**Book 2**| Chapter 12)*	
PEDAGOGY STRATEGIES • Lecturing • Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Morris Mano M, "Digital Logic and Computer Design", Pearson Education, 2016.
2	Morris Mano M, "Computer System Architecture", Pearson Education, 2012.
3	John Patrick Hayes, "Computer Architecture and Organization", Tata McGraw Hill, 2007.
4	Albert Paul Malvino, Donald P. Leach, "Digital Principles and Applications", Tata McGraw Hill, 2002.
FURTHER READING:	
1	Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2	William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3	Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson, Education Inc
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://www.edx.org/learn/computer-architecture
3	https://www.udemy.com/topic/computer-architecture/
4	https://www.coursera.org/learn/comparch\
5	https://nptel.ac.in/courses/106/103/106103068/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓	✓	✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA14C	DATA STRUCTURES AND ALGORITHMS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Ability to analyse the performance of algorithms using different
2	Ability to understand asymptotic notations.
3	Analyze problem and propose solution by selecting appropriate data structures like stacks, Queues, Linked List, Trees, Graphs, Hash Tables.
4	Demonstrate different methods for traversing trees and graph applications
5	Design and implement an appropriate hashing function and sorting techniques for an application

Unit - I

Introduction: Algorithmic Notation – Programming Principles – Creating Programs – Analyzing Programs. **Arrays:** One Dimensional Array – Multidimensional Array – Pointer Arrays. **Searching:** Linear Search – Binary Search – Fibonacci Search.
*(**Book 1** | Chapter 1; **Book 2** | Chapter 2, 11)*

Unit - II

Stacks: Primitive operations – Application of stacks. **Queues:** Primitive operations – Priority queues – Dequeues – Applications. **Linked list:** Singly Linked List – Doubly Linked List – Circular Linked List – linked stacks – Linked queues – Applications of Linked List – Dynamic storage management.
*(**Book 2** | Chapter 3, 4, 5)*

Unit – III

Trees: Binary tree – Terminology – Representation – Traversal – Types – Applications. **Graph:** Terminology – Representation – Traversals – Applications: Spanning Trees, Shortest Path and Transitive Closure, Topological Sort. **Sets:** Representation – Operations on Sets – Applications.
*(**Book 2** | Chapter 7, 8, 9)x*

Unit – IV

Tables: Symbol tables – Hash tables. **Sorting techniques:** Internal and External sorting: Insertion Sort – Selection Sort – Shell Sort – Bubble Sort – Quick Sort – Heap Sort – Merge Sort – Radix Sort.
*(**Book 1** | Chapter 9; **Book 2** | Chapter 6, 10)*

Unit - V

Files: Queries – Sequential Organization – Index Techniques. **B Trees:** B Tree Indexing – Operations on a B Tree – Lower and Upper Bounds of a B Tree. – B+Tree Indexing – Trie Tree Indexing. *(**Book 1** | Chapter 10; **Book 2** | Chapter7)*

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Ellis Horowitz and Sartaj Sahni "Fundamentals of Data Structures" Galgotia Book Source, Pvt. Ltd., 2004.
2	D. Samanta, "Classic Data Structures", Prentice-Hall of India, Pvt. Ltd.,
3	Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in C", Prentice-Hall of India, Pvt. Ltd., Second edition, 2007.
4	Jean Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw-Hill, Second edition, 2001.
5	Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Pearson Education, Second edition, 2006.

FURTHER READING:

1	Data structures: A Pseudocode Approach with C, 2nd edition,
2	R.F.GilbergAndB.A.Forouzan, CengageLearning.
3	Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
4	Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
5	Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/specializations/data-structures-algorithms
2	https://www.geeksforgeeks.org/data-structures-and-algorithms-online-courses-free-and-paid/ https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java/
3	https://www.codingninjas.com/courses/onlline-c-plus-plus-course

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA15C	OPERATING SYSTEMS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Illustrate the role of resource management, interfaces and system calls as handled by the operating system.
2	Apply the process scheduling algorithms to select the processes for execution and compare their performances.
3	Describe and analyze the memory management and its allocation methods.
4	Identify the storage management methods with respect to different storage management techniques.
5	Describe and analyze the basic concepts of Linux, IPC, Security.

Unit - I

Introduction: What is an OS - Mainframe systems - Desktop systems - Multiprocessor systems - Distributed systems - Clustered systems - Real-Time systems. **Operating system structures:** Systems components - OS services - System calls - System Programs - Systems structure - Virtual machines - System Design & Implementation - System Generation.
(Chapter 1, 3)

Unit - II

Process Management: Process concept - Process scheduling - Operations on process - Cooperating process - Inter-process communication. **CPU scheduling:** Scheduling criteria - Scheduling algorithms - Multiple-processor Scheduling - Real-Time Scheduling. **Deadlocks:** Deadlock characterization - Methods for handling Deadlocks - Deadlocks prevention - Deadlock avoidance - Deadlock detection - Recovery from Deadlock.
(Chapter 4, ,6, 8)

Unit – III

Memory Management: Background - Swapping - Contiguous memory allocation - Paging - Segmentation - Segmentation with paging. **Virtual memory:** Demand paging - Process creation - Page replacement - Allocation of frames - Thrashing. ***(Chapter 9, 10)***

Unit – IV

I/O Systems: Disk structure - Disk scheduling - Disk management - Swap - Space management. **File systems:** File concept - Access methods Directory structure - File system structure - File system implementation - Directory implementation - Allocation methods - Free space management.
(Chapter 11, 12, 14)

Unit - V

CASE STUDY: Linux: Design Principles - Kernel modules - Process management, scheduling - Memory management - File systems - Input & Output - Inter-process Communication

- Network structure - Security. ***(****Chapter 20****)***
PEDAGOGY STRATEGIES • Lecturing • Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback

REFERENCES:	
1	Silberschatz, Galvin, Gagne, "Operating Systems Concepts", Sixth Edition, John Wiley & Sons, 2013.
2	Tanenbaum, "Operating systems: Design & Implementation", PHI, Second Edition, 1998.
3	Deital, "Operating Systems", Pearson Education Asia, Second Edition, 2001.
4	D. M. Dhamdhere, "System Programming and Operating Systems", TMH, 2000.
FURTHER READING:	
1	Operating Systems - Internals and Design Principles. Stallings, 6th Edition-2009. Pearson education.
2	Modern Operating Systems, Andrew S Tanenbaum 3rd edition PHI.
3	Principles of Operating Systems, B.L.Stuart. Cengage learning, India Edition.
4	Operating Systems. A.S. Godboie.2nd Edition, TMH
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.javatpoint.com/os-tutorial
2	https://www.studytonight.com/operating-system/
3	https://hackr.io/tutorials/learn-operating-systems
4	https://www.udemy.com/courses/it-and-software/operating-systems/
5	https://www.lynda.com/Operating-Systems-training-tutorials/36-0.html
6	https://www.ohotraining.com/operating-system-online-training/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓	✓	✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓		✓
	PLO-9	✓	✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA16P	PRACTICAL – I: C++ PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Construct classes incorporating the object-oriented techniques to solve the problems.
2	Implement Object Oriented Programming Concepts in C++.
3	Identify the dynamic memory management techniques using pointers, constructors and destructors
4	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism.
5	Illustrate and implement files, exceptions to handle errors for object-oriented programs.

LIST OF PROGRAMS:

1. Implement a C++ Program using Operator Overloading Functions.
2. Implement a C++ Program using Function Overloading.
3. Implement a C++ Program using Default Arguments.
4. Implement a C++ Program using Functions with Call by Value.
5. Implement a C++ Program using Functions with Call by Reference.
6. Implement a C++ Program using Constructors and Destructors.
7. Implement a C++ Program using Exception Handling.
8. Implement a C++ Program using Type Conversion.
9. Implement a C++ Program using String Manipulation Functions.
10. Implement a C++ Program using Friend Functions.
11. Implement a C++ Program using Inheritance.
12. Implement a C++ Program using Files.
13. Implement a C++ Program using Pointers.
14. Implement a C++ Program using Templates.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8					✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	I	23MCA17P	PRACTICAL – II: RDBMS LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand underlying concepts of database technologies
2	Create and populate a RDBMS, using SQL.
3	Write queries in SQL to retrieve any type of information from a data base.
4	Understand, analyze, and apply common SQL Statements including DDL, DML and DCL statements to perform different operations
5	Analyze and Select storage and recovery techniques of database system.

LIST OF PROGRAMS:

1. DDL & DML – Data Types, Create, Alter, Drop table, Integrity constraints.
2. Insert, Delete and Update commands.
3. DCL & TCL – Grant, Revoke, Rollback and Commit.
4. Select command with operators like arithmetic, comparison, logical, order by, group by etc.
5. SQL Functions – date, numeric, character, conversion, avg, max, min, sum, count.
6. Set operations – union, intersect and minus.
7. Join query concept – simple, equi, non-equi, self, outer join.
8. Complex and sub queries.
9. Database objects – view, synonym, index, sequence – create, alter and drop.
10. Report writer using SQL.
11. PL/SQL – Introduction – character set, data types – execution.
12. PL/SQL attributes %type, %row type, function comparison, if condition, loop, for, while and goto etc.
13. Record management using cursors.
14. Function – definition and implementation.
15. Database triggers – syntax, parts and types of triggers.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓	✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓			
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA21C	PYTHON PROGRAMMING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
2	Express proficiency in the handling of Functions.
3	Express proficiency in the handling of strings and List.
4	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Unit - I

Introduction to Python: Python Overview - Getting Started with Python - Python Identifiers - Reserved Keywords - Variables - Standard Data Types - Operators. Statement and Expression - String Operations - Boolean Expressions - Control Statements - Iteration - while Statement - Input.

Unit - II

Functions: Introduction - Built-in Functions - Composition of Functions - User Defined Functions – P`2fqaarameters and Arguments - Function Calls. The Return Statement - Python Recursive Function- The Anonymous Functions - Writing Python Scripts.

Unit – III

Strings: Strings - Compound data types - len function - String slices - String traversal - String formatting operators and functions. Lists: Values and accessing elements - lists are mutable - Traversing and deleting elements - Built-in operators and methods.

Unit – IV

Tuples: Creating tuples-accessing values - tuples assignment - tuples as return values - variable length argument tuples - basic tuple operations - built-in tuple functions. Dictionaries: Creating and accessing a dictionary - updating and deleting - properties of dictionary keys - operations and built-in dictionary methods. Exceptions: Exceptions with Arguments - User-Defined Exceptions.

Unit - V

Classes and Objects: Overview of OOP (Object-Oriented Programming) - Class Definitions - Creating Objects-Objects as Arguments - Objects as Return Values - Built-in Class Attributes – Inheritance - Method Overriding.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning

• Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	E. Balagurusamy, "Introduction to Computing and Problem-Solving Using Python", McGraw Hill Education Private Limited, New Delhi.
2	Mark Lutz, David Ascher, "Learning Python", Shroff Publishers & Distributors Private Limited,2009.
FURTHER READING:	
1	Starting Out with Python (2009) Pearson , Tonny Gaddis
2	Beginning Pyhton Wrox Publication Peter Norton, Alex Samuel
3	Python Algorithms Apress, Magnus Liet Hetland,
4	Python Object Oriented Programming PACKT Press, Dusty Phillips
5	Python for Unix and Linux System Administration O'Relly, Noad Gif
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.python.org/about/gettingstarted/
2	https://www.learnpython.org/
3	https://www.programiz.com/python-programming
4	https://mikkegoes.com/learn-python-online-best-resources/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3	✓		✓	✓	
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓	✓	✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA22C	JAVA PROGRAMMING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Knowledge of the structure and model of the Java programming language
2	Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem
3	Write Java programs to implement error handling techniques using exception handling
4	Develop the skills to apply java programming in problem solving and design GUI based applications
5	Develop software in the Java programming language

Unit - I

The Genesis of Java - The Java class Libraries - Data types, Variables - Operators - Arrays. Control Statements: Selection statements - Iteration statements - Jump statements. Introducing classes: Class Fundamentals - Declaring objects - Methods.

Unit - II

Constructors - this keyword - Garbage collection. Overloading Methods - Access controls - Nested and Inner classes. Inheritance: Inheritance basics - using Super - Method overriding - Dynamic method Dispatch - Abstract classes - using final with inheritance. Packages and Interfaces: Packages - Access protection - Importing Packages - Interfaces.

Unit – III

Exception Handling: Exception Handling Fundamentals - Java's Built in Exceptions - creating own Exception subclasses. Multithreaded Programming: The Java Thread Model - Creating a Thread - Synchronization - Inter Thread communication.

Unit – IV

I/O Basics - Reading console Input -Writing Console Output - Reading and writing Files - Exploring java.io. Applet Fundamentals - Applet Basics - Introducing the AWT.

Unit - V

Software Development using Java: Java Beans introduction - Servlets: Life cycle - A simple servlet - servlet API - Handling HTTP Request and Responses - Session tracking. Networking Basics - Remote Method Invocation (RMI) - Accessing Database with JDBC.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Herbert Schildt, "The Complete Reference Java 2", 2nd Ed, Tata McGraw Hill (I) Pvt. Ltd.,2002.
2	H.M. Deitel and P. J. Deitel, "Java How to Program", 6th Ed, PHI/Pearson Education Asia 2005.
3	Keyur shab, "Java 2 Programming", Tata McGraw-Hill pub. Company Ltd.
4	C. Xavier, "Programming with Java 2", SciTech Publications (India) Pvt. Ltd.
5	Cays S. Horstmann, Gary Cornell, "Core Java2 Volume I- Fundamentals", Person Edition, 2001.
6	Cays S. Horstmann, Gary Cornell, "Core Java2 Volume II - Fundamentals", Person Edition, 2003.
FURTHER READING:	
1	Head First Java, O'rielly publications
2	T. Budd (2009), An Introduction to Object Oriented Programming, 3rd edition, PearsonEducation, India.
3	J. Nino, F. A. Hosch (2002), An Introduction to programming and OO design using Java, John Wiley & sons, New Jersey.
4	Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education, India
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.codecademy.com/learn/learn-java
2	https://www.learnjavaonline.org/
3	https://www.udemy.com/topic/java/
4	https://www.classcentral.com/course/udacity-java-programming-basics-6686

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	
	PLO-9		✓	✓		✓
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA23C	COMPUTER NETWORKS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe the functions of each layer in OSI and TCP/IP model
2	Explain the functions of physical layer paradigms and Protocols
3	Apply the knowledge of error correction and detection algorithms; understand data link layer
4	Understand the IP protocols.
5	Understand and analyze application layer protocols, internet routing protocols, and transport layer protocols.

Unit - I

Introduction: Use of computer networks - Network Hardware - Network Software - Reference models - Example of networks.

Unit - II

The Physical Layer: The Theoretical basis for data communication - Guided transmission Media - Wireless transmission - Communication satellites - The Public switched Telephone network - Cable Television - Mobile telephone system.

Unit – III

Data Link Layer: Data link layer design issues - Error detection and correction - Elementary data link protocols - Sliding window protocols -Example data link Protocols.

Unit – IV

Network Layer: Network layer design issues - Routing algorithms - Congestion, Control algorithms - Quality of service - Internetworking - Network layer in the internet.

Unit - V

Transport Layer: The transport service - Elements of transport protocol - A simple transport protocol - The internet Transport Protocols: UDP - The Internet Transport Protocols: TCP.

Application Layer: DNS - Electronic mail: The World Wide Web- Basics of Network Security.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Andrew S. Tanenbaum, "Computer Networks", 2012, Pearson Education,
2	P. Green - Computer Network Architectures and Protocols, Plenum Press, 1982.
3	Harry Katzan - An Introduction to "Distributed Data Processing", A Petrocelli Book, New York / Princeton.
4	Tittel - Theory and Problems of Computer Networking, Schaum's outline series, TMH.
5	Godbole - Data Communication & Networking, TMH.
6	Leon Garcia - Communication Networks: Fundamental Concepts & Key Architecture, TMH.
FURTHER READING:	
1	An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education
2	Understanding communications and Networks,3rd Edition, W.A.Shay,Cengage Learning.
3	Computer and Communication Networks ,Nader F. Mir, Pearson Education
4	Computer Networking:A Top-Down Approach Featuring the Internet,James F.Kurose,K.W.Ross,3rd Edition,Pearson Education.
5	Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH,2006.
6	An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
2	https://www.omnisecu.com/basic-networking/index.php
3	https://www.udemy.com/topic/computer-network/
4	https://www.edx.org/learn/computer-networking
5	https://www.udacity.com/course/computer-networking--ud436

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA24C	DIGITAL IMAGE PROCESSING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Remember the fundamental concepts of Image Processing
2	Explain different Image enhancement techniques
3	Understand and review image transforms
4	Analyze the basic algorithms used for image processing &image compression with morphological image processing.
5	Understand Image processing applications in python.

Unit - I

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels.

Unit - II

Image Enhancement in the Spatial Domain: Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters.

Unit – III

Color Image Processing: Color Fundamentals - Color Models - Pseudo color Image Processing - Color Transformations – Smoothing and Sharpening -Color Segmentation - Noise in Color Images.

Unit – IV

Morphological Image processing: Preliminaries-Dilation and Erosion-Opening and Closing-The Hit-or-Miss Transformation-Some Basic Morphological Algorithms. Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary detection – Thresholding – Region-Based segmentation- Segmentation by Morphological watersheds.

Unit - V

Image Processing with OpenCV - Python: Introduction to OpenCV – Python - OpenCV GUI - Basic operations on Images - Arithmetic operations on Images – Image Processing in OpenCV: Changing Color Spaces- Geometric Transformation of Images – Smoothing Images – Morphological Transformations- Image Gradients-Edge Detection – Contours – Histograms.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

• Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, PHI/Pearson Education.
2	Alexander M., Abid K., "OpenCV-Python Tutorials", 2017.
3	B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2003.
4	Nick Efford, "Digital Image Processing a practical introducing using Java", Pearson Education, 2004
FURTHER READING:	
1	Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
2	Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3	Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
4	John C.Russ, "The Image Processing Handbook", CRC Press,2007.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://eeweb.poly.edu/~onur/lectures/lectures.html.
2	http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3	https://www.coursera.org/learn/digital
4	https://www.classcentral.com/course/swayam-digital-image-processing-14005
5	https://onlinecourses.nptel.ac.in/noc19_ee55/preview

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA25C	CORE PAPER V – PROBABILITY AND STATISTICS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Distinguish between different types of probability concepts.
2	Demonstrate an understanding of the basic concepts of random variables.
3	Understand the concept of expectation and joint probability distribution of random variables.
4	Describe the main properties of probability distributions and its applications.
5	Distinguish different types of probability distributions with real life problems.
6	Understand and apply the test of significance concept for large and small sample theories.
7	Identify the applications of z-test, t-test and Chi-Square test with appropriate examples.

Unit - I

Probability - Basic Definitions - Mathematical Probability - Statistical Probability - Axiomatic Approach to Probability - Addition Theorem - Multiplication Theorem - Independent Events – Baye's Theorem - Simple Problems.

Unit - II

Random Variables - Discrete Random Variable - Probability Mass Function – Continuous Random Variable - Probability Density Function - Simple Problems.

Unit – III

Mathematical Expectation of a Random Variable – Properties of Expectation - Moment Generating Function - Joint Probability Distribution of Two-Dimensional Random Variables - Marginal and Conditional Distributions - Simple Problems.

Unit – IV

Discrete Distributions - Binominal and Poison Distributions - Results and it's Applications - Continuous Distributions – Rectangular (Uniform) and Normal Distributions - Results and it's Applications - Simple Problems. (No derivations).

Unit - V

Tests of Significance for Large Samples - Basic Definitions - Normal Test of Single Mean and Difference of Means - Tests of Significance for Small Samples - t-Test for Single Mean and Difference of Means - Chi-Square Test for Independence of Attributes.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Gupta, S.C. and Kapoor, V.K. (2018) - Fundamentals of Mathematical Statistics, Sultan Chand &Sons, New Delhi, 11th revised Edition.
2	Hogg R.V and craig A.H. (2012) – Introduction to Mathematical Statistics, Seventh Edition, Pearson Education.
FURTHER READING:	
1	Kapoor J. N. and Sexena H. C. (2011) – Mathematical Statistics - Sultan Chand & Sons.
2	Gupta, S.P. (2014) - Statistical Methods, Sultan Chand & Sons, New Delhi, 44th Thoroughly Revised Edition.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/105/111105041/
2	https://nptel.ac.in/courses/111/106/111106112/
3	https://www.dcpehvpm.org/EContent/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5	CLO-6	CLO-7
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓	✓	✓
	PLO-2			✓	✓	✓		✓
	PLO-3							
	PLO-4		✓	✓		✓		✓
	PLO-5							
	PLO-6							
	PLO-7						✓	✓
	PLO-8	✓	✓			✓		✓
	PLO-9	✓				✓		✓
	PLO-10							

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA26P	PRACTICAL – III: PYTHON PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Write, Test and Debug Python Programs
2	Describe the Python language syntax including control statements, loops and functions to write programs for a wide variety problem in mathematics, science, and games.
3	Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
4	Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance.
5	Discover the capabilities of Python regular expression for data verification and utilize in-built functions to develop performance efficient Python programs.

LIST OF PROGRAMS:

1. Develop Python Program using standard input/output .
2. Develop Python Program using various operators.
3. Develop Python Program using control statements and iteration.
4. Develop Python Program Using Strings.
5. Develop Python Program Using Functions.
6. Develop Python Program Using Python Scripts.
7. Develop Python Program Using Lists.
8. Develop Python Program Using Tuples.
9. Develop Python Program Using Dictionaries.
10. Develop Python Program Using Exceptions.
11. Develop Python Program Using Classes and Objects.
12. Develop Python Program using Inheritance.
13. Develop Python Program using Method overriding.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓	✓		✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	II	23MCA27P	PRACTICAL – IV: JAVA PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Apply object-oriented programming, exception handling and multithreading concepts in problem solving.
2	Design and implement Applets, Parameterized Applets program and incorporating multithreading and event handling mechanisms.
3	Use of Swings aspects in graphical interactive application development and JDBC for database transactions, Handling HTTP requests and responses.
4	Develop applications using Socket connection and RMI and JSP.
5	Demonstrate the concepts of polymorphism and inheritance

LIST OF PROGRAMS:

1. **Develop Java Applications for the following:**
   a. Reverse and sum of individual digits of a given number (while, do...while and for loops)
   b. Arranging numbers in Ascending and Descending order (One Dimensional Array).
   c. Matrix Manipulation (Two Dimensional Arrays with switch statement).
2. **Classes and Objects:**
   a. Develop a Java application for finding the area and perimeter of a Rectangle. (Class).
   b. Develop a Java application for Pay-roll preparation. (Array of Objects).
3. **Inheritance:**
   a. Develop a Java application to implement inheritance concept.
4. **Interfaces and Packages:**
   a. Define an interface Area to find the area of the circle, area of the Rectangle and area of the Triangle.
   b. Prepare an Electricity Bill using the package concept.
5. **String Handling:**
   a. Develop a program to test the methods in String and String Buffer classes.
   b. Develop a program for arranging the given names in Alphabetical order.
6. **I/O Streams: Write java programs using stream for;**
   a. Displaying contents of the file.
   b. Copying files.
   c. Updating files.
7. **Multi-Threading Programs using:**
   a. Thread Class.
   b. Runnable Interface.
   c. Methods in the Thread Class.
8. **Networking: Write a server and client programs for sending and receiving text messages using:**
   a. Server Socket and Socket classes.
   b. Datagram Sockets.
9. **Exception Handling:**
   a. Develop a Java program to implement built-in exceptions.
   b. Develop a Java program to implement user-defined exceptions.

10. Swings:
a. Develop a Swing program to implement GUI components interactions with Event Handling.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	**CLO-2**	**CLO-3**	**CLO-4**	**CLO-5**
Program Level Outcomes (PLO)	**PLO-1**	✓	✓	✓	✓	✓
	PLO-2		✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓		✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓		✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA31C	BIG DATA ANALYTICS AND R PROGRAMMING	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2	Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
3	Design algorithms to analyze Big data like streams, Web Graphs and Health care data
4	Understand the basics in R programming in terms of constructs, control statements, string functions
5	Understand the use of R for Big Data analytics

Unit - I

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives –Association rule mining: Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various kinds of association rules.

Unit - II

Classification and Clustering: Classification and Prediction - Basic Concepts- Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation Cluster Analysis - Types of Data – Categorization of Major Clustering Methods– K-means-Partitioning Methods – Hierarchical Methods – Clustering High Dimensional Data-Constraint Based Cluster Analysis-Outlier Analysis – Data Mining Applications.

Unit – III

Big Data Analytics: Introduction to the Big Data Era – Description of Big Data – Industry Examples of Big Data – Descriptive power and predictive Pattern Matching – The Value of Data – Big Data Analytics – Architectures, Frameworks, and Tools – Big Data Analytics Methodology – Challenges-Big Data Analytics in Healthcare.

Unit – IV

Getting Started with R- R Nuts and Bolts - Getting Data in and Out of R - Using Textual and Binary Formats for Storing Data- Interfaces to the Outside World- Sub setting R Objects - Vectorized Operations - Managing Data Frames with the dplyr package.

Unit - V

Control Structures -Functions- Scoping Rules of R - Loop Functions- Debugging Tool in R- Profiling R Code- Simulation.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning

- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, 2007. (Unit I and II)
2	Stephan Kudyba Foreword by Thomas H.Davenport, "Big Data, Mining, and Analytics", CRC Press, 2015. (Unit III)
3	Roger D. Peng, "R Programming for Data Science" Lean Publishing, 2014. (Unit IV & V).
4	K.P. Soman, Shyam Diwakar and V. Ajay, "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
5	G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
6	Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, "A Beginner's Guide to R", Springer, 2009.

FURTHER READING:

1	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2	Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3	Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle REnterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4	ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
5	Big Data and Hadoop: Learn by Example by Mayank Bhushan

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/learn/r-programming
2	https://www.udemy.com/topic/r-programming-language/
3	https://www.futurelearn.com/courses/big-data-r-hadoop
4	https://tell.colvee.org/course/view.php?id=17

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9	✓		✓		✓
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA32C	MOBILE APPLICATIONS DEVELOPMENT	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand mobile devices and mobile platforms
2	Design User Interface and develop activity for Mobile App
3	knowledge concerning mobile operating systems and their architecture
4	Describe Android platform, Architecture and features
5	Design and implement Database Application and Content providers.

Unit - I

Introduction: Introduction to mobile applications - Importance of mobile applications – Strategies and challenges – Software and hardware requirements for developing mobile applications – Types of mobile applications – Benefits of creating mobile applications – Marketing and advertising mobile applications

Unit - II

Mobile User Interface Design: Mobile application users – Social aspect of mobile interfaces - Accessibility – Design patterns – Designing for the platforms.

Unit – III

Mobile Applications Architecture: Smart Client – Smart Client Architecture – Messaging Architecture – The Model-View-Controller Model - Delegate Pattern- Building Smart Client Applications-Design, Development, implementation, testing and deployment phase- MVVM mobile architecture design.

Unit – IV

Mobile Application Development: Introduction to Android Platform – Android architecture overview - Application life cycle - UI design for Android - UI fragments - Different types of layouts – Widgets – List view – View pager - Dialogs.

Unit - V

Database: Files and database – SQLite on Android – Loading asynchronous data - Map API.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Jeff McWherter and Scott Gowell , “Professional Mobile Application Development”, John Wiley & Sons, 2012.
2	Bill Philips, Kristin Marsicano and Chris Stewart, “Android Programming: The big Nerd Ranch guide”, O’Reilly, 2017.
3	Martyn Mallick, “Mobile and Wireless Design Essentials”, Wiley, 2003
4	Ronan Schwarz, Phil Dutson, James Steele and Nelson To, “The Android Developer's Cookbook - Building Applications with the Android SDK”, Addison Wesley, 2013.
5	Mark Murphy, “The Busy Coder's Guide to Android Development”, Commons Ware, 2009.
FURTHER READING:	
1	Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd
2	Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
3	Android Application Development All in one for Dummies by Barry Burd, Edition: I
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.edx.org/learn/app-development
2	https://www.fita.in/mobile-app-development-course/
3	https://www.udemy.com/courses/development/mobile-apps/
4	https://www.coursera.org/learn/android-app

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓		✓	✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓	✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA33C	CRYPTOGRAPHY AND NETWORK SECURITY	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields.
2	Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3	Apply network security basics, analyze different attacks on networks and evaluate the security protocols like SSL, IPSec, and PGP.
4	Evaluate the performance of Web security includes firewall
5	Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Unit - I

Introduction: OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security. Classical Encryption Techniques: Symmetric Cipher Model - Substitution Techniques - Transposition Techniques - Steganography. Block Cipher Principles - The Data Encryption Standard - the Strength of DES.

Unit - II

Advanced Encryption Standard: AES Structure - The AES Encryption and Decryption. Public-key Cryptography and RSA: Principles of Public-Key Cryptosystems - The RSA Algorithm -Security of RSA. Key Management - Diffie-Hellman Key Exchange –Key Exchange Protocols- Man in the Middle Attack- Elliptic Curve Cryptography.

Unit – III

Hash and MAC: Hash Functions – Applications of Cryptographic Hash functions- Secure Hash Algorithm. Message Authentication Codes -Authentication Requirements - Authentication Functions - Security of Hash Functions and MACs. HMAC Algorithms- Digital Signatures - Digital Signature Standard. Remote User authentication Principles-Authentication Applications: Kerberos – Version 4 Message exchanges-X.509 Authentication Service - Public-key infrastructure.

Unit – IV

E-mail Security: Pretty Good Privacy – Operational Description-S/MIME Functionality-Messages. IP Security: IP Security overview – Network and Internet Security :Web Security Considerations - Secure Socket Layer and Transport Layer Security - Secure Electronic Transaction.

Unit - V

System Security: Intruders - Intrusion Detection - Password Management. Malicious Software: Viruses and Related Threats - Virus Countermeasures-worms -Firewalls: Firewall Design Principles. Legal and Ethical Issues: Cyber crime and Computer Crime, Intellectual property. **Casestudy :** Current Trends in Network Security-Cyber security – Cloud Security.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	William Stallings, "Cryptography and Network Security", PHI/Pearson Education.
2	Bruce Schneir, "Applied Cryptography", CRC Press.
3	A.Menezes, PVanOorschotand , S.Vanstone,"Hand Bookof Applied Cryptography", CRC Press, 1997 (Free Downloadable).
4	Ankit Fadia, "Network Security", MacMillan.

FURTHER READING:

1	Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.
2	W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
3	Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India. 4. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
4	Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
5	Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.classcentral.com/course/swayam-cryptography-and-network-security-9896
2	https://onlinecourses.nptel.ac.in/noc21_cs16/preview
3	https://www.coursera.org/lecture/managing-network-cybersecurity/cryptography-and-network-security-w9SuJ
4	https://www.edx.org/learn/cryptography
5	https://www.udemy.com/topic/cryptography/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6					✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA35P	PRACTICAL – V: R PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Install and use R for simple programming tasks.
2	Extend the functionality of R by using add-on packages
3	Extract data from files and other sources and perform various data manipulation tasks on them.
4	Use R Graphics and Tables to visualize results of various statistical operations on Data
5	Able to appreciate and apply the R programming from a statistical perspective

LIST OF PROGRAMS:

1. Implement an R program for string operations.
2. Implement R program to combine two data frames into one.
3. Implement R program to take input from the user and display it.
4. Implement R program for the following: i) To check Armstrong number ii) To generate fibonacci sequence and iii)To find biggest of three numbers
5. Create a simple Bar plot for an application.
6. Implement R program for classification using decision tree.
7. Implement R program for clustering using K-Means.
8. Implement R program to create a data frame for an application.
9. Implement R program for Hierarchical clustering.
10. Implement R program for Linear Regression.
11. Implement R program for outlier detection.
12. Implement R program to visualize the data using histogram.
13. Implement R Program to visualize the data using Box plot.
14. Implement R program to visualize the data using Scatter plot.
15. Implement R program to implement vector operations.
16. Implement R program for Apriori Algorithm

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA36P	PRACTICAL – VI: MOBILE APPLICATIONS DEVELOPMENT LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Experiment on Integrated Development Environment for Android Application Development.
2	Design and Implement User Interfaces and Layouts of Android App.
3	Design and Implement Database Application and Content Providers
4	Develop Android App with Security features.
5	Apply essential Android Programming concepts.

LIST OF PROGRAMS:

1. SDK installation and develop an Android application for displaying a welcome message.
2. Android application to add numbers using single activity.
3. Android application for student information system using table layout.
4. Android application for multiple activities using explicit intent.
5. Android application to create a widget to change font size and color.
6. Android application to display items in grid using Toast Notification.
7. Android application for saving and retrieving information using shared preferences.
8. Android application for implementing data manipulation using SQLite Database.
9. Android application for currency conversion.
10. Android application to create a login form.
11. Android application to manipulate an image.
12. Android application to draw graphical primitives.
13. Android application to generate captcha.
14. Android application to implement form Validation.
15. Android application to check palindrome.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓		✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓	✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	IV	23MCA43P	PRACTICAL – VII: SOFTWARE DEVELOPMENT AND TESTING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Develop software in C #
2	Propose the use of certain technologies by implementing them in the C # programming language to solve the given problem
3	Create and manipulate GUI components in C#
4	Apply in-built and create user defined functions in PHP programming.
5	Design and Develop a website using form controls for presenting web based content.

LIST OF PROGRAMS:

1. Implement a C# program to perform arithmetic operations.
2. Implement a C# program to Calculate nCr and nPr values.
3. Implement a C# program to Find the area and circumference of circle.
4. Implement a C# program to implement the Student details using inheritance.
5. Implement a C# program Sales bill preparation using interface.
6. Implement a C# program to display the clock time using delegates and events.
7. Implement a C# program to find the area of square, triangle, and rectangle using method overloading.
8. Implement a C# program to Pass values from one form to another form.
9. Implement a C# program to implement Calculator.
10. Write a PHP program to validate the Textbox.
11. Write a PHP program to draw different shapes.
12. Write a PHP program using MySQL table.
13. Write a PHP program to perform string manipulation.
14. Write a PHP program to check user login.
15. Write a PHP program to check student grade based on marks.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓			✓
	PLO-3	✓				✓
	PLO-4	✓	✓	✓	✓	
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓		✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	IV	23MCA44V	PROJECT AND VIVA VOCE	17

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Discover potential research areas in the field of IT
2	Conduct a survey of several available literature in the preferred field of study
3	Demonstrate an ability to work in teams and manage the conduct of the research study
4	Formulate and propose a plan for creating a solution for the research plan identified
5	To report and present the findings of the study conducted in the preferred domain

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓		✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓			✓	
	PLO-6	✓	✓	✓	✓	✓
	PLO-7	✓	✓			✓
	PLO-8		✓		✓	
	PLO-9	✓				✓
	PLO-10	✓	✓	✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 Onwards	III	23MCA34E	ELECTIVE 1.1: IoT ARCHITECTURE AND PROTOCOLS	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe the Internet of Things and its Architecture.
2	Discuss the architecture, operation, and business benefits of an IoT solution.
3	Examine the potential business opportunities that IoT can uncover.
4	Justify the relationship between IoT, cloud computing, and big data.
5	Identify how IoT differs from traditional data collection systems.

Unit - I

OVERVIEW

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

Unit - II

REFERENCE ARCHITECTURE:

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Unit – III

IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS:

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP.

Unit – IV

TRANSPORT & SESSION LAYER PROTOCOLS:

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

Unit - V

SERVICE LAYER PROTOCOLS & SECURITY:

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer.

PEDAGOGY STRATEGIES

- Lecturing

• Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "**From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence**", 1 st Edition, Academic Press,2014.
2	Peter Waher, "**Learning Internet of Things**", PACKT publishing, 2015.
3	Bernd Scholz-Reiter, Florian Michahelles, **"Architecting the Internet of Things**", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2,Springer.
4	Daniel Minoli, "**Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications**", ISBN: 978-1-118- 47347-4, WileyPublications,2013.
5	Vijay Madisetti and Arshdeep Bahga, "**Internet of Things (A Hands-onApproach)**", 1 st Edition, VPT, 2014.
FURTHER READING:	
1	Raj Kamal , **"Internet of Things : Architecture and Design Principles"** , First edition, Tata McGraw Hill Education, 2017.
2	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
3	CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/specializations/iot
2	https://online.stanford.edu/courses/xee100-introduction-internet-things
3	https://www.udemy.com/topic/internet-of-things/
4	https://www.futurelearn.com/courses/internet-of-things
5	https://nptel.ac.in/courses/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 Onwards	III	23MCA34E	ELECTIVE 1.2: MULTIMEDIA AND ITS APPLICATIONS	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the basic concepts of Multimedia
2	Demonstrate Multimedia authoring tools
3	Analyze the concepts of Sound, Images, Video & Animation
4	Apply and Analyze the role of Multimedia in Internet and real time applications
5	Analyze multimedia applications using HDTV

Unit - I

What is Multimedia? – Introduction to making Multimedia – Macintosh and Windows Production platforms – Basic Software tools.

Unit - II

Making Instant Multimedia – Multimedia authoring tools – Multimedia building blocks – Text – Sound.

Unit – III

Images – Animation – Video.

Unit – IV

Multimedia and the Internet – The Internet and how it works – Tools for World Wide Web – Designing for the World Wide Web.

Unit - V

High Definition Television and Desktop Computing – Knowledge based Multimedia systems.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Tay Vaughan, “Multimedia making it work”, Fifth Edition, Tata McGrawHill.
2	John F. Koegel Bufford, “Multimedia Systems”, Pearson Education.

FURTHER READING:

1	Judith Jeffloate, “Multimedia in Practice (Technology and Applications)”, PHI,2003.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/multimedia/index.htm

2	https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm
3	https://nptel.ac.in/courses/117/105/117105083/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓		✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓	✓	✓
	PLO-8		✓		✓	
	PLO-9	✓	✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA34E	ELECTIVE 1.3: SOFTWARE ENGINEERING CONCEPTS	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe Software Engineering, Various models, Software Design, Software Development and Various Testing Strategies.
2	Discuss engineering layered technology and Process frame work.
3	Justify the role of project management including planning, scheduling, risk management, etc.
4	Analyze approaches to verification and validation including static analysis, and reviews.
5	Assess software testing approaches such as unit testing and integration testing.
6	Recommend quality control and how to ensure good quality software.

Unit - I

SOFTWARE ENGINEERING: Software Engineering – A Layered Technology – A Process Framework - CMMI – **PROCESS MODELS**: Prescriptive Models – The Waterfall Model – Incremental Process Model – Evolutionary Process Model - Specialized Process Model. **SYSTEM ENGINEERING:** The System Engineering Hierarchy. **REQUIREMENTS ENGINEERING**: Requirements Engineering Tasks – Initiating the Requirements Engineering Process.

Unit - II

BUILDING THE ANALYSIS MODEL: Requirements Analysis - Data Modeling Concepts- Flow Oriented Modeling. **DESIGN ENGINEERING**: Design Process – Design Concepts – Design Model. **ARCHITECTURAL DESIGN**: Software Architecture – Architectural Styles and Patterns - Architectural Design. **COMPONENT- LEVEL DESIGN:** Component – Designing Class Based Components. **UI DESIGN**: The Golden Rules - UI Analysis and Design.

Unit – III

METRICS FOR PROCESS AND PROJECTS: Metrics in the Process and Project Domains – Software Measurement – Metrics for Software Quality. **ESTIMATION FOR SOFTWARE PROJECT**: Resources – Decomposition Techniques. **PROJECT SCHEDULING**: Project Scheduling - Defining a Task Set for the Software Project.

Unit – IV

RISK MANAGEMENT: Software Risks – Risk Identification – Risk Projection. **QUALITY MANGEMENT:** Quality Concepts – Software Quality Assurance – Formal Technical Reviews – Software Reliability.
CHANGE MANAGEMENT: Software Configuration Management – The SCM Process.

Unit - V

SOFTWARE TESTING: A Strategic Approach to Software Testing – Test, Test Case and Test Suite – Verification and Validation – Alpha, Beta and Acceptance Testing – Functional Testing – Structural Testing – Levels of Testing – Validation Testing – The Art of debugging – Testing Tools.

PEDAGOGY STRATEGIES

- Lecturing

• Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback

REFERENCES:	
1.	Roger S. Pressman, "Software Engineering – A Practitioners Approach", 6th Edition , Tata McGraw Hill International, 2005. (UNITS: I, II, III &IV).
2.	K.K. Aggarwal, Yogesh Singh, "Software Engineering", 3rd Edition, New Age International Publishers, 2008. (UNIT:V).
3.	Ian Sommerville, "Software Engineering", Eighth Edition, Pearson Education, 2009.
4.	Srinivasan Desikan and Gopalasamy Ramesh, "Software Testing for Principles and Practices", Pearson Education , 2007.

FURTHER READING:	
1	Richard Fairley, "Software Engineering Concepts" Tata McGraw Hill Education ,2017.
2	https://nptel.ac.in/courses/106101061

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.w3schools.in/sdlc/software-development-life-cycle-sdlc
2	https://www.udemy.com/courses/development/software-engineering/
3	https://www.javatpoint.com/software-engineering-software-design-principles

COU

RSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes	PLO-1	✓	✓		✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3			✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/Week
2023-2024 onwards	IV	23MCA41E	ELECTIVE 2.1: Open Source Technology (PHP/MySQL)	4

1	Describe major elements of the PHP & MySQL work and justify why PHP is good for web development.
2	Describe how a static website be turned into a dynamic website to run from a database using PHP and MySQL.
3	Analyze the basic structure of a PHP web application and be able to install and maintain the web server, compile, and run a simple web application.
4	Design databases and use PHP MyAdmin to work with MySQL.
5	Propose the ways of connecting to MySQL through PHP, and how to manipulate tables how to Connect to SQL Server and other data sources.

Unit - I

Basic Syntax, Defining variable and constant, Php Data type, Operator and Expression.- Decisions and loop Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html.-. Function What is a function, Define a function, Call by value and Call by reference, Recursive function, String Creating and accessing, String Searching & Replacing String, Formatting String, String Related Library function.

Unit - II

Array Anatomy of an Array, Creating index based and Associative array Accessing array, Element Looping with Index based array, Looping with associative array using each () and for each(), Some useful Library function-Handling Html Form with Php Capturing Form, Data Dealing with Multi-value filed, and Generating File uploaded form, redirecting a form after submission.

Unit – III

Working with file and Directories Understanding file& directory, Opening and closing, a file, Coping, renaming and deleting a file, working with directories, Creating and deleting folder, File Uploading & Downloading- Session and Cookie Introduction to Session Control, Session Functionality.

Unit – IV

What is a Cookie, Setting Cookies with PHP.Using Cookies with Sessions, Deleting Cookies, Registering Session variables, Destroying the variables and Session.

Unit - V

Database Connectivity with MySql Introduction to RDBMS, Connection with MySql Database, Performing basic database operation(DML) (Insert, Delete, Update, Select), Setting query parameter, Executing query Join (Cross joins, Inner joins, Outer Joins, Self joins)

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	W Jason Gilmore “Beginning PHP and MySQl From Novice to professional” 4th EditionApress,2010.
2	Robin Nixon, “Learning PHP, MySQL, and java Script: A Step-By-Step Guide to Creating Dynamic Websites ”o'reillyPress,2021.

FURTHER READING:	
1	Luke Welling and Laura Thmsan, “ PHP and MySQL Web Development” Fifth edition , Pearson Education,2016.
2	Lokesh Gupta , “PHP and MySQL Web Development By Lokesh Gupta” 1st edition, Notion Press,2020.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/topic/php/
2	https://www.toptal.com/php/
3	https://www.javatpoint.com/php-tutorial
4	https://www.coursera.org/courses?query=php

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes	PLO-1	✓	✓		✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3			✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/Week
2023-2024 onwards	IV	23MCA41E	ELECTIVE 2.2: WEB PROGRAMMING ESSENTIALS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Outline Internet, HTML5, CSS3, JavaScript, PHP with a view to developing professional software development skills.
2	Explain functionalities of World Wide Web.
3	Explore mark-up languages features and create interactive web pages using them.
4	Design Client side validation using scripting languages.
5	Illustrate Open source JavaScript libraries.
6	Design front end web page and connect to the back end databases.

Unit - I

INTRODUCTION TO WWW:-Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response — Generation of dynamic web pages.

Unit - II

Markup Language (HTML5): Basics of Html -Syntax and tags of Html- Introduction to HTML5 -Semantic/Structural Elements -HTML5 style Guide and Coding Convention– Html Svg and Canvas – Html API's - Audio & Video - Drag/Drop - Local Storage - Web socket API– Debugging and validating Html.

Cascading Style Sheet (CSS3): The need for CSS – Basic syntax and structure Inline Styles – Embedding Style Sheets - Linking External Style Sheets - Introduction to CSS3 – Backgrounds - Manipulating text - Margins and Padding - Positioning using CSS -Responsive Web Design - Introduction to LESS/SASS

Unit – III

OVERVIEW OF JAVASCRIPT: Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements Functions - Objects - Array, Date and Math Related Objects - Document Object Model - Event Handling
- Controlling Windows & Frames and Documents - Form validations.

Unit – IV

JavaScript ES6: The let Keyword- the const keyword-Javascript Arrow Functions- Javascript For/of-Javascript Classes- Javascript promises-Javascript Symbol- default Parameters-Fuction Rest parameter-Array.find() and Array.findindex().

Unit - V

Node.js: Node.js Introduction-Node.js Modules-Node.js File System-Node.js URLModule-Node.js NPM- Node.js Events-Node.js Upload Files-Node.js Email –Connecting with DB(Node.js with Mongo DB).

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning

- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1.	David Flanagan, "JavaScript: The Definitive Guide", Sixth Edition, O'Reilly Media,2011.
2.	Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "InternetandWorldWide Web - How To Program", Fifth Edition, PearsoEducation,2011.
3.	James Lee, BrentWare, "Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP" , 4th Edition, Addison Wesley, Pearson 2009.
4.	Thomas A. Powell, "HTML & CSS: The Complete Reference", Fifth Edition,2010.
5.	Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference",Third Edition, Tata McGraw Hill,2013.
6.	Unit IV:https://www.w3schools.com/js/js_es6.asp
7.	Unit V: https://www.w3schools.com/nodejs/nodejs_intro.asp

FURTHER READING:	
1	Shriram K. Vasudevan, SunandhiniMuralidharan, Meenakshi Sundaram, Chandni Suresh, "Essentials of Internet Programming",I K International Publishing House Pvt. Ltd, 2015.
2	David Sawyer McFarland, "JavaScript and JQuery: Interactive Front-End Web Development" O'Reilly Media ,2008.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/course/html-css-web-development/
2	https://www.javatpoint.com/javascript-tutorial
3	https://www.w3schools.com/js/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes	PLO-1	✓	✓		✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3			✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	III	23MCA41E	ELECTIVE 2.3: INFORMATION RETRIEVAL TECHNIQUES	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the basic concepts and techniques in Information Retrieval
2	Analyze on querying languages used for IR
3	Identify the common text compression algorithms and their role in the efficient building and storage of inverted indices
4	Analyze on the various methods being followed to retrieve the contents from the web like text, image and multimedia contents
5	Acquire the necessary experience to design, and implement real applications using Information Retrieval system

Unit - I

INTRODUCTION : Basic Concepts – Retrieval Process – Modeling – Classic Information Retrieval – Set Theoretic, Algebraic and Probabilistic Models – Structured Text Retrieval Models – Retrieval Evaluation –Word Sense Disambiguation.

Unit - II

QUERYING: Languages – Key Word based Querying – Pattern Matching – Structural Queries – Query Operations – User Relevance Feedback – Local and Global Analysis – Text and Multimedia languages.

Unit – III

TEXT OPERATIONS AND USER INTERFACE : Document Preprocessing – Clustering – Text Compression - Indexing and Searching – Inverted files – Boolean Queries – Sequential searching – Pattern matching – User Interface and Visualization – Human Computer Interaction – Access Process – Starting Points –Query Specification - Context – User relevance Judgment – Interface for Search.

Unit – IV

MULTIMEDIA INFORMATION RETRIEVAL : Data Models – Query Languages – Spatial Access Models – Generic Approach – One Dimensional Time Series – Two Dimensional Color Images – Feature Extraction.

Unit - V

APPLICATIONS : Searching the Web – Challenges – Characterizing the Web – Search Engines – Browsing – Meta-searchers – Online IR systems – Online Public Access Catalogs – Digital Libraries – Architectural Issues – Document Models, Representations and Access – Prototypes and Standards.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", Pearson Education Asia, 2005.
2	G.G. Chowdhury, "Introduction to Modern Information Retrieval", Neal-Schuman Publishers; 2nd edition, 2003.
3	Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson Education, 2000.

FURTHER READING:

1	David A. Grossman, Ophir Frieder, " Information Retrieval: Algorithms, and Heuristics", Academic Press, 2000
2	Charles T. Meadow, Bert R. Boyce, Donald H. Kraft, "Text Information Retrieval Systems", Academic Press, 2000.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://csenotescorner.blogspot.com/2018/02/information-retrieval-techniques.html
2	https://www.youtube.com/playlist?list=PL0ZVw5-GryEkGAQT7lX7oIHqyDPeUyOMQ
3	https://cse.iitkgp.ac.in/~pawang/courses/IR16/lec1.pdf

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓		✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3			✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	IV	23MCA42E	ELECTIVE 3.1: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Analyze and formalize the problem as a state space with introduction of Artificial Intelligence
2	Demonstrate awareness of heuristic search methods.
3	Attain the capability to represent various real life problem domains using logic-based Techniques and use this to perform inference or planning.
4	Formulate and solve problems with uncertain information using Bayesian approaches
5	Develop knowledge of Intelligent Agents, learning methods and Solve various problems using Expert System

Unit - I

Introduction: The Foundations of Artificial Intelligence, The History of Artificial Intelligence and state of the Art, AI Problems – Al techniques – Criteria for success. Problems, Problem Spaces, Search: State space search – Production Systems – Problem Characteristics – Issues in design of Search.

Unit - II

Heuristic Search Techniques: Generate and Test – Hill Climbing – Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings – Approaches to Knowledge representations – Issues in Knowledge representations – Frame Problem.

Unit – III

Using Predicate Logic: Representing simple facts in logic – Representing Instance and Isa relationships – Computable functions and predicates – Resolution – Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge – Logic programming – Forward Vs Backward reasoning – Matching – Control knowledge.

Unit – IV

Statistical Reasoning: Probability and Bayes Theorem- Certainly Factors and Rule- Based systems Bayesian Networks - Dempster - Shafer Theory-Fuzzy logic. Knowledge representation: Syntactic- Semantic Spectrum of Representation-Logic and Slot-and Filter Structures - Other Representational Techniques – Planning – Understanding.

Unit - V

Intelligent Agents : Introduction to Intelligent Agents, How Agents should act structure of Intelligent Agents, Learning – Common sense – Perception and Action – Expert System.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

• Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Elaine Rich and Kevin Knight," Artificial Intelligence", Tata McGraw Hill Publishers company Pvt. Ltd, Second Edition, 1991. (Chapters 1 – 6 only).
2	George F Luger, "Artificial Intelligence", 4th Edition, Pearson Education Publ., 2002.
FURTHER READING:	
1	Nils J. Nilsson: Principles of Artificial Intelligence, Narosa Publication house.
2	Artificial Intelligence- A Modern Approach Stuart Russel, Peter Norvig PEI 3rd edition,2015
3	Winston, Patrick, Henry, Artificial Intelligence, Pearson Education.
4	Gopal Krishna, Janakiraman, Artificial Intelligence.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/lecture/uol-machine-learning-for-all/artificial-intelligence-XGOL3
2	https://www.edx.org/learn/artificial-intelligence
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/
4	https://www.udemy.com/topic/artificial-intelligence/
5	https://nptel.ac.in/courses/106/105/106105077/
6	https://www.umsl.edu/~joshik/msis480/chapt11.htm

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓			✓	✓
	PLO-4		✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7		✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	IV	23MCA42E	ELECTIVE 3.2: MACHINE LEARNING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the objectives of Machine Learning and to learn how to use different notations of it and different types of Learning
2	Understanding and Learning the fundamental algorithms
3	Understanding, Learning the concepts of Neural Networks and Deep Learning.
4	Understanding, Learning, Analyzing and Using the different types of classification and clustering as per the necessity of application.
5	Understanding and Learning the different concepts of Feature Engineering such Encoding, binning, standardization etc.

Unit - I

Introduction: What is Machine Learning-(Supervised Learning, Unsupervised Learning ,Semi-Supervised Learning ,Reinforcement Learning)*.Notation and Definition-Data Structures, Capital Sigma Notation, Capital Pi Notation, Operation on Sets, Operation on Vectors, Functions , Max and Arg Max, Assignment Operator, Derivative and Gradient, Random Variable ,Unbiased Estimators, Bayes Rule, Parameter Estimation, Parameters Vs Hyper parameters, Classification vs Regression, Model-Based vs Instance-Based Learning, Shallow vs Deep Learning.

Unit - II

Fundamental Algorithms: Linear Regression- Logistic Regression- Decision Tree Learning-(Support Vector Machine)*- Dealing with Noise, Dealing with Inherent: Non-Linearity-k-Nearest Neighbors-Anatomy of a Learning Algorithm-Building Blocks of a Learning- Algorithm Gradient Descent.

Unit – III

Neural Networks and Deep Learning: (Neural Networks)*-Multilayer Perceptron Example, Feed-Forward Neural Network Architecture-Deep Learning-Convolutional Neural Network, Recurrent Neural Network

Unit – IV

Classification and Clustering: Kernal Regression, Multiclass Classification ,One-class Classification, (Multi-Label Classification)*,Ensemble Learning, Learning to Label Sequences, Sequence-to- Sequence Learning, Active Learning ,Semi-Supervised Learning ,One-Shot Learning, Zero-Shot Learning.

Unit - V

Feature Engineering : One-Hot Encoding, Binning, Normalization- Standardization –Dealing with missing features-Data Imputation Techniques- Learning algorithm Selection – Three sets-Underfitting and Overfitting.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

• Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Andriy Burkov,(2019).”The Hundred-Page Machine Learning Book”.
2	Introducing Machine Learning,(2019)MATLAB eBook, Math works Inc.
FURTHER READING:	
1	Y. S. Abu - Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AML Book Publishers, 2012.
2	P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.geeksforgeeks.org/machine-learning/
2	https://www.tutorialspoint.com/machine_learning_with_python/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓	✓		✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓		✓	✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8	✓		✓	✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2023-2024 onwards	IV	23MCA42E	ELECTIVE 3.3: CLOUD COMPUTING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Define Cloud Computing and memorize the different Cloud service and deployment Models
2	Understand the Cloud computing stack such as SaaS, IaaS, PaaS
3	Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
4	Design different workflows according to requirements and apply map reduce programming model.
5	Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application

Unit - I

Introduction – Essentials – Benefits – Why cloud – Business and IT perspective – cloud and virtualization – cloud service requirements – dynamic cloud infrastructure – cloud computing characteristics – cloud adoption – cloud rudiments. Cloud deployment models: introduction – cloud characteristics – measured service accounting – cloud deployment models – security in a public cloud – public versus private clouds – cloud infrastructure self-service. (Chap 1,2)

Unit - II

Cloud as a service: introduction – gamut of cloud solutions – principal technologies- cloud strategy – cloud design and implementation using SOA – conceptual cloud model – cloud service defined. Cloud solutions: introduction – cloud ecosystem – cloud business process management – cloud service management – on premise cloud orchestration and provisioning engine – computing on demand. (Chap 3,4)

Unit – III

Cloud offerings: Introduction – introduction storage, retrieval archive and protection-cloud analytics – testing under cloud – information security – virtual desktop infrastructure-storage cloud. Cloud Management: Introduction – resiliency – provisioning – asset management-cloud governance – high availability and disaster recovery – charging models – usage reporting, and metering. Cloud Virtualization Technology: Introduction – virtualization demand – virtualization benefits – server virtualization – virtualization for x86 architecture – hypervisor management software – virtual infrastructure requirements. (Chap 5,6,7)

Unit – IV

Cloud Infrastructure: Introduction – storage virtualization – storage area networks-networkattached storage – cloud server virtualization – networking essential to the cloud. Cloud and SOA: Introduction – SOA Journey to Infrastructure – SOA and the cloud – SOA Defined – SOA and infrastructure as a service – SOA based cloud infrastructure steps – SOA Business and IT services. (Chap 8,9)

Unit - V

Cloud Mobility: Introduction – the business problem – mobile enterprise application platforms – mobile application architecture overview. Cloud Governance: Introduction – service level agreement and compliance – data privacy and protection risks – enterprise governance – risk management – third party management – information management. (Chap 10,11)

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Dr. Kumar Saurabh "Cloud Computing-Unleashing Next Gen Infrastructure to Application", 3rd Edition, Wiley India Pvt Ltd, 2014.
2	Rajkumar Buyya, James Broberg and Andrzej Goscinskj, "Cloud Computing: Principles and Paradigms", John willey and Sons, New Delhi, 2011.
3	Judith Hurwitz, Marcia Kaufman, Fern Halper and Daniel Kirsch," Hybird Cloud for Dummies", Willey Publications, New Delhi,2012.

FURTHER READING:

1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
3	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
4	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/browse/information-technology/cloud-computing
2	https://www.udemy.com/topic/cloud-computing/
3	https://www.edx.org/learn/cloud-computing
4	https://www.lynda.com/Cloud-Computing-training-tutorials/1385-0.html

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓			✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓		✓	✓	✓
	PLO-7		✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓	✓	✓	

QUESTION PAPER PATTERN

EXTERNAL

SECTION – A	10 Marks (10 × 1)	(Answer all; Choose the Best Answer with 4 distractors; Each question carries 1 mark)
SECTION – B	25 Marks (5 × 5)	Answer all; 'Either or' type; Each question carries 5 marks
SECTION – C	40 Marks (4 × 10)	Answer any FOUR out of FIVE; Each question carries 10 marks

INTERNAL

SECTION – A	5 Marks (5 × 1)	(Answer all; Choose the Best Answer with 4 distractors; Each question carries 1 mark)
SECTION – B	25 Marks (5 × 5)	Answer all; 'Either or' type; Each question carries 5 marks
SECTION – C	20 Marks (2 × 10)	Answer any TWO out of THREE; Each question carries 10 marks