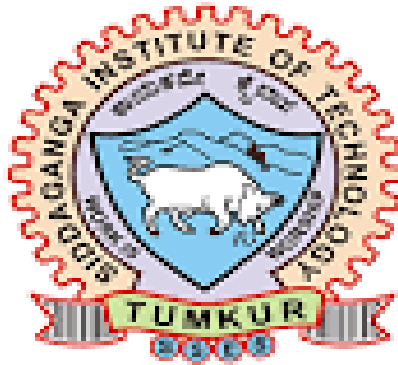


Siddaganga Institute of Technology-Tumakuru

Department of Master of Computer Applications



SCHEME & SYLLABUS

2025-2027

VISION STATEMENT

“To effectively mould quality and responsible computer professionals with a service mindset and spirituality for nurturing the global technological competence”.

MISSION STATEMENT

M1: *To develop computer professionals with technical proficiency, soft skills, ethical values, and a service-oriented mindset.*

M2: *To foster research, innovation, and problem-solving skills catering to the needs of industry, academia, and society.*

M3: *To promote entrepreneurship and continuous adaptability to emerging technologies.*

Program Educational Objectives

- PEO 1** Graduates will have strong theoretical and technical proficiency to meet the evolving global needs of society, industry, and academia.
- PEO 2** Graduates will demonstrate professionalism, teamwork, and ethical values in solving innovative problems.
- PEO 3** Graduates will engage in continuous learning and upskilling to adapt to emerging technologies and practices.

Program Outcomes (POs)

- PO1: (Foundation Knowledge): Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
- PO2: (Problem Analysis): Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.
- PO3: (Development of Solutions): Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
- PO4: (Modern Tool Usage): Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
- PO5: (Individual and Teamwork): Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
- PO6: (Project Management and Finance): Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
- PO7: (Ethics): Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
- PO8: (Life-long learning): Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

Master of Computer Applications (MCA) Scheme of Teaching and Examinations – 2025

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	SDA / Tutorial	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P						
1	BSC	S1MC01	Mathematical Foundations for Computer Applications	03	-	02	3	50	50	100	4
2	PCC	S1MC02	Web Technologies	03	-	02	3	50	50	100	4
3	PCC	S1MC05	Python Programming	03	- -	02	3	50	50	100	4
4	IPCC	S1MCI02	Data Structures and Algorithms	03	02	-	3	50	50	100	4
5	PCL	S1MCL1	Web Technologies Lab with Mini Project	--	03	--	3	50	50	100	1.5
6	PCL	S1MCL3	Python Lab	--	03	--	3	50	50	100	1.5
7	NCMC	S1MCRMI	Research Methodology and IPR	02	-	-	2	100	-	100	PP/NP
8	AEC	S1ARAS	Aptitude Related Analytical Skills	36 hrs. during the entire semester				100	-	100	PP/NP
Total				15	08	06	20	500	300	800	19

Note: **BSC**-Basic Science Courses, **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB)**: Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab, **NCMC**- None Credit Mandatory Course, **L**-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students) Research Methodology and IPR for the students who have **not studied** this course in the Undergraduate level. This course is not counted for vertical progression, Students have to qualify for the award of the master's degree.

BSC: Basic Science Courses: Courses like Mathematics/ Science are the prerequisite courses that the concerned engineering stream board of Studies will decide. **PCC:** Professional Core Course: Courses related to the stream of engineering, which will have both CIE and SEE components, students have to qualify in the course for the award of the degree. **Integrated Professional Core Course (IPCC):** Refers to a Professional Theory Core Course Integrated with practicals of the same course. The IPCC's theory part shall be evaluated by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. **Project Based Learning Course (PCC(PB)):** Project Based Learning course is a professional core Course only Students have to complete a project out of learning from the course and SEE will be viva voce on project work. **PCCL:** Professional Core Course Laboratory: Practical courses whose CIE will be evaluated by the class teacher and SEE will be evaluated by the two examiners.

Master of Computer Applications (MCA) Scheme of Teaching and Examinations – 2025											
II SEMESTER											
Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	SDA / Tutorial	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	S2MC01	Database Systems	03			03	50	50	100	3
2	IPCC	S2MCI02	Full Stack Development	03	02		03	50	50	100	4
3	PCC	S2MC03	Object Oriented Programming with Java	03			03	50	50	100	3
4	PCC	S2MC04	Computer Networks	03			03	50	50	100	3
5	PCC	S2MC05	Artificial Intelligence and Machine Learning	03			03	50	50	100	3
6	PCC	S2MC02	Software Engineering and Project Management	03			03	50	50	100	3
7	PCCL	S2MCL1	Database Lab		02		03	50	50	100	1
8	PCCL	S2MCL3	Object Oriented Programming with Java Lab		02		03	50	50	100	1
9	NCMC	S2MCSS	Soft Skills	36 Hrs. for the entire semester				100	--	100	PP/NP
10	NCMC	S2MCAE	Ability Enhancement Courses with Seminar -1					100		100	PP/NP
Total				18	06		24	600	400	1000	21
Ability Enhancement Courses with Seminar-I - None Credit Mandatory Course (NCMC), Students have to select the Topic like ERP, R Programming, Scripting language, Web Development Application, etc. They have to develop a small prototype and demonstrate to all the class.											

Master of Computer Applications (MCA)											
III SEMESTER			Scheme of Teaching and Examinations – 2025-2027								
Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Development Activities (Hours are for interaction between faculty)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA/ Tutorial					
1	PEC	S3MCXX	Specialization	03			03	50	50	100	03
2	PEC	S3MCXX	Specialization	03			03	50	50	100	03
3	PEC	S3MCXX	Specialization	03			03	50	50	100	03
4	PROJ	S3MCP	Project Work		25-30 hours per week		03	50	50	100	15
Total Credits							12	200	200	400	24
Project work is a significant component aimed at fostering research, practical application of knowledge, and innovation. The evaluation process generally follows these steps: 1. Selection and Approval of Project Work: • Topic Selection: Students propose project topics, often in consultation with their faculty advisor. • Approval Process: The proposed topic is submitted for approval by a project committee or department, ensuring alignment with academic standards and relevance. 2. Project Execution: • Research and Development: Students carry out research, experiments, or development work as per the project plan. • Periodic Reviews: Regular progress reviews are conducted by faculty to monitor the project’s progress and provide feedback. • Documentation: Students maintain a detailed record of their methodology, data, results, and analysis. 3. Submission of the Project Report: • Format and Guidelines: The report must follow the prescribed format by the university or department. • Plagiarism Check: The report is often checked for plagiarism to ensure originality. 4. Evaluation Process: • Internal Evaluation: Faculty members from the department review the project report and presentation for content quality, innovation, and depth of research. • External Evaluation: An external examiner, often an industry expert or academician from another institution, reviews the project.											

- Viva Voce Examination: The student defends their project work before a panel comprising internal and external examiners. This assesses their understanding, analytical ability, and application of the project work.

5. Grading Criteria (Guidelines only)

- Report Quality: Depth of research, organization, and clarity of the document.
- Presentation Skills: Effectiveness in communicating key aspects of the project.
- Technical Merit: Innovation, accuracy, and the applicability of the research.
- Viva Performance: Understanding of the subject, responses to questions, and ability to discuss the work effectively.

6. Final Outcome:

- Marks Allocation: Typically, evaluation is a blend of internal (guided by the department) and external (examiner's input) assessments, distributed over the report, presentation, and viva.
- Pass Requirement: Students must meet a minimum threshold to pass, as per university policies.

This structured evaluation ensures a comprehensive assessment of the student's practical and research capabilities, preparing them for further research or professional practice.

Specialization A (AI and Data Science)		Specialization B (Security)		Specialization C (Application Development)		Specialization D (Allied)	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
S3MCA1	Data Analytics	S3MCB1	Mobile and Wireless Security	S3MCC1	C# using .Net	S3MCD1	Big Data
S3MCA2	Generative AI and Prompt Engineering	S3MCB2	Cryptography and Network Security	S3MCC2	Mobile Application Development	S3MCD2	Software Testing
S3MCA3	Deep Learning Fundamentals	S3MCB3	Cyber Security	S3MCC3	Internet of Things with Cloud	S3MCD3	Software Design and Patten
S3MCA4	Business Intelligence	S3MCB4	Ethical Hacking	S3MCC4	Augmented Reality and Virtual Reality	S3MCD4	Blockchain Technology

Master of Computer Applications (MCA)

IV SEMESTER										
Scheme of Teaching and Examinations – 2025-2027										
Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination			
				Theory	Practical / Seminar	Skill Development Activities (Hours are for interaction between faculty and students)	Duration in hours	CIE Marks	SEE Marks	Total Marks
				L	P	SDA				
1	MOOC	S4MCMOOC	Online Courses (12 Weeks Duration)				--	--	---	100
2	TS	S4MCTS	Technical Seminar /Paper Presentation				03	100	---	100
3	INT	S4MCINT	Research Internship /Industry-Internship / Startup Internship					100	100	200
Total							03	200	100	400
INT: Industry/ Research Internship leading to the project work /startup TS: Technical Seminar: Students can present the seminar based on the new technologies in the seminar by all postgraduate students of the program shall be mandatory. The CIE marks awarded for the Seminar shall be based on the evaluation of the Report, Presentation skill, and performance in the Question and Answer session in the ratio 50:25:25. Seminar shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/ complete shall be declared as fail in the seminar course and have to complete the same during the subsequent semester. MOOC : Online NPTEL course (12 Week Duration)										

Mathematical Foundations for Computer Applications

Contact Hours/ Week:	03+02(L+T)	Credits:	04
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S1MC01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Familiarize the notation and concepts of combinatorial mathematics such as sets and relations.
2.	Identify types of graphs, outline properties of graphs.
3.	Understand the basics of data, Frequency Distributions, Central tendency measures and dispersion.
4.	Learn types of probability, axioms, and Bayes Theorem.

UNIT I

Basic Structures:

Sets, Set operations, Algebra of Sets, Partitions and Duality, Principle of Inclusion and Exclusion, Pigeonhole principle.

8 Hours

UNIT II

Relations

Relations, Properties of Relations, Computer Recognition- Zero-One Matrices and Digraphs, Partial order relation -Poset and Hasse-Diagrams, Equivalence Relation and Partitions, Extremal elements of a Poset, Lattice.

8 Hours

UNIT III

Introduction to Graph Theory:

Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles.

8 Hours

UNIT IV

Statistics:

Introduction to Statistics, classification of variables, types of data, data collection and sampling methods, data representation- diagrammatic methods (line diagram, bar diagram, pie chart), graphical methods (Histogram, frequency polygon, frequency curve, ogive). Measure of central tendency- mean, median, mode, quartiles, harmonic mean and geometric mean. Measure of dispersion- mean deviation, quartile deviation, standard deviation and coefficient of variation.

8 Hours

UNIT V	
Probability: Basic terminology, Definition of probability, Probability and set notations, Types of events, Addition law of probability, conditional probability, multiplication law of probability, Baye's theorem.	
8 Hours	

TEXT BOOKS		
1	Ralph P. Grimaldi	"Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, 2012, ISBN 9780201726343.
2	Sc Gupta	Fundamentals of Statistics, Himalaya Publisher ,7 th Edition, , 2018, ISBN: 9350517698
3	Douglas C. Montgomery And George C. Runger	Applied Statistics and Probability for Engineers, Wiley ,7 th Edition, 2018, ISBN 978-1-119-40036-3.

REFERENCE BOOKS		
1	Ralph P Grimaldi, B V Ramana	Discrete and Combinatorial Mathematics, , PEARSON, 5 th Edition, 2004.
2	Kenneth H Rosen	Discrete mathematics and Its Applications, TATA McGRAW-HILL, 5th Edition, 2003.
3	B S Grewal:	Higher Engineering Mathematics, , Khanna Publishers, 43 rd Edition, 2017.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply the fundamentals of combinatorics to solve the real world problems.
CO2	Apply the concept of relations to solve the real world problems.
CO3	Recognize types of graphs, outline properties of graphs and apply Graph theory tools in solving real world problems.
CO4	Acquire ability to represent the data and calculate the measures of central tendency and dispersion.
CO5	Apply the concept of probability for real world problems with uncertainty.

WEB LINKS:

1.	https://archive.nptel.ac.in/courses/111/106/111106086/
2.	https://onlinecourses.nptel.ac.in/noc20_cs82/preview
3.	https://learn.careers360.com/maths/sets-relations-and-functions-chapter/
4.	https://www.javatpoint.com/discrete-mathematics-tutorial

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	3	1						
	CO2	3	1						
	CO3	3	1						
	CO4	3	1						
	CO5	3	1						

1: Low, 2: Medium, 3: High

Web Technologies

Contact Hours/ Week:	3	Credits:	4
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S1MC02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Apply foundational web concepts, protocols, HTML5 semantics, and modern CSS techniques for responsive design
2.	Implement advanced, accessible HTML5 tables and modern forms using Bootstrap 5
3.	Apply modern JavaScript (ES6+) concepts, including asynchronous programming, DOM manipulation, and the Fetch API, to build dynamic client-side applications
4.	Implement server side applications with Node.js, using CommonJS and ES Modules, leveraging a modern framework
5.	Architect and integrate the components of the MERN stack to build dynamic, data-driven full-stack web applications

UNIT I

Web Basics: Web Applications in Comparison to Desktop Applications, Static Web sites versus Dynamic Web sites, Internet Protocols, Hypertext Transfer Protocol with focus on modern HTTP/2 features, Headers and advanced Request Methods, Detailed Response Codes analysis, HTML5 semantic structure elements including header, footer, navigation, articles and sections with accessibility focus, Complete CSS with Flexbox and Grid layout systems, Responsive design techniques using media queries, CSS custom properties and variables.

8 Hours

UNIT II

HTML5 Tables and Forms

Advanced table structuring with accessibility considerations, Modern form implementations with HTML5 validation attributes, Secure form submission methods, File upload APIs using multipart/form-data, Comprehensive Bootstrap 5 coverage including utility-first classes, Offcanvas components and updated grid system, Deep customization techniques using Bootstrap's Sass variables.

8 Hours

UNIT III

Modern JavaScripts:

Modern JavaScript ES6+ features including arrow functions, template literals and destructuring, Asynchronous programming using Promises and async/await, Advanced DOM manipulation techniques with event delegation, Modern Fetch API replacing traditional XHR, Comprehensive form handling and validation patterns.

8 Hours

UNIT IV	
Node.js: Node.js runtime environment with ES Modules support, Comparison of CommonJS vs ES Modules, Advanced module management, Introduction to modern frameworks like Fastify as Express alternative, Basic performance optimization techniques.	
8 Hours	

UNIT V	
MERN Stack: Complete MERN stack architecture explanation, MongoDB with Mongoose ODM integration, Modern authentication patterns, Real-time features implementation using WebSockets, Deployment strategies for full-stack applications.	
8 Hours	

TEXT BOOKS		
1	Randy Connolly	Fundamentals of Web, Pearson 3 rd Edition, 2021, ISBN 10: 1292057092, ISBN 13: 978-1-29-205709-5.
2	<u>Amit Diwan</u>	Ultimate Bootstrap for Responsive Web Design, Orange Education Pvt Limited, 1 st Edition, 2024
3	<u>Be Sure Academy</u>	The Modern JavaScript Basics, Be Sure Academy, 1 st edition, 2025
4	Anik Acharjee	Mastering AI App Development with MERN Stack, Orange Education Pvt Limited, 1 st Edition, 2024

REFERENCE BOOKS		
1	Joelsklar	Principles of web Design, <u>Cengage</u> , 5 th edition, 2012
2	Benjamin Jakobus	Mastering Bootstrap 4, Benjamin Jakobus, Packt, 2016

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Build and style responsive static websites using HTML5 and CSS Flexbox/Grid
CO2	Implement rich tables and validated forms, customizing Bootstrap 5 layouts for responsive design
CO3	Create dynamic web pages using ES6+, Promises, and the Fetch API to handle and validate form data
CO4	Develop and manage a basic back-end application using Node.js, Fastify, and ES Modules.
CO5	Build and deploy a full-stack MERN application, implementing database integration, user authentication, and real-time functionality

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2	2	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	2	1			
	CO4	2	2	2	2	1			
	CO5	2	2	2	2	1			

1: Low, 2: Medium, 3: High

Python Programming

Contact Hours/ Week:	4	Credits:	4
Total Lecture Hours:	52 (39L+26T)	CIE Marks:	50
Course Code:	S1MC05	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the syntax and semantics of the Python programming language.
2.	Illustrate the process of structuring the data using lists, tuples, strings and dictionaries.
3.	Learn the Python's file manipulation and file organization techniques.
4.	Demonstrate the concepts of exception handling and object-oriented programming in Python.
5.	Implement the concepts of performing database operations and fundamentals of web page development in python.

UNIT I

Python Basics

Introduction to Python: Installation, working with interactive shell, basic syntax, variables, operators, and data types (integers, floats, strings, lists, tuples, dictionaries, sets). String concatenation and replication. Example program.

Flow control: Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules.

Functions: Defining and calling functions, arguments, return values, lambda functions. Scope of local and global variables.

8 Hours

UNIT II

Lists

The *List* data type, Working with lists, loops with lists, augmented operators, methods: `index()`, `append()`, `insert()`, `remove()`, `sort()`, programs on lists.

Tuples: tuple data type, converting types with tuple and list functions, references,

Dictionaries and Structuring data:

The Dictionary Data Type: dictionaries versus lists, `keys()`, `values()`, `items()`, methods: `in`, `get()`, `setdefault()`. Pretty Printing, Using Data Structures to Model Real-World Things.

Working with Strings: Manipulation of strings with loops, mutable and non mutable data types, useful string methods,

8 Hours

UNIT III		
Reading and Writing Files Key characteristics, file types, file paths, the os.path module, join operator, current working directory, home directory, absolute and relative paths, create folder, getting parts of a file path, finding the file size and folder contents, usage of glob patterns, checking path validity. The File Reading/Writing Process, open(), read(), write() and close(), working with readlines(), writing to files, create new files, read from files, delete a file, folder,		
Organizing Files The shutil module, copying files and folders, deleting files, walking a directory tree, creating zip file, reading/extracting zip file, compressing files with the zip file module, backing up a folder into a ZIP file.		
		8 Hours
UNIT IV		
Debugging Exception handling, raising exceptions, processing exceptions using exception objects, defining custom exception classes. Getting the Trace back as a String, Assertions, Logging.		
Object-Oriented Programming (OOP): Defining classes for objects, immutable objects vs. mutable Objects, hiding data fields, class abstraction and encapsulation. Inheritance & Polymorphism: super classes and subclasses, overriding methods, the object Class, polymorphism and dynamic Binding.		
		7 Hours
UNIT V		
Database Handling: Connecting to and interacting with databases. Create table, perform select, insert, update and delete operations with database tables. Create ORM – manage database operations by mapping classes to database tables and reducing raw SQL usage.		
Demonstrate Python Packages – SQLAlchemy – ORM for database integration, Pydantic – Data validation and parsing, FastAPI – Web framework with modern async support, Uvicorn – ASGI server for running FastAPI apps, Alembic – For handling DB migrations with SQLAlchemy,		
Use FastAPI over Flask – FastAPI is async-ready, faster, and widely adopted in the industry. It supports modern features like type hints, automatic docs generation, and better performance than Flask.		
		8 Hours
TEXT BOOKS		
1	Al Sweigart	“Automate the Boring Stuff with Python”, No Starch Press , 3 rd Edition, , 2025. (Available under CCBY-NC-SA license at https://automatetheboringstuff.com/)
2	Y Daniel Liang	“Introduction to Programming using Python”, Pearson, 3 rd Edition, 2023

REFERENCE BOOKS		
1	Allen Downey	“Think Python: How to Think Like a Computer Scientist”, Shroff/O'Reilly; Second edition, 2016.
2	Charles Severance	“Python for Everybody”, Shroff Publishers; First edition , 2017
3	Jake Vanderplas	“Python Data Science Handbook”, O'Reilly, 1st edition 2016.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Interpret the Python language fundamentals and demonstrate proficiency in handling loops and creation of functions.
CO2	Identify the methods to create and manipulate lists, tuples, strings and dictionaries.
CO3	Illustrate file manipulation and file organization techniques.
CO4	Develop the concepts of exception handling and object-oriented programming in Python.
CO5	Demonstrate to perform database operations and fundamentals of web page development in Python.

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	2	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			
	CO5	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Data Structures and Algorithms

Contact Hours/ Week:	03+02(L+T)	Credits:	04
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S1MCI02	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Distinguish the properties of various data structures such as stacks, queues, lists, trees and Graphs.
2.	Comprehend working of various sorting and searching techniques.
3.	Recognize various analysis and design of Algorithm techniques.

UNIT – I

Classification of Data Structures: Primitive and Non- Primitive Data types, Linear and Nonlinear; Data structure Operations, Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, conversion of infix to postfix, evaluation of postfix expression, Recursion - Factorial, GCD, Fibonacci Sequence, product of two numbers.

Practical Component:

- Implementing menu driven stack operations using arrays.
- Program to evaluate postfix expression using stack.
- Program on recursion as applications of stack

08 Hours

UNIT – II

Queue: Definition, Representation, Queue Variants: Linear queue Circular Queue, Priority Queue, Double Ended Queue.

Linked List: Dynamic memory allocation: malloc(), calloc(), realloc(), free(). Types of linked list, Singly linked list basic operations: Inserting (at first, at last,) and removing nodes (at first, at last), search key in singly linked list.

Practical Component:

- Design to develop and implement simple Queue and circular queues.
- Implementing menu driven Stack using Singly Linked List.
- Implementing menu driven Queue using Singly Linked List.

08 Hours

UNIT – III

Nonlinear data structures: Binary trees, Operations on Binary Trees, Applications of Binary Trees, types of Binary Tree: complete binary tree, strictly binary trees, expression trees, Memory Representations of binary trees, Binary Tree Traversals, Creation of BST, find minimum, find maximum node in BST, tree traversals.

Practical Component:

- Implementing Binary search tree of integers and demonstrate tree traversal

08 Hours

UNIT – IV	
Introduction, Fundamentals of the Analysis of Algorithm Efficiency Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Asymptotic Notations and Basic efficiency classes. Brute Force: Selection Sort, Sequential Search Divide-and-Conquer: Merge sort, Binary Search Practical Component: • Sorting a given set of n integer elements using Merge sort • Sorting a given set of n integer elements using selection sort • Searching using Linear and Binary search	
08 Hours	

UNIT – V	
Graphs and its Applications Introduction to Graph, graph memory representation, graph traversal: DFS and BFS Greedy Technique: Prim's and Dijkstra's Algorithm Dynamic Programming: Warshalls and Floyds algorithms Space and time tradeoffs : hashing(open and closed hashing) Practical Component: • All-Pairs Shortest Paths problem using Floyd's algorithm • Program to Find the Transitive Closure of a Graph using Warshall's Algorithm	
08 Hours	

TEXT BOOKS		
1.	Aaron M. Tenenbaum, Yedidiah Langsam, Moshe J. Augenstein	Data Structures Using C, Pearson Education, 1 st edition, Paperback 2019.
2.	Mark Allen Weiss	Data structures and Algorithm Analysis in C, Generic Publication, Perfect Paperback, 1 st edition, 2020
3	Anany Levitin	Introduction to the Design and Analysis of Algorithms, Pearson Education, 3 rd edition, Paperback, 2017

REFERENCE BOOKS		
1.	Richard F Giberg and Behrouz AForouzan	Data Structures– A Pseudocode Approach with C, Cengage Learning , 2nd Edition, 2007
2.	George Heineman, Gary Pollice, Stanley Selkow	Algorithms in a Nutshell, O'Reilly Media, 2nd Edition, 2016

WEB LINKS	
1.	https://www.javatpoint.com/data-structure-in-c
2.	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3.	https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
4.	https://www.geeksforgeeks.org/data-structures/
5.	https://www.programiz.com/dsa

Course Outcomes:**Upon completion of this course the student will be able to:**

CO1	Interpret basic data types and implement Stack operations and its applications.
CO2	Design and implement linear data structures : Queue & Singly Linked List
CO3	Design and Implement non-linear data structure : Trees and Graphs
CO4	Analyze the working of Brute force and Divide-and-Conquer algorithm techniques.
CO5	Analyze the working of Greedy, Dynamic Programming techniques, and Space & Time Tradeoffs.

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	2	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			
	CO5	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Web Technologies with Mini Project Lab

Contact Hours/ Week:	03	Credits:	1.5
Total Lecture Hours:	36	CIE Marks:	50
Course Code:	S1MCL1	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Design and develop responsive web interfaces using semantic HTML5 elements, CSS3 Flexbox and Grid layouts, media queries, and CSS variables for cross-device compatibility.
2.	Utilize front-end frameworks such as Bootstrap and modern JavaScript (ES6+) to create dynamic, user-friendly web applications with robust form handling and event-driven interactivity
3.	Implement full-stack web development workflows by integrating Node.js with CommonJS and ES Modules, using REST APIs and modern frameworks like Fastify for server-side logic
4.	Build and deploy complete MERN stack applications incorporating user authentication, real-time communication using WebSockets, and performance optimization techniques

Experiment No	Problem statement of Lab Program
1	Design a semantic HTML5 webpage with header, nav, section, article, and footer using Flexbox and Grid layout, and implement responsive design using media queries and CSS variables
2	Create a Responsive Web design using HTML5, CSS and Bootstrap grid system.
3	Design and develop a dynamic web-based Student Management System using HTML, CSS, DOM and JavaScript.
4	Modern Form Handling with ES6 and Fetch API: Create a dynamic form using modern JavaScript features like arrow functions, template literals, form validation, and form submission via the Fetch API with POST method.
5	Implement Event Delegation with DOM and Promises
6	ES Modules vs CommonJS in Node.js: Compare CommonJS and ES Modules by creating two separate Node.js scripts performing the same functionality (math operations), each using a different module system
7	REST API with Fastify and Performance Logger
8	MERN Stack App with Authentication and Real-Time Messaging

WEB LINKS:

1.	https://www.w3schools.com
2.	https://getbootstrap.com/2.0.1/less.html#compiling
3	https://www.nodejs.org
4	https://expressjs.com
5	https://www.mongodb.com/docs/

6	https://www.mongodb.com/resources/languages/mern-stack-tutorial
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Course Outcomes:

After completing this Course students will be able to:

CO1	Apply semantic HTML5 and modern CSS layout techniques to construct accessible, responsive web pages for diverse screen sizes.
CO2	Develop dynamic client-side applications using JavaScript ES6 features, DOM manipulation, event delegation, Promises, and Fetch API
CO3	Differentiate between CommonJS and ES Modules in Node.js and demonstrate effective usage of modern frameworks like Fastify for API development
CO4.	Develop basic MERN stack applications incorporating user authentication, real-time communication using WebSockets, and performance optimization techniques

Course Articulation Matrix (Correlation between CO's and PO's)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	2	1			
CO2	2	2	2	2	1			
CO3	2	2	2	2	1			
CO4	2	2	2	2	1			

1: Low, 2: Medium, 3: High

Python Lab

Contact Hours/ Week:	3	Credits:	1.5
Total Lecture Hours:	36	CIE Marks:	50
Course Code:	S1MCL3	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the syntax and semantics of the Python programming language.
2.	Illustrate the process of structuring the data using lists, tuples
3.	Demonstrate the use of built-in functions to navigate the file system.
4.	Implement the Object Oriented Programming concepts in Python.
5.	Implement the connectivity with database and develop web applications.

List of Lab Programs:

1	a) Develop a program to generate fibonacci sequence for a given length(n) by accepting from console. b) Develop a function to calculate factorial of a number and also compute binomial coefficient (Given N and R).
2	Develop functions to search a key element by using a) Linear search b) Binary Search
3	a) Develop a program to create a list, read n numbers from the console and compute mean, variance and standard deviation with suitable messages. b) Develop a program to read a multi-digit number from the console and to print the frequency of each digit with suitable messages.
4	a) Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. b) Develop a program to backing up a given folder in a current working directory into a ZIP file by using relevant modules and suitable methods.
5	a) Define a function which takes two objects representing complex numbers and returns new complex number with a addition of two complex numbers. Develop a program to read 'n' (n >=2) complex numbers and compute the addition of 'n' complex numbers. b) Develop a program that uses class Student which prompts the user to enter marks in three subjects and calculates total marks, percentage and displays the score card details.
6	a) Develop a program to enter the filename and count the number of occurrences of each letter in the file regardless of the case. b) Develop a program that counts the number of lines, characters and the keywords present in a python source file.
7	Develop a program to solve the quadratic equation by demonstrating at least four built in exceptions using exception handling.
8	Develop a program that creates a form to accept rate of interest, number of years, and loan amount, then calculate monthly EMI and total amount to pay by using tkinter.

9	Develop a program that performs CRUD operations with a database (SQLite).
10	Develop a program to design and implement a GUI to perform four basic arithmetic operations. (addition, subtraction, multiplication & division)

Course Outcomes:

After the completion of this course, students will be able to:

CO1	Demonstrate proficiency in handling decision based statements, loops and creation of functions in Python.
CO2	Identify the methods to create, manipulate lists, tuples and dictionaries in Python.
CO3	Develop programs for string processing, file organization and object-oriented concepts in Python.
CO4	Illustrate the CRUD operations with database and Develop web applications in Python.

Course Articulation Matrix :

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	2	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Research Methodology and IPR

Contact Hours/ Week:	02	Credits:	0
Total Lecture Hours:	20	CIE Marks:	50
Course Code:	S1MCRMI	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Identify the area of research and set the objectives and Research process
2.	Carryout literature review and define the research problem.
3.	Develop research plan and sampling design.
4.	Understand the concepts/section of Copy Right Act /Patent Act / Trademark to the given case and develop –conclusions.

UNIT – I

An exploration of the concept of research- Meaning, Objectives and Motivation. Types of research: Overview with examples, Research Process, Criteria of Good Research and problems Encountered by researchers India.

04 Hours

UNIT – II

Research Problem, Selecting the Problem, Necessity of Defining the Problem, Techniques involved in Defining a problem, Literature Review: Place of the literature review in research, Bringing clarity and focus to your research problem, Writing about the literature reviewed.

04 Hours

UNIT – III

Measurement and scaling techniques, Experimental and modelling skills: Experiment design, Data collection methods, Data analysis and interpretation.

04 Hours

UNIT – IV

Writing and presentation skills, Significance of Report writing, Different steps and Layout of the Research Report, How to prepare effective oral, poster and digital presentation.

04 Hours

UNIT – V

Intellectual Property Rights (IPR)-Basic Introduction and laws, IPR: Patent, Design, Trademark, Geographical Indication, and Copyrights, Trademark, Service mark, Certification mark and Collective mark

World Intellectual Property Organization's (WIPO) role and activity.

04 Hours

TEXT BOOKS:

1.	Kothari, C.R. and Gaurav Garg,	Research Methodology: Methods and Techniques. New Age International, 4th Edition, 1 September 2019.
2.	Ranjit Kumar	Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), SAGE Publications, 4 th Edition, 2024

REFERENCE BOOKS:

1.	Handbook	of Research Ethics and Scientific Integrity, Springer, 2020.ISBN: 978-3-030-16758-5
2.	Study Material (For the topic Intellectual Property under module 5),	Professional Program Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

WEB LINKS AND VIDEO LECTURES (e-RESOURCES) :

	https://onlinecourses.nptel.ac.in/noc22_ge08/preview
	https://www.youtube.com/watch?v=XEMyDu_VoeQ
	https://www.youtube.com/watch?v=GSeeyJVD0JU

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Identify research categories and develop research plans.
CO2	Conduct and investigate research problems and carry out literature review.
CO3	Investigate and Develop Research design and framework for experimentation.
CO4	Plan and develop systematically the research and technical report.
CO5	Analyze and Evaluate Intellectual Property Rights

Course Articulation Matrix (Correlation between CO's and PO's)

COs	POs							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1			1			1
CO2		1			1		2	1
CO3		1	1		1			1
CO4		1			1			1
CO5							2	

1: Low, 2: Medium, 3: High

Aptitude Related & Analytical Skill

Contact Hours/ Week:	36 Hours for the entire semester	Credits:	00
Total Lecture Hours:		CIE Marks:	100
Course Code:	S1ARAS	SEE Marks:	50

Contact Hours/Week	:	36 Hours for the entire semester	Credits	:	0
Total Lecture Hours	:	-	CIE Marks	:	100
Total Tutorial Hours	:	-	SEE Marks	:	-
Course Code	:		Course		AEC

Modules Covered:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with debrief	02
	Total Course	36

Methodology: Instructor led – Concepts with guided question-solving, assignments and homework assessments

Sl.no	Programs
1.	Quantitative Aptitude (with focus on questions from top recruiters) (16 Hours) a) Number System • Classification of numbers Divisibility tests • Power cycles and remainders • Factors and multiples • Applications of HCF and LCM b) Profit and Loss, Partnerships and Averages • Basic terminology in Profit and Loss • Partnerships • Averages and weighted averages • Mixtures and alligations c) Time and Work • Working with different efficiencies • Pipes and cisterns • Work equivalence • Division of wages d) Time, Speed and Distance • Basics of Time Speed and Distance • Relative Speed • Problems based on trains • Problems based on boats and streams • Problems based on Races

	e) Percentages, Simple and Compound Interest • Percentages as fractions and decimals • Percentage increase / decrease • Simple interest and compound interest • Relationship between simple and compound interest f) Permutation, Combination and Probability • Fundamental counting principle • Basics of permutation and combination • Computation of permutation • Circular permutation • Computation of combination • Probability g) Logarithms, Progressions, Geometry and Quadratic Equations • Logarithms • Progressions – Arithmetic, Geometric and Harmonic • Geometry • Mensuration • Quadratic equations
2.	Verbal Reasoning (with focus on questions from top recruiters)– (8 Hours) a) Reading Comprehension – • Eyespan • Speed reading techniques • Types of questions • Comprehension strategies b) Sentence Correction – • Subject-Verb Agreement • Parallelism • Modifiers • Pronoun Antecedent Agreement • Verb Time Sequence • Comparison • Determiners • Prepositions c) Vocabulary – • Etymology of words • Prefix and suffix • Memory techniques to remember words • Synonyms and antonyms • Analogy d) Sentence Completion and Para Jumbles – • Sentence completion – single blank and double blank questions • Para jumbles – Moving and anchored jumbles
3	Logical Reasoning (with focus on questions from top recruiters) - (8 Hours)

	a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning • Coding and decoding • Number and alphabet series • Analogy • Odd man out • Visual Reasoning b) Data Arrangements and Blood Relations • Linear, circular and distribution arrangements • Blood Relations c) Data interpretation and Data Sufficiency • Tables • Pie Charts • Bar Graphs • Data Sufficiency c) Clocks, Calendars, Direction sense and Cubes • Clocks • Calendars (Conventional and shortcut methods to find day of a date) • Cubes • Direction Sense
4	Test taking strategies – (2 Hours) This module will focus on: • Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional) • Best strategies to maximize scores and clear cut-offs • Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections
5.	Post Training Assessment with debrief – (2 Hours) An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on: • Cut-off • Percentile w.r.t the batch • Percentile w.r.t. the college • Corrective measures to be taken to improve the score In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.
6.	Tests outside training schedule An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The ‘training duration’ focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of: 1. Pre-Assessment test 2. Full-length practice tests 3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

<i>Description</i>	<i>Schedule</i>	<i>Duration (min)</i>	<i>Conducted for</i>
<i>Test - 1</i>	<i>7th Week</i>	<i>90</i>	<i>50 marks</i>
<i>Test - 2</i>	<i>14th Week</i>	<i>90</i>	<i>50 marks</i>
<i>CIE</i>			<i>100 marks</i>

Minimum marks to pass the course is 50% of total CIE.

No SEE component for ARAS.

Reference material –

1. ‘Aptipedia’, Wiley India
2. ‘Quantitative Aptitude for Competitive Examinations’ by R S Agarwal
3. ‘The Pearson Guide to Verbal Ability’ by Nisht K Sinha

II Semester Database Systems

Contact Hours/ Week:	4	Credits:	4
Total Lecture Hours:	52 (39L+26T)	CIE Marks:	50
Course Code:	S2MC01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	To familiarize students with basic concepts, architecture, and functionalities of database systems and their role in managing and organizing data efficiently.
2.	To enable students to design database structures using conceptual, logical, and physical models, with emphasis on Entity-Relationship (ER) diagrams and its extended features.
3.	To provide practical knowledge and expertise in writing SQL queries for data definition, manipulation, and retrieval in relational database systems.
4.	To teach students to create optimized database designs that ensure data integrity, reduce redundancy, enhance performance by using Normalization techniques and to explore programming techniques in PL/SQL.
5.	To introduce students to NoSQL systems and its emerging trends in database technologies.

UNIT I

Introduction

Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.

8 Hours

UNIT II

Entity-Relationship Model

Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two.

Relational Model and Relational Algebra: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations : JOIN and DIVISION;

Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping.

8 Hours

UNIT III

SQL

Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, More Complex SQL Retrieval Queries, Views (Virtual Tables) in SQL, Schema Change Statements in SQL, Discretionary Access Control Based on Granting and Revoking Privileges, Transaction Support in SQL (Commit, Rollback, Save point)

8 Hours

UNIT IV

Introduction to PL/SQL Programming and Database Design

Introduction to PL/SQL programming, PL/SQL blocks, Cursor types, Stored Procedures, Functions, Exception handling, Packages and Triggers.

Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Cod Normal Form, De-normalization.

8 Hours

UNIT V

Introduction to NoSQL

NoSQL, SQL versus NoSQL, Types of NoSQL Databases, CAP theorem, Getting Started with MongoDB – Documents, Collections, Databases, Getting and Starting MongoDB, MongoDB Shell, Data Types, Inserting and Saving Documents, Removing Documents, Updating Documents, Introduction to find, Query Criteria, Type Specific Queries and \$where Queries.

7 Hours

TEXT BOOKS

1	Elmasri and Navathe	Fundamentals of Database Systems, 7th Edition, Pearson Publishers, 2021
2	Raghu Ramakrishnan and Johannes Gehrke	Database Management Systems, 7 th Edition, McGraw-Hill, 2019.
3	Shashank Tiwari	Professional NOSQL, 2020, Inc.WROXPress, John Wiley & Sons, ISBN: 978-0-470-94224-6,
4	Kristina Chodorow and Michael Dirolf	MongoDB: The Definitive Guide, 3 rd Edition, 2021 O'Reilly Media, ISBN: 978-1-449-38156-1.
5	Scott Urman	PL/SQL Programming, Develop Powerful PL/SQL Applications, 7 th Edition, 2020, TaTa McGraw –Hill Publications, ISBN: 0-07-048680-8.

REFERENCE BOOKS		
1	Silberschatz, Korth and Sudharshan	Data base System Concepts, 7 th Edition, Mc-GrawHill, 2019.
2	C.J. Date, A. Kannan, S. Swamynatham	A Introduction to Database Systems, 8th Edition, Pearson education, 2018.
3	Steven Feuerstein	Oracle PL/SQL Best Practices, O'Reilly Publications, ISBN – 10-81-8404-541-7

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	<i>Identify</i> the fundamentals of database technologies and its different architectures.
CO2	<i>Analyse</i> the Entity Relational model concepts and Design relational algebraic expressions for SQL queries.
CO3	<i>Illustrate</i> the various concepts of SQL and Develop Queries to perform CRUD (Create, Retrieve, Update and Delete) operations on database.
CO4	<i>Analyze</i> the fundamentals of PL/SQL programming constructs and its relevance to the applications and Apply the database design process with Normalization concepts.
CO5	<i>Illustrate</i> a non-relational data model for any given problem and analyze performance of the data models with respect to design and manipulations.

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	2		1			
	CO2	2	2	2		1			
	CO3	3	2	2	1	1			
	CO4	2	2	2	1	1			
	CO5	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Full Stack Development

Contact Hours/ Week:	03+02	Credits:	4
Total Lecture Hours:	40+12(T+L)	CIE Marks:	50
Course Code:	S2MCI02	SEE Marks:	50

Course objectives:

This course will enable students to:

5.	Articulate the fundamentals of Node.js and MongoDB, enabling them to create, connect, and perform CRUD operations on a database
6.	build secure RESTful APIs with Express.js, implementing middleware, routing, and JWT authentication
7.	Implement the core constructs of React, including project setup, JSX rendering, functional components, and component interactions to develop dynamic web applications
8.	Master advanced React patterns, including state management with Redux and Context API, and component composition with React Router
9.	Build, connect, and optimize full-stack applications by integrating the MERN stack's frontend and backend components

UNIT I

Node.js and MongoDB : Introduction to MongoDB & Node.js Installation and setup, MongoDB basics (collections, documents, CRUD operations), Node.js fundamentals (modules, npm, package.json), Connecting Node.js to MongoDB.

Experiments:

- Create a Node.js server that performs basic CRUD operations on MongoDB.
- Build a REST API using Express.js to interact with MongoDB.

8 Hours

UNIT II

Express.js & RESTful APIs:

Express.js & RESTful APIs Express.js framework, Middleware concepts, Routing, REST API principles, Error handling, JWT authentication.

Experiments:

- Develop a RESTful API for a blog application with user authentication.
- Implement file upload functionality in an Express application.

8 Hours

UNIT III

React:

React Fundamentals React introduction (components, props, state), JSX syntax, Event handling, Lifecycle methods, React hooks (useState, useEffect).

Experiments:

- Create a React application to display dynamic data from an API.
- Build a form with validation using React hooks.

8 Hours

UNIT IV	
Advanced React: Advanced React & State Management React Router, Context API, Redux fundamentals, Component composition, Higher-order components.	
Experiments: - Implement a single-page application with multiple views using React Router. - Build a shopping cart application using Redux for state management.	
8 Hours	

UNIT V	
MERN Stack Integration: MERN Stack Integration Full stack application architecture, Connecting frontend and backend, Deployment strategies, Performance optimization.	
Experiments: - Create a complete MERN stack application with user registration and login. - Develop a real-time chat application using Socket.io integration.	
8 Hours	

TEXT BOOKS		
1	Alex Banks and Eve Porcello	Learning React: Functional Web Development with React and Redux, O'Reilly Media, 2nd Edition, 2020 , ISBN: 978-1492051718.
2	Chirag Meghwal	Mastering MERN Stack Development: From Beginner to Pro, Kindle Edition, 2024
3	Nabendu Biswas	Ultimate Full-Stack Web Development with MERN, Kindle Edition, 2023, ISBN-10: 8119416422
4	Accomazzo, Murra and Seltzer	Fullstack React: The Complete Guide to ReactJS 2nd Edition, 2020, ISBN: 978-0991344620,

REFERENCE BOOKS		
1	Shama Hoque	Full-Stack React Projects, Kindle Edition, 2nd Edition, 2020

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Set up a Node.js and MongoDB environment, use Node.js to connect to a MongoDB database, and implement basic CRUD functionality
CO2	Create secure RESTful APIs using Express.js, demonstrating proficiency in middleware, routing, and JWT authentication
CO3	Master React templates, data binding, and state management with JSX, controlled components, and the Context API
CO4	Build complex React applications, expertly managing state and routing, and creating reusable components
CO5	Construct and deploy a complete MERN stack application, establishing seamless communication between client and server.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2	2	2	1			1
	CO2	2	2	2	2	1			1
	CO3	2	2	2	2	1			1
	CO4	2	2	2	2	1			1
	CO5	2	2	2	2	1			1

1: Low, 2: Medium, 3: High

Object Oriented Programming with Java

Contact Hours/ Week:	3	Credits:	04
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S2MC03	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Comprehend the fundamental concepts of Java environment and Object oriented
2.	programming, interpretation of Classes, Objects and the various methods usage.
3.	Interpret and implement Java basic programming with the concepts such as packages, inheritance, interfaces and usage of exceptions and I/O streams.
4.	Interpret and implement of Thread life cycle methods, multi-threading, synchronization and running Applets.

UNIT I

Java Programming Fundamentals: The Java Language, The Key Attributes of Object-Oriented Programming, The Java Development Kit, A First Simple Program, Handling Syntax Errors, The Java Keywords, Identifiers in Java, The Java Class Libraries.

Introducing Classes, Objects and Methods

Class Fundamentals, How Objects are Created, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors, The new operator Revisited, Garbage Collection and Finalizers, The this Keyword.

8 Hours

UNIT II

A Closer Look at Methods and Classes: Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes, Varargs: Variable-Length Arguments.

Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why Overridden Methods, Using Abstract Classes, Using final, The Object Class.

8 Hours

UNIT III

Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Constants in Interfaces, Interfaces can be extended, Nested Interfaces, Final Thoughts on Interfaces.
Packages : Package Fundamentals, Packages and Member Access, Importing Packages, Static Import.

The Exception Handling: Exception Handling Fundamentals, The Consequences of an Uncaught Exception, Exceptions Enable you to handle errors gracefully, using Multiple catch clauses, Catching subclass Exceptions, try blocks can be nested, Throwing an Exception, A

Closer look at Throwable, using finally, using throws, Java's Built-in Exceptions, New Exception features added by JDK 7, Creating Exception Subclasses.

8 Hours

UNIT IV

Multithreading fundamentals The Thread Class and Runnable Interface, Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities, synchronization, using Synchronization Methods, The Synchronized Statement, Thread Communication using notify(), wait() and notify All(), suspending, Resuming and stopping Threads.

8 Hours

UNIT V

Auto boxing and Annotations

Enumerations, Java Enumeration are class types, The Values () and Valueof() Methods, Constructors, methods, instance variables and enumerations, Auto boxing, Annotations (metadata) Networking with Java.net

Networking fundamentals The Networking classes and Interfaces, The InetAddress class, The Socket Class, The URL class, The URLConnection Class, The HttpURL Connection Class.

8 Hours

TEXT BOOKS

1	Herbert Schildt	Java: The Complete Reference, Tata McGraw-Hill, 12 th Edition, 2022,
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REFERENCE BOOKS

1	E.Bala guruswamy	Programming with Java, Tata McGraw-Hill, 6 th Edition, 2019
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WEB LINKS:

1	https://www.roseindia.net/
2	https://javatpoint.com/
3	https://tutorialspoint.com/

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Apply the concept of class and objects with access control to represent real world entities.
CO2	Identify and review the types of methods, class and inheritance concept.
CO3	Investigate the concept of interface, usage of package and review the run time exceptions.
CO4	Analyze the thread concepts, communication and synchronization.
CO5	Review the network fundamentals, enumerations, annotations and auto boxing wrapping class.

Course Articulation Matrix

		Program Outcomes							
		1	2	3	4	5	6	7	8
COs	CO1	2	2	1	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			
	CO5	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Computer Networks

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S2MC04	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Impart knowledge on of computer networks by going through basic terminologies and concepts
2.	Study the conceptual and implementation aspects of network applications, including application layer protocols, clients, servers, processes and interfaces
3.	Understand the principles as to how two entities can communicate reliably over a medium through series of complicated scenarios.
4.	Understand how forwarding and routing functions of the network layer.
5.	Recall the different types of link layer channels, Random access protocols and basic networking hardware transmission technologies of a network.

UNIT – I

Introduction to Computer Networks, Protocol layers: Computer Networks and the Internet: The network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and their Service Models, Networks under attacks.

08 Hours

UNIT – II

Application Layer: Application Layer: Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet-SMTP, DNS- The Internet's Directory Service: Services provided by DNS, overview of how DNS works.

08 Hours

UNIT – III

Transport Layer: Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, UDP checksum, Principles of Reliable Data Transfer, Connection-Oriented Transport-TCP, positive and negative acknowledgements, ARQ protocols, Go-Back-N protocol, SR protocol.

08 Hours

UNIT – IV

Network Layer: Overview of Network Layer, introduction to Router The Internet Protocol (IP), IPv4 datagram format, fields, functions. IPv6 protocol, format, fields, differences between IPv4 and IPv6.

08 Hours

UNIT – V

Date Link Layer: Introduction to the link layer, Error-Detection and Correction Techniques, Multiple Access Links and Protocols: Channel Partition, Random Access protocols, Dynamic host configuration protocol-DHCP.

Physical layer: Guided transmission media, magnetic media and twisted pairs, coaxial cables, fiber optic cables, satellite communication. Wireless networks, components of wireless networks, network characteristics.

08 Hours

TEXT BOOKS:

1.	James F Kurose and Keith W Ross “Computer Networking”: A Top-Down Approach (9 th Edition), Pearson Publication, 2023
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REFERENCE BOOKS:

1.	Andrew S. Tanenbaum and David J. Wetherill,	“Computer Networks”, Prentice Hall, 5th edition, 2014.
2.	Larry L Peterson and Bruce S. Davie,	"Computer Networks": A Systems Approach, Morgan Kaufmann, 6th Edition,. 2016.

WEB LINKS:

1.	https://gaia.cs.umass.edu/kurose_ross/lectures.php
2.	https://gaia.cs.umass.edu/kurose_ross/interactive/
3.	https://gaia.cs.umass.edu/kurose_ross/knowledgechecks/
4.	https://nptel.ac.in/courses/106105081
5.	https://archive.nptel.ac.in/courses/106/105/106105183/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Identify the different network components and layers.
CO2.	Identify and review the functionalities of the predominant protocols of application layer.
CO3.	Review the functionalities and services of Transport layer.
CO4.	Identify and analysis the functionalities of network layer.
CO5.	Identify and analysis the various functionalities of link layer protocols and transmission technologies of a network.

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	3	2	1		1			
	CO2	2	2	1		1			
	CO3	2	2	1		1			
	CO4	3	2	1		1			
	CO5			3		1			

1: Low, 2: Medium, 3: High

Artificial Intelligence and Machine Learning

Contact Hours/ Week:	03+02(L+T)	Credits:	04
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S2MC05	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Realize the significance of Machine learning and data pre-processing
2.	Understanding the data mining algorithms for classification
3.	Understanding association and clustering techniques

UNIT – I

Introduction to artificial intelligence Acting humanly and thinking humanly, thinking rationally and acting rationally, Intelligent Agents: Agents and Environments, Good Behaviour: The concept of Rationality: Rationality, Omniscience, Learning and autonomy, The nature of Environments: specifying the task environment, properties of task environments, The structure of Agents: Agent Programs, simple reflex agents, Model-based reflex agents, Goal-based agents, Utility based agents, Learning agents, How the components of agents programme work

08 Hours

UNIT – II

Introduction to Machine learning. Applications of machine learning. Types of data interval-scaled variables, binary variables, categorical, ordinal, ratio-scaled variables, Data Pre-processing: Why pre-process data, Descriptive data summarization – measuring the central tendency, dispersion of data, Data cleaning - missing values, noisy data, data cleaning as process, Data integration and Transformation , data reduction – data cube aggregation, attribute subset selection.

08 Hours

UNIT – III

Introduction to classification and prediction, Classification by decision tree induction algorithm, attribute selection method: information gain, gain ratio, Gini index. Lazy learners: k-nearest-neighbor classifier, Prediction: Linear regression.

08 Hours

UNIT – IV

Bayesian Classifier, Rule based classifier, Accuracy and error measures- classifier accuracy measure, predictor error measures, evaluating the accuracy of a classifier or predictor – holdout method and random sub sampling, cross validation, bootstrap. Introduction of ensemble method bagging, Model selection: ROC curves

08 Hours

UNIT – V

Introduction to is Cluster analysis, Typical requirements of clustering, A categorization of major clustering methods, Partitioning Methods: The K-means method, K-medoids clustering, Hierarchical methods: Agglomerative and Divisive hierarchical clustering, plotting Dendrogram, Measures for distance between clusters: Minimum distance, maximum distance, average distance. Density based methods : DBSCAN

08 Hours

TEXT BOOKS:

1.	Jiawei Han & Micheline Kamber,	Data Mining Concepts and Techniques , Morgan Kaufmann Publishers – 4 th Edition, 2023
2	Stuart Russel PeterNorvig,	Artificial Intelligence: A Modern Approach, Pearson Education, 4th edition, 2020

REFERENCE BOOKS:

1.	Tom M. Mitchell,	Machine Learning, McGraw Hill Education, First Edition, 2017
2.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar	Introduction to Data mining, Pearson Education , 2020

WEB LINKS:

1.	https://www.geeksforgeeks.org/machine-learning/
2.	https://www.w3schools.com/python/python_ml_getting_started.asp
3.	https://www.javatpoint.com/machine-learning

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Analyse and develop Artificial Intelligent agents for simple applications.
CO2	Apply data preprocessing steps for real world data applications
CO3	Analyze various classification techniques and their applications
CO4	Analyze various clustering techniques and their applications

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	1	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Software Engineering & Project Management

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S2MC02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the foundations of software engineering and recognize its significance in professional practice.
2.	Explain the concepts of software products and software development processes.
3.	Recognize the importance of professional and ethical responsibility in software engineering.
4.	Manage and deliver software projects that align with organizational goals and strategic objectives.
5.	Apply project management principles to plan and control each stage of the Software Development Life Cycle (SDLC).
6.	Develop effective project plans that address real-world challenges in software engineering and project management.

UNIT I

Introduction to Professional Software Development and Ethics:

Professionalism in Software Engineering, Software Engineering Ethics, and IEEE/ACM Code of Ethics

Software Processes and Methodologies:

Overview of Software Processes, Waterfall, Incremental, and Plan-Driven Models, The Rational Unified Process (RUP), Extreme Programming (XP) and Scrum, Introduction to DevOps and DevOps vs. Agile, Case Study: Selecting Development Method for Real-world Problems.

8 Hours

UNIT II

Requirements Engineering: Software Requirements: Functional and Non-functional requirements; User requirements; System requirements; Interface specification; the software requirements document, Requirements Specification, Characteristics and components of SRS, Structure of SRS (IEEE format)

Requirements Engineering Processes: Feasibility studies; Requirements elicitation and analysis; Requirements validation; Requirements management.

8 Hours

UNIT III

System Modeling and Architectural Design:

Context models; Structural models; Behavioral models; Model driven engineering, Architectural Design: Architectural design decisions, Architectural patterns; Interaction Modeling: Use case models, Sequence diagrams; Structural modeling : Classdiagrams;

Agile Software Development and Project Management Overview:

Agile Methods and Principles; Plan- Driven and Agile Development; Agile Project Management; Scaling Agile Methods.

8 Hours

UNIT IV

Introduction to Project Management

Understanding the Importance of Software Project Management

Importance of software project management: introduction to project and Project Management, Problems with Software Projects Stages of Project. The Feasibility Study Planning. Project Execution. The Stakeholder of Project. All parties of project. The Role of Project Manager. Project Management Framework Project Planning

Integration Management. introduction to Integration Management. Project Plan Development. Plan Execution. Scope Management, Methods for Selecting Projects. Project Charter. Scope Statement. Work Breakdown Structure. Stepwise Project Planning Overview. Main Steps in Project Planning.

8 Hours

UNIT V

Project Scheduling

Time Management. Importance of Project Schedules. Schedules and Activities. Sequencing and Scheduling Activity. Project Network Diagrams. Network Planning Models. Duration Estimating and Schedule Development. Critical Path Analysis. Program Evaluation and Review Technique (PERT).

Project Quality Management

Quality of Information Technology Projects. Stages of Software Quality Management Quality Planning. Quality Assurance. Quality Control. Quality Standards. Tools and Techniques For Quality Control.

Project Communication Management

Communications Planning. Information Distribution. Performance Reporting. Administrative Closure. Suggestions for Improving Project Communications.

8 Hours

TEXT BOOKS

1	Ian Sommerville	Software Engineering, Pearson Education Ltd, 10 th Edition, 2017.
2	Kathy Schwalbe,	Information Technology Project Management, Course Technology Inc , 10 th Edition 2018.

REFERENCE BOOKS

1	Roger .S. Pressman	Software Engineering-A Practitioners approach, , McGraw-Hill, 7 th edition ,2009.
2	Waman S Jawadekar	Software Engineering Principles and Practice, McGraw-Hill , 1 st edition, 2004.
3	Kshirasagara Naik, Priyadarshi Tripathy	Software Testing and Quality Assurance, Wiley India 2012 2. M.G.Limaye: Software Testing-Principles, Techniques and Tools – McGraw Hill, 2009

WEB LINKS:	
1.	IEEE/ACM Code of Ethics: https://ethics.acm.org
2.	Software Process Models Overview: https://www.geeksforgeeks.org/software-engineering-software-processes/
3.	DevOps vs Agile: https://www.atlassian.com/devops/devops-tools/devops-vs-agile
4.	IEEE SRS Standard: https://ieeexplore.ieee.org/document/720574
5.	Requirements Engineering Overview: https://www.tutorialspoint.com/software_engineering/software_requirements.htm
6.	UML Diagrams Basics: https://www.uml-diagrams.org/
7.	Architectural Design Patterns: https://www.geeksforgeeks.org/software-architecture-patterns/
8.	Agile Methods & Principles: https://agilemanifesto.org/
9.	https://www.tutorialspoint.com/software_engineering/software_project_management.htm

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyze and apply professional and ethical principles in software development based on IEEE/ACM codes and industry standards, while selecting and utilizing appropriate methodologies such as Waterfall, RUP, XP, Scrum, and DevOps for real-world problem scenarios.
CO2	Develop a comprehensive Software Requirements Specification (SRS) using IEEE standards by identifying various types of requirements and applying the complete requirements engineering process.
CO3	Design and interpret system models and architectural patterns and apply Agile methodologies and project management principles in software development.
CO4	Demonstrate an understanding of software project management by describing project life cycle stages and applying scope and integration management in planning.
CO5	Apply project scheduling and quality management techniques, including network diagrams, critical path analysis, and communication planning.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2			1			
	CO2	2	2			1			
	CO3	2	2			1			
	CO4	2	2			1			
	CO5	2	2	2	2	1	2		

1: Low, 2: Medium, 3: High

Database Lab

Contact Hours/ Week:	2	Credits:	01
Total Lecture Hours:	36	CIE Marks:	50
Course Code:	S2MCL1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Design and implement SQL queries in DBMS
2.	Implement the features of PL/SQL programming objects.
3.	Design and implement NoSQL queries in DBMS.
4.	Compare the performance of SQL and NoSQL queriesL.

Part A: SQL Programming

Practical-1

Consider the following tables with their attributes

Staff (StaffId, StaffName, JoinDate, Qualification, Designation, Salary, BranchId)

Branch (BranchId, BranchName, Intake)

Create the above tables by properly specifying the primary keys and the foreign keys.

Enter atleast ten tuples (i.e. records) for each relation (i.e. table).

Write the SQL Queries for the following requirements

- 1) List the staff details who hold the Ph. D degree and are working in a particular branch.
- 2) List the staff details who are drawing the salary in the range of 50000 to 80000.
- 3) List the staff name whose name starts with 'R' as first character and 'A' as the 3rd character.
- 4) List the staff details who have joined the institution in the month of January.
- 5) List the staff details who are working in a particular branch where number of intake is exceeding 60 students.
- 6) List the branch names along with number of staff members working in each branch, sum of their salaries and average of their salaries.
- 7) List the staff members who have finished their service by more than 100 months.
- 8) List the Branch name in which number of staff members working is exceeding by 2.
- 9) Update the salary of the staff members by increasing 25% who are working in a particular branch where intake is 60 students.
- 10) Delete the staff member who is drawing a highest salary in a particular branch.

Practical-2

Consider the following relations for an order processing database application in a company.

CUSTOMER (CustomerId, CustomerName, City, ContactNo)

ITEM (ItemId, ItemName, Unitprice)

CORDER (OrderId, OrderDate, CustomerId)

ORDER-ITEM (OrderId, ItemId, Quantity)

WAREHOUSE (WarehouseId, WarehouseName, Address)

SHIPMENT (OrderId, WarehouseId, ShipDate)

Create the above tables by properly specifying the primary keys and the foreign keys.
Enter at least ten tuples for each relation.

Execute SQL queries for the following requirements:

- 1) List the order details done by a particular customer belongs to a particular city.
- 2) List the item details purchased by a particular customer whose total quantity items are exceeding by 5.
- 3) List the Customer details belong to a particular city and whose contact no ends with “__222”
- 4) List the customer name, number of orders they made, their total ordered amount and their average ordered amount for all the customers:
- 5) List all warehouses and number of orders they obtained from different customers.
- 6) List the warehouse which has got number of orders more than 2.
- 7) List the warehouse which has received number of orders in the month of January.

Practical – 3

Consider the following database of student enrollment in courses and books adopted for each course.

STUDENT (USN, StudentName, Dob, Gender, Class)

COURSE (CourseNo, CourseName, Department)

TEXT (BookId, BookTitle, Publisher, Author)

ENROLL (USN, CourseNo, Semester, Marks)

BOOK_ADOPTION (CourseNo, BookId, Semester)

Create the above tables by properly specifying the primary keys and the foreign keys
Enter at least 10 records to each table.

Execute SQL queries for the following requirements:

- 1) List the student details and their course details for a particular semester.
- 2) List the student details under a particular department whose name is ordered in an ascending order.
- 3) List all the book details under a particular course.
- 4) List the courses in which number of students enrolled will be more than 2.
- 5) List the publisher who has published more than 2 books.
- 6) List the author details who has authored more than 2 books.
- 7) List the author details who have written book for I semester, computer science course.
- 8) List only the girls student details whose total number of months starting from their date of birth is more than 200.
- 9) Update the marks by giving grace marks of 15 % to the boys student who has scored lowest in his class of a particular course.
- 10) List the course to which maximum number of students have joined.

Practical – 4

Consider the following Employee database.

Department (Deptno, Deptname, Location)

Employee (EmpNo, EmpName, Job, Manager, HireDate, Salary, Commission, Deptno)

SalaryGrade (Grade, LowSalary, HighSalary)

Create the above tables by properly specifying the primary keys and the foreign keys
Enter at least ten tuples for each relation.

Execute SQL queries for the following requirements:

- 1) List employee names who have joined between the months July to December of the year 1981.
- 2) List employee details including department and their grade based on the salary of all the employees except clerks.
- 3) List the employees whose name should not start with a letter 'A' and should not end with a letter 'A' but it should be there in the name.
- 4) Find all the employees who have joined the company before their managers
- 5) List the name of employees who have finished their 25 years of experience in the company.
- 6) List the employee name, salary, PF, HRA, DA and gross; order the results in the ascending order of gross. (PF is 10%, HRA is 50%, DA is 30% of the salary and gross is sum of salary, PF, HRA & DA)
- 7) List the departments for which no employee is working.
- 8) List the department name, number of employees working, total salary, average salary, maximum salary and minimum salary in each of the department.
- 9) List year in which most of the employees have joined the organization (Display the year and no of employees).
- 10) List the department in which maximum number of employees working.

Part B: PL/SQL Programming**Practical – 5**

Consider the following table :

Login (LoginId, LoginName, Password, FirstName, LastName)

Write a stored procedure to validate Login name and password with following cases

Case-1: Procedure has to check the existence of login name.

Case-2: Procedure has to validate password with existing login name

Note: Procedure has to rise the proper exceptions in both the cases.

Practical – 6

Consider the following table :

Product (ProductId, ProductName, ProductType, PricePerUnit)

Write a PL/SQL Package to auto generated product id and insert the values in to the above table by considering following cases.

Case-1: Package has to check the existence of records.

Case-2: Package has to generate the next number if there are records already exists.

Note: Package has to rise the proper exceptions in both the cases.

Practical – 7

Consider the following table :

Product (ProductId, ProductName, ProductType, PricePerUnit)

Write appropriate triggers by considering following events based on the above table.

Case-1: A trigger before insert / after insert

Case-2: A trigger before update / after update

Case-3: A trigger before delete / after delete

Part C: NoSQL Programming**Practical- 8**

Create the below Collections, insert suitable tuples and perform the following operations using MongoDB

Employee (SSN, Name, Job, Salary)

Project (ProjectNo, ProjectName, Duration)

Assigned_To (SSN, ProjectNo, NoofHours)

- List the employees who are working with a particular designation
- List the employees who are drawing the salary greater than 35000
- List the employees who are working as Analyst and drawing the salary greater than 35000
- List the employees who are working for a particular project.
- Update the employee salary with a new value for particular employee.

Practical-9

Create the below Collections, insert suitable tuples and perform the following operations using MongoDB

Part (PartNo, PartName, Price, Colour),

Supplier (SupplierNo, SupplierName, Address)

Part_Supplier(PartNo, SupplierNo, SupplyDate, Quantity)

- List the supplier name who are supplying particular parts
- List the SteelGrey colored Part names whose price greater than 1000
- List the part names which are supplied by suppliers from a particular address.
- Update the price of the White colored parts with a new price.
- Remove the suppliers who are supplying parts from a particular address.

Practical-10

Create the below Collections, insert suitable tuples and perform the following operations using MongoDB

Book (ISBN, Title, Price, Author, Publisher)

Student (Usn, StudentName, Class, Gender)

Borrow (ISBN, Usn, BorrowedDate)

- List the Book titles in which there is a particular keyword pattern "Computing".

- b) Obtain the Names of students who have borrowed DBMS books.
- c) List the Author names who have authored more than 1 Book.
- d) List the Publisher names who have published more than 2 Books.
- e) List the student names who have borrowed more than 1 Book.

Course Outcomes:

After the completion of this course, students will be able to:

CO1	Construct a database by using data definition, data manipulation and control languages.
CO2	Analyze and formulate SQL queries for the given relational database schema.
CO3	Implement PL/SQL programming objects for the given relational database schema.
CO4	Analyze and apply NoSQL techniques of non-relational database to solve real time applications.

Course Articulation Matrix :

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	1	1			
CO2	2	2	2	1	1			
CO3	2	2	2	1	1			
CO4	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Object Oriented Programming with Java Lab

Contact Hours/ Week:	2	Credits:	01
Total Lecture Hours:	36	CIE Marks:	50
Course Code:	S2MCL3	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Design and build Java applications with the implementation of basic Java object oriented methods dynamically.
2.	Implement the mutable and immutable elements and console based implementation of Java String and Thread API .
3.	Design and build Java web applications and implement the usage of packages and enumerations.

Sl.no	Programs
1.	Program on object oriented concepts
2.	Program on this keyword
3	Programs on method overloading and overriding
4	Program on Varargs
5.	Programs on inheritance concepts
6.	Programs on packages
7.	Programs on abstract classes and interfaces
8.	Programs on Exception handling
9.	Programs on multithreading
10.	Programs on autoboxing and annotation

WEB LINKS:

1.	https://www.roseindia.net/
2.	https://javatpoint.com/
3.	https://tutorialspoint.com/
4.	https://w3schools.com/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Apply the Object-Oriented programming language features.
CO2	Design and develop the concept of inheritance, interfaces and packages.
CO3	Analysis & develop the run time exception handling.
CO4	Identify the concept of multithreading, autoboxing and annotation.

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	2	1	1			
	CO2	2	2	2	1	1			
	CO3	2	2	2	1	1			
	CO4	2	2	2	1	1			

1: Low, 2: Medium, 3: High

Soft Skills

Contact Hours/Week	:	3	Credits	:	0
Total Lecture Hours	:	3	CIE Marks	:	100
Course Code:	:	S2MCSS	SEE Marks	:	-

Course Objectives:

This Course will enable students :	
1.	To make the students aware of the importance of soft skills in the present-day business world and work environment
2.	To learn the science behind picking up any skill quickly
3.	To help students realize as well as develop key soft skills interviewers look for – such as changemanagement, professionalism, inter- and intra-personal skills, adaptability etc.
4.	To develop effective resumes (paper-based as well as video)
5	To understand the importance of and create an effective digital footprint
6	To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
7	To understand professional etiquette to be displayed in workplaces.

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies.

Day	#	Topic	Sub-topics covered	Duration (Hrs)
1.	1	How to pick up skills faster?	1. Knowledge vs skill 2. Skill introspection 3. Skill acquisition 4. "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction 1.Interpersonal Communication 2.Peer Communication 3.Bonding 4.Types of social interaction Emotional Management Responsibility 1. Types of responsibilities 2. Moral and personal responsibilities	2
	3.	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette Telephone etiquette Email and business correspondence etiquette	2
2.	4	Change Management	Who moved my cheese? Tolerance of change and uncertainty Joining the Bandwagon Adapting change for growth – overcoming inhibition Adapt to changes(tolerance of change and uncertainty) Adaptability Curve Survivor syndrome	2
	5	Creating a digital footprint	1.How what you post online / information online can affect people's and recruiter's perception about you 2. Usage of LinkedIn to further one's career prospects	2

			3. Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself Why is it important to leave a digital footprint?	
	6	Time Management	Prioritization - Time Busters Procrastination Scheduling Multitasking Monitoring Working under pressure and adhering to deadlines	2
3	7	Group Discussion –Basics	1.Importance of GDround Skills assessed in a GD How to ace a GD Dos and don'ts in a GD Idea generation techniques One mock GD involving participation from 12 volunteers, facilitated by the trainer	2
	8	Personal Interview - Basics	Self-introduction practice. Body language – especially grooming for personal interview. Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	1. How to write a good and impressive Resume. 2. Important aspects of an impressive resume.3.Sample template and formatting ideas.	2
4	10	Group Discussion – Advanced	GD sample Video with analysis and discussion.GD Dos and Don'ts – Worksheet practice. Role-plays for Dos and Don'ts. Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	1.Extensive discussion on PI FAQs. 2.Interview questions from based on resume - discussion. 3. PI Videos – discussion and analysis. 4. Highlighting successful answers for PI:3 questions.5.Body language during a personal interview. 6.Unconventional types of interviews (Stress, panel, MR, guess estimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	1. Resume writing – Worksheet practice. 2. 3 stage Resume drafting. 3. Rough draft-1. 4. Rough draft -2. 5. Fair draft. 6. Discussion on specific aspects of an impressive Resume. 8. Creating a video resume	3
	13	Setting and achieving Targets	Ambition, goal, passion and career objective - difference SMART goals and Action plans Obstacles -Failure management (case studies)	1.5
	14	Introspection	Identify your USP - Unique Selling Proposition Recognize your strengths and weakness (SWOT) Nurture strengths Fixing weakness Overcoming your complex Confidence building	1.5
6	15	Group Discussion - Mock	1. Mock Group Discussions featuring group of 10 people, with each GD lasting for 15 minutes. 2. Detailed feedback for each participant	3

			3.Introspection by the audience to add value to the GD	
	16	Personal Interview - Mock	1. Mock personal interview for a sample set of candidates 2. Simulate the real personal interview experience. 3. Individual feedback and areas of improvements are shared.	3
ASSESSMENTS PROVIDED The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills. 1. Team building tasks (Inside training hours) 2. Participation in group activities (Inside training hours) 3. Psychometric test 4. Creating a resume				

1.	'Who moved my Cheese?' by Spencer Johnson
2.	'Outliers' by Malcolm Gladwell
3.	'Emotional Intelligence' by Daniel Goleman 'Road Less Travelled' by Scott Peck M.
4.	'How to win friends and influence people' by Dale Carnegie
5.	'Who moved my Cheese?' by Spencer Johnson

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Display key soft skills expected by recruiters
CO2	Apply scientific methods to learn any skill quickly
CO3	Participate in Group Discussions and Personal Interviews effectively
CO4	Create effective resumes that impress interviewers (paper-based as well as video)
CO5	Apply professional etiquette to be displayed in various workplace scenarios

Soft Skills (0 Credit)

Description	Schedule	Conducted for
Activity-1	In regular class	20 marks
Activity-2	In regular class	20 marks
Activity-3	In regular class	20 marks
Activity-4	In regular class	20 marks
Activity-5	In regular class	20 marks
CIE		100 marks

Minimum marks to pass the course is 50% of total CIE.

No SEE component for Soft Skills.

III Semester

Specialization A (AI and Data Science)

Data Analytics

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCA1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Apply various locations, shape and dispersion measures and interpret the results for better understanding of data
2.	Use various visualization techniques and interpret the plots for understanding data
3.	Apply different types of correlation among data to interpret the association among data and interpret the outcome
4.	Apply various time series forecasting method for prediction and interpret the outcome
5.	Apply various types of hypothesis testing and interpret the outcome.

UNIT I

Introduction to Data analytics, Difference between data mining, data science and data analysis, descriptive and inferential statistics. Attribute understanding: types of attributes (numerical). Types of Attributes (categorical), Data Quality issues. Descriptive Statistics : Characteristic Measures for one dimensional data – Locations measures (ungrouped data), Dispersion measures , Shape measures (ungrouped data), Location measures with grouped data, Dispersion measures for grouped data, Shape measures for grouped data, One dimensional Data Visualization : histogram, bar chart, pie-chart, stem and leaf, One dimensional Data Visualization : boxplot; 2D plot: Scatter plot, Frequency distribution Table, ogive plot

8 Hours**UNIT II**

Visualization Methods for Higher dimensional data: Parallel Coordinates, Radar Plot, Characteristics Measures for Multidimensional Data: Correlation analysis- Pearson's Correlations coefficient. Ranks correlation – Spearman's rank correlation (without tie case), Ranks correlation – Spearman's rank correlation (with tie case), Kendall's tau rank correlation coefficient (without tie case), Kendall's tau rank correlation coefficient (with tie case), Linear Regression, Outlier Detection for single and multidimensional data, Multiple correlations, Partial correlation coefficients.

8 Hours**UNIT III**

Time series Analysis: Importance of Time series analysis, components of a time series, Trend of time series using method of simple moving average, Simple weighted moving average, weighted moving centred average method, Centred moving average (Odd and even years), Trend chart, Method of least square, Linear regression method for forecasting, Simple

exponential smoothing, Adjusted exponential smoothing, Forecasting using seasonal indexing
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8 Hours

UNIT IV

Testing of Hypothesis – Introduction to hypothesis testing, Procedure of testing hypothesis, Type I error, Tails of a test, Z test : Lower Tail Test of Population Mean with known variance, Upper Tail Test of Population Mean with known Variance, Two-Tailed Test of Population Mean with Known Variance, t test : Lower Tail Test of Population Mean with Unknown Variance, Upper Tail Test of Population Mean with Unknown Variance, Two-Tailed Test of Population Mean with Unknown Variance, Chi-square distribution- properties, Chi-square distribution the goodness of fit test, Chi-square distribution test of independence, Chi-square distribution test of homogeneity.

8 Hours

UNIT V

Data Preparation: Select Data – Feature Selection, Dimensionality Reduction Record Selection. Clean data – improve data quality, missing values. Construct data – Provide operability, assure impartiality (Data transformation). Data Integration: Vertical and Horizontal data integration (different types of joins). Data analysis process- CRISP-DM process.

8 Hours

TEXT BOOKS

- | | | |
|---|--|---|
| 1 | Michael R. Berthod, Christian Borgelt, Frank Hoppner | Guide to Intelligent Data Analysis, Springer Series, 2020 |
| 2 | G C Beri | Business Statistics, 3rd Edition. Tata Mc-GrawHill, 2017 |

REFERENCE BOOKS

- | | |
|---|---|
| 1 | Christina Albright, Wayne L. Winston, Business Analytics: Data Analysis and Decision Making, CENGAGE 5th edition, 2020
Web resource: http://www.r-tutor.com/elementary-statistics/hypothesis-testing |
|---|---|

Course Outcomes:

Upon completion of this course the student will be able to:

- | | |
|-----|---|
| CO1 | Apply various Data Preparation methods; Compute various locations, shape and dispersion measures and interpret the results. |
| CO2 | Apply various visualization techniques and interpret the plots. |
| CO3 | Apply different types of correlation methods among data to interpret the association among data. |
| CO4 | Apply various time series forecasting method for prediction and interpret the outcome. |
| CO5 | Apply various types of hypothesis testing and interpret the outcome. |

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2	1					
	CO2	2	2	1					
	CO3	2	2	1					
	CO4	2	2	1					
	CO5	2	2	1					

1: Low, 2: Medium, 3: High

Generative AI and Prompt Engineering

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCA2	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	To provide a comprehensive understanding of generative AI models and their applications.
2.	To explore the key components and workings of LangChain and its comparison with other frameworks.
3.	To develop skills for building and implementing chatbots using advanced retrieval and vector techniques.
4.	To introduce the fundamentals and importance of prompt engineering in AI communication.
5.	To equip students with best practices and strategies for writing effective prompts and addressing common challenges in prompt engineering.

UNIT I

Introducing generative AI: Generative models, Understanding LLMs, Other LLMs, Major players, Working of GPT models, Pre-training, Tokenization, Scaling, Conditioning, text-to-image models, LangChain for LLM Apps: Going beyond stochastic parrots, limitations of LLMs, mitigating LLM limitations, LLM app.

8 Hours

UNIT II

Exploring key components of LangChain, chains, agents, memory, tools, working of LangChain, Comparing LangChain with other frameworks, Building a Chatbot like ChatGPT: introduction to chatbot, Understanding retrieval and vectors, Embeddings, Vector storage, Vector indexing, Vector libraries, Vector databases, Loading and retrieving in LangChain, Document loaders, Retrievers in LangChain, kNN retriever, PubMed retriever, Custom retrievers

8 Hours

UNIT III

Implementing a chatbot, Document loader, Vector storage, Memory, The Future of Generative Models, The current state of generative AI, Challenges, Economic consequences: Creative industries and advertising, Education, Law, Manufacturing, Medicine, Military, Societal implications: Misinformation and cyber security, Regulations and implementation challenges.

8 Hours

UNIT IV

Introduction to ChatGPT, Overview of Large Language Models, Output Formats Generated By ChatGPT, Use Cases for ChatGPT, Differences Between ChatGPT and Web Search,

Introduction to Prompt Engineering: Definition of Prompt Engineering, Importance of Prompt Engineering in AI Communications, Overview of the Different Types of Prompts, Understanding the Foundation of Prompt Engineering, Power Up Your Prompts With Effective Verbs, Elevate Your Prompts with Nuances of Tone, Progressive Experimentation for Refining Prompts

8 Hours

UNIT V

Writing Effective Prompts, Key Attributes of Good Prompt Writing, Tips for Getting the Most Out of Prompt Responses, Best Practices in Prompt Engineering: Understanding the Nuances of Language & Tone, Testing & Iterating Prompts for Improved Performance, Incorporating Feedback from AI Models to Refine Prompts, Enhancing Reliability of Responses, Give More "Think Time" to the Model, Staying Up to Date with the Latest Advancements, Tips for Getting the Most Out of Prompt Responses, Challenges in Prompt Engineering: Addressing Common Challenges & Pitfalls, Strategies for Improving Prompt Effectiveness, Ethical Considerations in Prompt Engineering.

8 Hours

TEXT BOOKS

1	Ben Auffarth	Generative AI with LangChain, Packt Publishing Ltd., 1st Edition, 2023
2	Harish Bhat	Demystifying Prompt Engineering, Harish Bhat, 1 st Edition, 2023

REFERENCE BOOKS

1	David Foster	"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play., O'Reilly Media, 2nd Edition, 2023
2	James Phoenix, Mike Taylor	Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs, O'Reilly Media, 1 st Edition, 2024

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Gain a solid understanding of generative AI models, including large language models and text-to-image models.
CO2	Utilize LangChain for developing advanced LLM applications and understand its components and functionalities.
CO3	Develop skills in implementing chatbots, managing vector storage
CO4	Understand the principles of prompt engineering and learn how to design effective prompts for various AI applications.
CO5	Apply best practices in prompt engineering, address challenges, and incorporate ethical considerations in their work.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2			1			
	CO2	2	2			1			
	CO3	2	2			1			
	CO4	2	2		1	1			
	CO5	2	2			1			

1: Low, 2: Medium, 3: High

Deep Learning Fundamentals

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCA3	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the fundamentals of deep learning
2.	Understanding the working of Convolutional Neural Networks and RNN in decision making.
3.	Illustrate the strength and weaknesses of many popular deep learning approaches.
4.	Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems

UNIT I

Introduction: Neural Network. The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures

Rosenblatt's Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

8 Hours

UNIT II

Multilayer Perceptrons: Introduction, Some Preliminaries, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Computer Experiment: Pattern Classification, Back Propagation and Differentiation.

8 Hours

UNIT III

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under Constrained Problem, Dataset Augmentation, Semi-Supervised Learning.

Optimization for Training Deep Models: How Learning Differs from pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rate.

8 Hours

UNIT IV

Convolution Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or

Unsupervised Features, The Neuroscientific Basic for Convolutional Network, Convolutional Networks and the History of Deep Learning.

8 Hours

UNIT V

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.

8 Hours

TEXT BOOKS

1	Simon Haykin	Neural networks and Learning Machines, Third Edition, Pearson, 2016
2	Ian Goodfellow, Yoshua Bengio and Aaron Courville	Deep Learning, MIT Press, 2016.

REFERENCE BOOKS

1	Bengio, Yoshua	. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009
2	N.D. Lewis	"Deep Learning Made Easy with R: A Gentle Introduction for Data Science", 2016
3	Nikhil Buduma	"Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Gain knowledge on Deep Learning.
CO2	Design and implementation of Neural Networks.
CO3	Analyze and Optimize for Training Deep Models.
CO4	Apply advanced deep learning architecture.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	1	1		1			
	CO2	2	1	1		1			
	CO3	2	1	1		1			
	CO4	2	1	1		1			

1: Low, 2: Medium, 3: High

Business Intelligence

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCA4	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Explain the Decision Support systems and Business Intelligence framework.
2.	Illustrate the significance of computerised Decision Support and understand the mathematical modelling behind decision support.
3.	Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.
4.	Explore knowledge management, explain its activities, approaches, and its implementation.
5.	Describe the Expert systems, areas suitable for application of experts' system.

UNIT I

Decision Support and Business Intelligence: Opening Vignette , Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A Framework for Business Intelligence (BI), A Work System View of Decision Support

8 Hours

UNIT II

Decision Making Systems, Modelling and Support: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported, personality types, The decision makers.

Decision support system development: Introduction to DSS development, The traditional system development life cycle, Alternative development life cycle, Prototyping: The DSS development methodologies.

8 Hours

UNIT III

Business intelligence: Data Warehousing, Data Acquisition, Business Analytics & Visualization: The Nature and Sources of Data, Data Collection, Problems and Quality, The Web/Internet and Commercial Database Services, Database Management System in Business Intelligence, Data Warehousing, Data Marts, Business Intelligence, Online Analytical Processing, Data Mining, Data Visualization, Multidimensionality and Real Time Analytics, Business Intelligence, and the Web

8 Hours

UNIT IV	
Knowledge Management: Introduction to Knowledge Management, Organizational learning and transformation, Knowledge management initiatives, Approaches to knowledge management, Information technology in knowledge management, Knowledge management system implementation, roles of people in knowledge management, ensuring success of knowledge management.	
8 Hours	

UNIT V	
Expert system: Basics concepts of expert system, Applications of expert system, Structure of expert systems, How expert system works, Problems areas suitable for expert systems, Benefits and capabilities of expert systems, Problems and limitations of expert system, Expert system success factors, Types of expert systems, Expert systems on the web	
8 Hours	

TEXT BOOKS		
1	Sharda, R, Delen D, Turban E.	Business Intelligence, A Managerial Perspective on Analytics, Pearson, 2014
2	Efraim Turban , Jay E. Ting-Peng Liang	Decision support systems and intelligent systems, PHI, 7 th edition, 2010

REFERENCE BOOKS		
1	Ramesh Sharda, Dursun Delen Efraim Turban	Business Intelligence, Analytics, and Data Science, Pearson Education, 2019
2	Foster Provost & Tom Fawcett	Data Science for Business, O'Reilly Media, Inc, 2013

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework.
CO2	Describe the significance of computerised Decision Support, apply the basics of mathematics to understand the mathematical modelling behind decision support.
CO3	Illustrate Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.
CO4	Analyse the importance of knowledge management and explain its activities, approaches and its implementation.
CO5	Describe the Expert systems and analyse its development, discuss areas suitable for application of experts' system.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2			1			
	CO2	2	2			1			
	CO3	2	2			1			
	CO4	2	2			1			
	CO5	2	2			1			

1: Low, 2: Medium, 3: High

Specialization B (Security)

Mobile and Wireless Security

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCB1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand mobile and wireless communication fundamentals.
2.	Identify key security threats and vulnerabilities.
3.	Analyze security mechanisms in mobile and wireless systems.
4.	Design and implement security solutions
5.	Explore emerging trends and research areas

UNIT I

Security Issues in Mobile Communication: Mobile Communication History, Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application – level Security.

8 Hours

UNIT II

Security of Device, Network, and Server Levels: Mobile Devices Security Requirements, Mobile Wireless network level Security, Server Level Security. Application-Level Security in Wireless Networks: Application of WLANs, Wireless Threats, Some Vulnerabilities and Attack Methods over WLANs, Security for 1G Wi-Fi Applications, Security for 2G Wi-Fi Applications, Recent Security Schemes for Wi-Fi Applications

8 Hours

UNIT III

Application-Level Security in Cellular Networks: Generations of Cellular Networks, Security Issues and attacks in cellular networks, GSM Security for applications, GPRS Security for applications, UMTS security for applications, 3G security for applications, Some of Security and authentication Solutions.

8 Hours

UNIT IV

Application-Level Security in MANETs: MANETs, Some applications of MANETs, MANET Features, Security Challenges in MANETs, Security Attacks on MANETs, External Threats for MANET applications, Internal threats for MANET Applications, Some of the Security Solutions. Ubiquitous Computing, Need for Novel Security Schemes for UC, Security Challenges for UC, and Security Attacks on UC networks, Some of the security solutions for UC.

8 Hours

UNIT V	
Security for Mobile Commerce Application: M-commerce Initiatives, Security Challenges in Mobile E-commerce, Types of Attacks on Mobile E-commerce, A Secure M-commerce Model Based on Wireless Local Area Network, Some of M-Commerce Security Solutions	
8 Hours	

TEXT BOOKS		
1	Pallapa Venkataram, Satish Babu	Wireless and Mobile Network Security, 1st Edition, Tata McGraw Hill, 2010.
2	Frank Adelstein, K.S.Gupta	Fundamentals of Mobile and Pervasive Computing, 1st Edition, Tata McGraw Hill 2005.

REFERENCE BOOKS		
1	Randall k. Nichols, Panos C. Lekkas	Wireless Security Models, Threats and Solutions, 1st Edition, Tata McGraw Hill, 2006.
2	Bruce Potter and Bob Fleck:	802.11 Security, 1st Edition, SPD O'REILLY 2005.
3	James Kempf	Guide to Wireless Network Security, Springer. Wireless Internet Security – Architecture and Protocols, 1st Edition, Cambridge University Press, 2008

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Formalize the issues and technologies involved in designing wireless network.
CO2	Analyze various wireless network attacks and trade offs in protecting networks.
CO3	Apply various techniques in wireless and mobile security in solving real time problems.
CO4	Analyze various security problems involved in cloud computing.
CO5	Analyze various security issues related to GPRS and 3G.

Course Articulation Matrix

	POs								
		1	2	3	4	5	6	7	8
COs	CO1	2	2			1			
	CO2	2	2	1		1			
	CO3	2	2	1		1			
	CO4	2	2			1			
	CO5	2	2			1			

1: Low, 2: Medium, 3: High

Cryptography and Network Security

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCB2	SEE Marks:	50

Course objectives:

This course will enable students to:

1	To make the student learn different encryption techniques along with hash functions, MAC, digital signatures and their use in various protocols for network security and system security.
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UNIT I

INTRODUCTION: Computer Security Concepts, The 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

8 Hours

UNIT II

Private key cryptography : Block Ciphers And The Data Encryption Standard, Block Cipher Principles, The Data Encryption Standard (DES), A DES Example, The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. **BLOCK CIPHER OPERATION:** Multiple Encryption and Triple DES, Electronic Codebook Mode, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode. **AES, STREAM CIPHERS :** Stream ciphers, RC4 Ciphers, RC4.

8 Hours

UNIT III

Public key cryptography: Number Theory, Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, and Discrete Logarithms. **PUBLIC-KEY CRYPTOGRAPHY, RSA AND OTHER PUBLIC-KEY CRYPTOSYSTEMS:** Principles of Public-Key Cryptosystems, The RSA Algorithm, DiffieHellman Key Exchange, ElGamal Cryptosystem.

8 Hours

UNIT IV

CRYPTOGRAPHIC HASH FUNCTIONS: Applications of Cryptographic Hash Function, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA). **MESSAGE AUTHENTICATION CODES:** Message Authentication Requirements, Message Authentication Functions, Message Authentication Codes, Security of MACs, MACs Based on Hash Functions (HMAC).

8 Hours

UNIT V	
DIGITAL SIGNATURES- Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS). KEY MANAGEMENT AND DISTRIBUTION: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure, Kerberos authentication.	
8 Hours	

TEXT BOOKS		
1	William Stallings:	Cryptography and Network Security- Principles And Practice, Pearson/PHI, 8th Edition, 2020.

REFERENCE BOOKS		
1	William Stallings	Network Security Essentials (Applications and Standards)l, Pearson Education ,4th Edition,.2012
2	Charlie Kaufman, Radia Perlman and Mike Speciner	Network Security – Private Communication in a Public Worldl, Pearson Education ,2nd Edition, 2002.
3	Eric Maiwald	Fundamentals of Network Securityl, Dreamtech Press, 1st Edition, 2003
4	Whitman:	Principles of Information Security, Thomson, 3rd Edition, 2009.
5	Robert Bragg, Mark Rhodes	Network Security: The complete reference, TMH, 1st Edition, , 2004
6	Buchmann	Introduction to Cryptograph, Springer , 2nd Edition, , 2004.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze and design classical encryption techniques and block ciphers
CO2	Analyze data encryption standard.
CO3	Analyze public-key cryptography, RSA and other public- key cryptosystems
CO4	Explicate Management and distribution schemes and design User Authentication
CO5	Apply intrusion prevention techniques to prevent intrusion

Course Articulation Matrix

	Program Outcomes								
		1	2	3	4	5	6	7	8
Course Outcomes	CO1	2	1			1			
	CO2	2				1			
	CO3	2	2			1			
	CO4	2		2		1			
	CO5	2	1			1			

1: Low, 2: Medium, 3: High

Cyber Security

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCB3	SEE Marks:	50

Course objectives:

This course will enable students to:

1	To learn cybercrime and cyber law.
2	To understand the cyber-attacks and tools for mitigating them.
3	To understand information gathering.
4	To learn how to detect a cyber-attack.
5.	To learn how to prevent a cyber-attack.

UNIT I

INTRODUCTION Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

8 Hours

UNIT II

ATTACKS AND COUNTER MEASURES : Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Counter measures.

8 Hours

UNIT III

RECONNAISSANCE Harvester – Who is – Netcraft – Host – Extracting Information from DNS – Extracting Information from E- mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches.

8 Hours

UNIT IV

INTRUSION DETECTION Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

8 Hours

UNIT V

INTRUSION PREVENTION Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations –Intrusion Prevention Systems – Example Unified Threat Management Products.

8 Hours

TEXT BOOKS		
1	Patrick Engebretson	The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy, Elsevier, 2011. (Unit-3)
2	William Stallings, Lawrie Brown	Computer Security Principles and Practice, Pearson Education, Third Edition, , 2015. (Unit-4 & 5)
3	Anand Shinde	Introduction to Cyber Security Guide to the World of Cyber Security, Notion Press, 2021. (Unit-1 &2)

REFERENCE BOOKS		
1	David Kim, Michael G. Solomon	Fundamentals of Information Systems Security, Jones & Bartlett Learning Publishers, 2013.
2	Nina Godbole, Sunit Belapure	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publishers, 2011.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Explicate the basics of cyber security, cybercrime and cyber law
CO2	Classify various types of attacks and learn the tools to launch the attacks
CO3	Apply various tools to perform information gathering
CO4	Apply intrusion techniques to detect intrusion
CO5	Apply intrusion prevention techniques to prevent intrusion

Course Articulation Matrix

	Program Outcomes								
		1	2	3	4	5	6	7	8
Course Outcomes	CO1	1	1			1			
	CO2	1	2			1			
	CO3	2	2	1		1			
	CO4	2	2			1			
	CO5	1	1	1		1			

1: Low, 2: Medium, 3: High

Ethical Hacking

Contact Hours/ Week:	03	Credits:	03
Total Lecture Hours:	03	CIE Marks:	50
Course Code:	S3MCB4	SEE Marks:	50

Course objectives:

This course will enable students to:

1	To develop a comprehensive understanding of ethical hacking principles, methodologies, and tools, and recognize the significance of ethical and legal considerations in conducting security assessments.
2	To acquire hands-on proficiency in executing penetration tests, vulnerability assessments, and Ethical hacking techniques across various system components, networks, and applications.
3	To demonstrate the ability to identify, assess, and prioritize vulnerabilities in diverse computing environments using both manual and automated methods, and effectively communicate these findings to stakeholders.
4	To develop a strategic mindset towards cyber security by acquiring knowledge of common attack Vectors, learning to simulate real-world attacks, and implementing preventive measures to secure systems, Networks and web applications.

UNIT I

Introduction to Ethical Hacking

Introduction to ethical hacking and its importance, Legal and ethical considerations in ethical hacking, Differentiating between black hat, white hat, and grey hat hacking, Basic cyber security concepts and terminology, Overview of penetration testing methodologies

8 Hours

UNIT II

Foot printing and Information Gathering

Passive and active information gathering techniques, Who is lookup, DNS enumeration, and social engineering, Tools and methodologies for foot printing, Google hacking and OSINT (Open Source Intelligence) techniques.

8 Hours

UNIT III

Scanning and Enumeration: Port scanning techniques: SYN, TCP, UDP scans; Service enumeration and version detection; NetBIOS, SNMP, and SMTP enumeration; Vulnerability scanning and assessment.

8 Hours

UNIT IV

System Hacking and Exploitation Password cracking techniques and tools; Privilege escalation and maintaining access; Malware types and counter measures; Exploiting common vulnerabilities (e.g., buffer overflow, SQL injection).

8 Hours

UNIT V	
Web Application and Network Security Common web vulnerabilities: SQL injection, XSS, CSRF; Web application penetration testing methodology; Network sniffing and spoofing; Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)	
8 Hours	

TEXT BOOKS		
1	RafayBaloch	Ethical Hacking and Penetration Testing Guide, CRC Press, 2015, ISBN978-1-4822-3161-8(Paperback)
2	HarperAllen, GrayHatHacking	The Ethical Hackers HandBook, McGrawHill, 3rd Edition, 2011.
	JayBeale, AndrewR.Baker, JoelEsler	Snort Intrusion Detection and Prevention Toolkit, Syngress Publishing, Inc, 2007, ISBN-13:978-1-59749-099-3

REFERENCE BOOKS		
1	William Stallings	Network Security Essentials: Applications and Standards, Pearson Education Limited 2017, ISBN13:978-1-292-15485-5
2	Patrick Engebretson	The Basics of Hacking and Penetration Testing, Syngress Publishing, 2013, ISBN978-0-12-411644-3

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Explicate the core concepts, principles and legal Considerations of ethical hacking.
CO2	Make us of different tools and techniques for information gathering, scanning and enumeration
CO3	Apply tools and techniques for exploiting vulnerabilities, Network sniffing, web application hacking, system hacking, Escalating privileges, etc.
CO4	Analyze the results of IDS/IPS, ethical hacking and penetration testing tasks

Course Articulation Matrix

	Program Outcomes								
		1	2	3	4	5	6	7	8
Course Outcomes	CO1	2	2			1			
	CO2	2	2			1			
	CO3	2	2			1			
	CO4	2	2			1			
	CO5	2	2			1			

1: Low, 2: Medium, 3: High

Specialization C (Application Development)

C# using .Net

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S3MCC1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand .NET framework and C# language features.
2.	Apply object-oriented concepts in C# programming.
3.	Use collections, file handling, and exception management.
4.	Develop GUI applications using Windows Forms.
5.	Introducing ASP.NET web development.
6.	Understand .NET framework and C# language features.

UNIT I

Introduction to C# and .NET:

.NET Framework architecture, C# syntax, data types, variables, Control structures: if, switch, loops, and Visual Studio environment

8 Hours

UNIT II

Object-Oriented Programming:

Classes and Objects, Encapsulation, Inheritance, Polymorphism, Interfaces and Abstract Classes, and Method Overloading and Overriding

8 Hours

UNIT III

Advanced C# Programming:

Delegates and Events, Collections and Generics, Exception Handling, and Properties and Indexers

8 Hours

UNIT IV

File Handling and Multithreading:

File I/O with StreamReader and StreamWriter, Binary File operations, Thread class and Synchronization, and Serialization and Deserialization

8 Hours

UNIT V

Building .NET Web APIs (ASP.NET Core):

Introduction to REST and .NET Web API fundamentals, API - GET, POST, PATCH, PUT, DELETE, and Endpoint design: CRUD operations, validation, error handling, pagination

8 Hours

TEXT BOOKS		
1	Mark J. Price	C# 9.0 and .NET 5 – Modern Cross-Platform Development”, Packt Publishing Limited, 2020
2	E. Balagurusamy	Programming in C#", McGraw-Hill Education 4 th edition 2017.

REFERENCE BOOKS		
1	Andrew Troelsen and Philip Japikse	Pro C# 8 with .NET Core 3", Apress. 2020
2	Valerio De Sanctis,	Building Web APIs with ASP.NET Core, Manning Publications, 2023.

WEB LINKS:	
1	https://learn.microsoft.com/en-us/dotnet/csharp/
2	https://www.tutorialspoint.com/csharp/
3	https://www.geeksforgeeks.org/csharp-programming-language/
4	https://www.w3schools.com/cs/

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Demonstrate an understanding of C# syntax, programming constructs, and .NET fundamentals.
CO2	Apply object-oriented programming concepts to develop applications in C#.
CO3	Utilize advanced C# features such as delegates, events, generics, and collections
CO4	Develop applications involving file input/output operations and multithreading.
CO5	Design and build RESTful Web APIs using ASP.NET Core with CRUD operations, input validation, error handling, and pagination.

Course Articulation Matrix

	Program Outcomes								
		1	2	3	4	5	6	7	8
Course Outcomes	CO1	3	2			1			
	CO2	3	3	2		1			
	CO3	3	3	2		1			
	CO4	3	3	2	2	1			
	CO5	3	3	3	2	1			

1: Low, 2: Medium, 3: High

Mobile Application Development

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S3MCC2	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Provide a solid foundation in Android application development, from setup to advanced features.
2.	Develop proficiency in mobile design principles, event handling, activities, and multithreading.
3.	Enable students to implement debugging, testing, data storage, and location-based services in Android.
4.	Introducing students to Flutter & Dart programming for cross-platform mobile app development.
5.	Equip students with knowledge of state management, user forms, and Firebase integration in Flutter.
6.	Encourage hands-on practice through structured lab exercises and real-time projects.

UNIT I

Introduction to Android overview, Android Studio & Project Basic:

History, Operating System, Setup, Configuring Android Studio, Hardware Acceleration, Project Basics, Create an AVD, The IDE, Main Editor, Editing Layout Files, TODO Items, Project Tool Window and Android Application Overview.

Getting Started with Android Programming

Introduction to Android – Obtaining the required tools– Anatomy of an Android Application – Components of Android Applications

8 Hours

UNIT II

Mobile Design, Event Handling, Fragments, Execution: Mobile Design: Mobile-Only Interactions, Interactions that are not possible on Mobile

Event Handling & Intents: Intro to Event Handling, Handling Long Clicks, What Intents are for, Implicit Intents

Introduction to Fragments Running in the Background: Basic Concepts, The UI Thread, Threads and Runnable

Activities and Layouts:

What Makes Up an Android Project, Application Entry Point, Activities, Intents, Activity, Layout File, View and View Group Objects, Containers, Activity Class

8 Hours

UNIT III

Debugging, Data Storage & Location Services: Debugging & Testing, Types of Errors Debugger, Types of Testing, Unit Testing, Instrumented Testing

Data Storage: Storing simple data, Read and write a text file to internal storage or external storage, Creating and using an SQLite database

8 Hours

UNIT IV	
Introduction to Flutter and Dart	
1.1 Introduction to Flutter: Features & architecture, Flutter vs Native & Hybrid frameworks and Setting up development environment (Flutter SDK, Android Studio/VS Code)	
1.2 Introduction to Dart Programming : Dart syntax and structure, Data types, variables, and functions, Object-Oriented Programming in Dart (classes, constructors, inheritance)	
1.3 Flutter Basics : Flutter app structure (main.dart, MaterialApp, Scaffold), Hot reload and development workflow, Basic widgets: Text, Image, Container, Row, Column, ListView	
1.4 Layout and Navigation: Layout widgets: Padding, Margin, SizedBox, Stack, Card, Navigation: Navigator, routes, passing data between screens, Building a simple multi-page app	
8 Hours	

UNIT V	
State Management, Forms, and Firebase Basics	
2.1 State Management : Stateful vs Stateless widgets, Managing local state using setState(), Introduction to Provider (basic example)	
2.2 User Input and Forms: TextFields, buttons, switches, Form validation, AlertDialogs and snackbars	
2.3 Connecting with Firebase: Introduction to Firebase services, Firebase setup for Flutter project, Firebase Authentication (Email/Password), Realtime Database or Firestore (CRUD basics)	
8 Hours	

TEXT BOOKS		
1	Jeff McWherter and Scott Gowell	Professional Mobile Application Development, Wrox, 1 st Edition, 2012, ISBN: 978-1-118-20390-3
2	Wei-Meng Lee	Beginning Android Application Development, Wiley India Private Limited 2011.
3	Alessandro Biessek	Flutter for Beginners, Packt Publishing Limited, 2019
4	Marco L. Napoli,	Beginning Flutter, Wiley, 2020.

REFERENCE BOOKS		
1	Reto Meier	Professional Android 4 Application Development”, Wrox Publications 2012
2	Ted Hagos	Learn Android Studio 4: Efficient Java-Based Android Apps Development, Apress Publishing, 2nd Edition, 2020,
3	Carmin Zaccagnino	Programming Flutter: Native, Cross-Platform Apps the Easy Way, O’Reilly, 2020.
4	Simone Alessandria	Flutter Cookbook, Packt Publishing, 2021.

WEB LINKS:	
1	https://www.tutorialspoint.com/android/index.htm
2	https://developer.android.com/

3	https://www.geeksforgeeks.org/android-tutorial/
4	Dart Language Documentation – https://dart.dev
5	Firebase & Flutter – https://firebase.flutter.dev
6	Youtube tutorial - https://www.youtube.com/watch?v=CzRQ9mnmh44

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Demonstrate understanding of Android fundamentals, development environment setup, and the anatomy of Android applications.
CO2	Apply mobile design principles, event handling, intents, and activities to develop interactive Android applications.
CO3	Implement debugging, testing, data storage, and location services in Android applications.
CO4	Develop cross-platform mobile applications using Flutter and Dart with basic widgets, layouts, and navigation.
CO5	Build Flutter applications with state management, form handling, and Firebase integration for cloud-based services.

Course Articulation Matrix

	Program Outcomes								
		1	2	3	4	5	6	7	8
Course Outcomes	CO1	2	2			1			
	CO2	3	3	2	3	1			
	CO3	3	3	2	3	1			
	CO4	3	3	2	3	1			
	CO5	3	3	3	3	1			

1: Low, 2: Medium, 3: High

Internet of Things with Cloud

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCC3	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Understand the fundamentals of Internet of Things and its building blocks along with their characteristics
2.	Understand the recent application domains of IoT in everyday life.
3.	Gain insights about the current trends of associated IoT technologies and IoT analytics.

UNIT – I

Basics of Networking
Introduction, Network Types, Layered network models
EMERGENCE OF IoT
Introduction, Evolution of IoT, Enabling IoT & the Complex Interdependence of Technologies, IoT Networking Components.

08 Hours

UNIT – II

IoT Sensing And Actuation
Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

08 Hours

UNIT – III

IoT Processing Topologies And Types
Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading

08 Hours

UNIT – IV

Associated IOT Technologies
Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.
IoT Case Studies
Agricultural IoT – Introduction and Case Studies

08 Hours

UNIT – V	
IOT Case Studies And Future Trends Vehicular IoT – Introduction to future trends, Demonstration Healthcare IoT IoT Analytics Case studies	
08 Hours	

TEXT BOOKS

1	Sudip Misra, Anandarup Mukherjee, Arijit Roy,	Introduction to IoT, Cambridge University Press, 1 st edition, 2021.
2	S. Misra, C. Roy, and A. Mukherjee,	Introduction to Industrial Internet of Things and Industry 4.0. CRC Press, 1 st edition, 2020

REFERENCE BOOKS

1	Vijay Madiseti and ArshdeepBahga,	Internet of Things (A Hands-on-Approach), VPT ,1 st Edition, 2014. (ISBN: 978-8173719547)
2	Francis daCosta,	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications, 1 st Edition, 2013.

WEB LINKS:

1.	Introduction To Internet of Things By Prof. Sudip Misra IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://www.edx.org/learn/iot-internet-of-things

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Identify the basics of IoT networking components and addressing strategies in IoT .
CO2	Classify various sensing devices and actuator types to solve the real world problems.
CO3	Demonstrate the fundamentals of Processing Topologies and its primary focus on IoT Device Design and Selection Considerations.
CO4	Elucidate Associated IoT Technologies through case studies to illustrate the architecture of applications and IoT analytics.

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	1			1			1
	CO2	2	1			1			1
	CO3	2	1			1			1
	CO4	2	1			1			1

1: Low, 2: Medium, 3: High

Augmented Reality and Virtual Reality

Contact Hours/ Week:	3+0(L+T)	Credits:	03
Total Lecture Hours:	40	CIE Marks:	50
Course Code:	S3MCC4	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Gain the knowledge of Virtual Reality concepts and its implication.
2.	Understand the Input-Output interactions in Virtual Reality
3.	Understand role of Computer Graphics in Virtual reality
4.	Gain the knowledge of Architecture of Augmented Reality

UNIT I

Introduction to Virtual Reality: History of Virtual Reality, Types of Virtual Reality, Three I's of Virtual Reality, Architecture / Components of Virtual Reality, Applications of Virtual Reality Common Issues of Human Communication Media

8 Hours

UNIT II

Input Devices: Trackers: Three Dimensional Position Trackers: Tracker Performance Parameters, Mechanical Trackers, Magnetic Trackers, Optical Trackers, Gesture Interfaces – The Pinch Glove, The 5DT Data Glove, The Cyber glove.

8 Hours

UNIT III

Output Devices: Graphic Displays The human visual system, Personal Graphics Displays, Sound Displays The human auditory system, Haptic Feedback – The Human Haptic System, Tactile Feedback Interfaces, Force Feedback Interfaces.

Programming with Unity: Unity Basics, Manipulating the Scene, Code blocks and Methods, Debugging Conditional and looping statements. Working with objects, Working with Scripts, Player movement, Camera Movement

Further Learning for Unity: The Asset Store

8 Hours

UNIT IV

Computing Architectures for VR: The Rendering Pipeline – The Graphics Rendering Pipeline, The Haptics Rendering Pipeline

Modeling: Geometric Modeling – Visual Object Shape, Object Visual Appearance; Kinematics Modeling – Homogeneous Transformation Matrices, Object Position; Physical Modeling – Collision Detection, Surface Deformation, Force Smoothing and Mapping, Haptic Texturing;

Behavior Modeling; Principles of touch feedback and force feedback;

8 Hours

UNIT V	
Introduction to Augmented Reality: Definition and scope, technology and features of augmented reality, difference between AR and VR, Challenges with AR, Augmented reality methods, Mixed Reality, Applications of AR & MR	
Computer Vision for Augmented Reality : Marker-based tracking, Marker-less tracking	
8 Hours	

TEXT BOOKS		
1	Burdea, G. C. and P. Coffet.	Virtual Reality Technology, Wiley-IEEE Press, 3 rd Edition, 2024.

REFERENCE BOOKS		
1	William R. Sherman, Alan B. Craig	Understanding Virtual Reality, Morgan Kaufmann Publishers, 1 st Edition, 2003
2	Schmalstieg/Hollerer	Augmented Reality: Principles And Practice, Pearson Education, 1 st Edition, 2016

WEB LINKS:	
1	https://freevidelectures.com/course/3693/virtual-reality
2	https://docs.unity3d.com/Manual/index.html
3	https://youtu.be/XLP4YTpUpBI

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply Virtual Reality concepts and its implications.
CO2	Illustrate the Input-Output interactions in Virtual Reality
CO3	Utilize UNITY tool to build applications.
CO4	Illustrate the role of modeling in Virtual Reality
CO5	Exemplify the Architecture of Augmented Reality

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	3	1			1			
	CO2	2	1			1			
	CO3	2	1		1	1			
	CO4	2	1			1			
	CO5	2	1			1			

1: Low, 2: Medium, 3: High

Specialization D (Allied)

Big Data

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCD1	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge of various technologies supporting Big DATA
2.	Get acquainted with Hadoop Ecosystem : YARN, MapReduce, Spark
3.	Get acquainted with HIVE and PIG

UNIT – I

Introduction to Big Data : Types of Data, Elements of Big Data, Careers in Big data.
Use of Big Data in Social Networking, Use of Big Data in Preventing Fraudulent Activities, Use of Big Data in Detecting Fraudulent Activity in Insurance Sector, Use of Big Data in Retail Industry

Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop, Cloud Computing and Big Data, and In-Memory Computing Technology for Big Data. The Hadoop Distributed Filesystem:

08 Hours

UNIT – II

YARN: Understanding Hadoop YARN Architecture

Anatomy of a YARN Application Run, Resource Requests, Application Lifespan, Building YARN Applications , YARN Compared to MapReduce 1, Scheduling in YARN, Scheduler Options ,Capacity Scheduler Configuration , Fair Scheduler Configuration , DelayScheduling, Dominant Resource Fairness.

Spark: Introduction to Spark, Difference between Hadoop and Spark (internet).

08 Hours

UNIT – III

Understanding Hadoop Ecosystem: Hadoop Ecosystem, HDFS: Architecture, Name nodes and data Nodes, MapReduce, Anatomy of a MapReduce Job Run :Job Submission, Job initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion. Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure. Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning. Task Execution: The Task Execution Environment, Speculative Execution, Output Committers

08 Hours

UNIT – IV

Hive: Introducing Hive, Hive Variables, Hive Properties, Hive Queries, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Creating Databases, Viewing a Database, Dropping a Database, Altering Databases, Creating Tables, Creating a Table Using the Existing Schema, Dropping Tables, Altering Tables, Using Hive DDL Statements, Data Manipulation in Hive, Loading Files into Tables, Inserting Data into Tables, Update in Hive, Delete in Hive, Using Hive

DML Statements, Data Retrieval Queries, Using the SELECT Command, Using the WHERE Clause, Using the GROUP BY Clause, Using the HAVING Clause, Using the LIMIT Clause, Executing HiveQL Queries, Using JOINS in Hive, Inner Joins, Outer Joins, Cartesian Product Joins, Map-Side Joins, Joining Tables.

08 Hours

UNIT – V

Pig :Execution Types

Comparison with Databases, Pig Latin : Structure, Statements, Expressions , Types, Schemas , Functions, Macros. User-Defined Functions: A Filter UDF, An Eval UDF, A Load UDF. Data Processing Operators Loading and Storing Data, Filtering Data, Grouping and Joining Data , Sorting Data, Combining and Splitting Data. Pig in Practice: Parallelism, Anonymous Relations, Parameter Substitution

08 Hours

TEXT BOOKS

1	DT Editorial Services	Big Data, Black Book: Covers Hadoop, MapReduce, Hive, YARN, Pig, R and Data Visualization, Edition, New Delhi Dreamtech , 2023, ISBN: 9789351199311
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REFERENCE BOOKS

1	V.K Jain	Big Data and Hadoop, Khanna Book Publishing, Edition 2017, ISBN: 9789382609131.
2	Sridhar Alla	Big Data Analytics with Hadoop 3, Packt Publisher, 2018, Pages 482, ISBN 978178862884.

WEB LINKS:

1.	https://youtu.be/p0TdBqIt3fg?si=QqZ2pjf8wKV_d7OI
2.	https://youtu.be/JK2MdJAWEGc?si=oUC59wertp2FhHB-
3.	https://www.youtube.com/watch?v=nmaA5_d4E8c&authuser=1
4.	https://www.youtube.com/watch?v=b-IvmXoO0bU&authuser=1
5.	https://www.youtube.com/watch?v=cEjDR3B_3cs&authuser=1
6	https://www.youtube.com/watch?v=rr17cbPGWGA&pp=ygUZd2hhdCBpcyBISVZFK3NpbXBseSBsZWYybg%3D%3D
7.	https://www.youtube.com/watch?v=qr_awo5vz0g&pp=ygUYd2hhdCBpcyBQSUrc2ltcGx5IGxlYXJu

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend various technologies supporting Big Data
CO2.	Analyze the working of YARN and SPARK
CO3.	Analyze and apply MapReduce for real time problems
CO4.	Apply Hive Query for real time problems
CO5.	Apply PIG Latin for real time problems

Big Data ABL Activity Rules:

1. Students should form a team of not more than 3, and deliver a presentation covering Hive, Pig, Map reduce and Tableau etc.
2. Each team must submit the report of the presentation
3. No two teams are allowed to use the same database for presentation.

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2				1			
	CO2	2				1			
	CO3	2				1			
	CO4	2	1		1	1			
	CO5	2	1		1	1			

1: Low, 2: Medium, 3: High

Software Testing

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCD2	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Realize the principles of testing and need for testing
2.	Analyze various testing techniques and testing levels
3.	Gain knowledge on object oriented testing and fault based testing
4.	Prepare and execute test plan, manage defects and realize the use software matrix.

UNIT – I	08 Hours
Introduction to Software testing: Introduction to testing as an engineering activity, Testing fundamentals of testing Software-testing principles, Software verification and validation, psychology of testing, the tester's role in a software development organization, Test design Techniques: Static testing- review, walkthrough, inspection testing types and techniques. Dynamic testing: Black box testing - boundary value analysis, equivalence partitioning (weak, strong and strong robust)	

UNIT – II	08Hours
Test design techniques: Dynamic testing- Black box testing: state transition, combinatorial testing types- decision table, cause effect graphing, White box testing: basis path testing, flow graph notation, cyclomatic complexity, code coverage testing: statement, condition, data flow, and branch.	

UNIT – III	08 Hours
Levels of testing: Unit Test, Integration tests - big-bang, top-down, bottom-up, sandwich; System Test; Regression Testing; Alpha, Beta and Acceptance Tests; Performance testing: load, stress, stability, scalability; Web testing: Introduction to web testing, web testing checklist.	

UNIT – IV	08 Hours
Object-Oriented Testing: Issues in Testing Object-Oriented Software, Object-Oriented Unit Testing, Object-Oriented Integration Testing, Object-Oriented System Testing. Fault based testing: Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis.	

UNIT – V	08 Hours
Test Plan: Importance of Test Plan , steps to create a test plan Test Execution: Test Execution Process, Ways to Perform Test Execution, Test Execution Priorities, Test Execution States, Test Execution Report. Defect/Bug Life Cycle in Software Testing, Bug Report in Software Testing, Software Testing Metrics	

TEXT BOOKS		
1	Dorothy Graham , Rex Black , Erik van Veenendaal	Foundations of Software Testing: ISTQB Certification Paperback, 4 th Edition, Cengage Learning India Pvt. Ltd, 2020
2	Paul C. Jorgensen , Byron DeVries	SOFTWARE TESTING : A CRAFTSMAN'S APPROACH Paperback –2021
3	Mauro Pezze, Michael Young,	Software testing and Analysis- Process, Principles and Techniques, Wiley India, 2012

REFERENCE BOOKS:

REFERENCE BOOKS		
1	Kshirasagara Naik, Priyadarshi Tripathy	Software Testing and Quality Assurance, Wiley India 2012
2	M.G.Limaye	Software Testing-Principles, Techniques and Tools – McGraw Hill, 2009
3	Adithya P.Mathur	Foundations of Software Testing – Fundamental Algorithms and Techniques, Pearson Education India, 2011
4	Dorothy graham, Erik van veenendaal, Rex black	Foundations of Software Testing ISTQB certification (Level I) by, Publisher : Cengage Publications, 3rd edition, 2015
5	Ilene Burnstein	Practical Software Testing, Springer international edition. Publisher : Springer, 1 st edition , 2003

WEB LINKS:

1.	https://www.coursera.org/specializations/software-testing-automation
2.	https://www.udemy.com/course/everything-for-software-tester/
3.	https://www.udacity.com/course/software-testing--cs258
4.	https://www.greatlearning.in/academy/learn-for-free/courses/software-testing-fundamentals1
5.	https://www.guru99.com/software-testing.html
6.	https://onlinecourses.nptel.ac.in/noc19_cs71/preview
7.	https://testinginstitute.com/Free-Software-Testing-Training.php
8.	https://onlinecourses.nptel.ac.in/noc23_cs38/
9.	http://tryqa.com/what-is-software-testing/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Identify and review the importance of software testing as an engineering activity
CO2.	Apply various software test design techniques for a given problem
CO3.	Review various levels of software testing.
CO4.	Identify and review various issues of object oriented testing and fault based testing.
CO5.	Review and design test plan for a given scenario.

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	1			1			
	CO2	2	2	1		1			
	CO3	2	2			1			
	CO4	2	2			1			
	CO5	2	2	1		1			

1: Low, 2: Medium, 3: High

Software Design and Patterns

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCA3	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Understand the importance and role of design patterns in software development.
2.	Learn how to implement various creational, structural, and behavioral design patterns.
3.	Analyze software design problems and apply appropriate design patterns to solve them.
4.	Develop reusable and maintainable object-oriented software

UNIT – I	08 Hours
Fundamentals and Design Principles: Introduction to Design Patterns, Definition, purpose, and history, Benefits and limitations of design patterns, Classification: Creational, Structural, Behavioral. Principles of Object-Oriented Design, SOLID principles, Coupling and Cohesion, UML for patterns.	

UNIT – II	08Hours
Creational Design Patterns: Singleton and Factory Method, Singleton: ensuring a single instance, Factory Method: object creation interface, Abstract Factory: related object families, Builder: step-by-step complex object creation.	

UNIT – III	08 Hours
Structural Design Patterns: Adapter and Decorator, Adapter: interface compatibility, Decorator: dynamic behavior extension, Composite and Proxy, Composite: tree-like structure, Proxy: controlling object access.	

UNIT – IV	08 Hours
Behavioral Design Patterns: Observer and Strategy, Observer: publish-subscribe systems, Strategy: interchangeable algorithms, Command and Template Method, Command: encapsulate requests, Template Method: algorithm skeleton	

UNIT – V	08 Hours
Case Studies and Pattern Integration: State and Chain of Responsibility, State: dynamic behavior changes. Chain of Responsibility: passing request chains, Pattern combination in real systems, Anti-patterns and refactoring using patterns.	

TEXT BOOKS:

1.	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides	Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley Professional, 2005
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REFERENCE BOOKS:

1.	Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra	Head First Design Patterns Publisher: O'Reilly Media, 2004 / 2020 (2nd Ed. covers modern Java and updated patterns)
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WEB LINKS:

1.	https://youtu.be/4Dtv16aaNLQ?si=aaDLJtJHEX7xdGEy
2.	https://youtu.be/T9zbvi8eUW0?si=qCucZA4uFYsd-6Q8

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Analyze the fundamental concepts and classifications of design patterns.
CO2.	Apply creational patterns to construct flexible and reusable objects.
CO3.	Demonstrate the use of structural patterns for building scalable architectures.
CO4.	Implement behavioral patterns for effective communication among objects.
CO5.	Integrate multiple design patterns into a real-world software solution

Course Articulation Matrix (Mapping between COs and POs):

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2			1			
	CO2	2	2	1		1			
	CO3	2	2	1		1			
	CO4	2	2	1		1			
	CO5	2	2	1		1			

1: Low, 2: Medium, 3: High

Blockchain Technologies

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	3	CIE Marks:	50
Course Code:	S3MCD4	SEE Marks:	50

Course Objectives:

This Course will enable students to:	
1.	Comprehend the fundamentals of the Blockchain and its organization
2.	Describe the underlying concepts of working of a Blockchain.
3.	Infer the working principle of Bitcoin .
4.	Interpret the working of using Ethereum.
5.	Examine possible business applications and research issues of Blockchain.

UNIT – I	
Introduction to blockchain, back history of blockchain, centralized vs. Decentralized systems, layers of block chain, application layer, execution layer, semantic layer, propagation layer, consensus layer, why is blockchain important? limitations of centralized systems, adoption so far, blockchain uses and use cases.	
08 Hours	

UNIT – II	
Laying the blockchain foundation, game theory, nash equilibrium, prisoner's dilemma, byzantine generals problem, zero-sum games, why to study game theory, computer science engineering. The blockchain , merkle trees, properties of solution, transaction, distributed consensus mechanisms, applications, scaling blockchain, off-chain computation, sharding state.	
08 Hours	

UNIT – III	
The history of money, introduction to bitcoin Working with bitcoins, the bitcoin blockchain, block structure, the genesis block, the bitcoin network, network discovery for a new node, bitcoin transaction, consensus and block mining, block propagation, putting it all together, bitcoin scripts, bitcoin transaction revisited, scripts, full nodes , vs spys, full nodes, spys	
08 Hours	

UNIT – IV	
From bitcoin to ethereum, ethereum as next-gen blockchain, design philosophy of ethereum, ethereum blockchain, ethereum accounts, trie usage, merkle patricia tree, rlp encoding, ethereum transaction and message structure, ethereum state transaction function, gas and transaction cost, ethereum smart contract, contract creation, ethereum virtual machine and code execution, ethereum ecosystem, swarm whisper, dapp, development components	
08 Hours	

UNIT – V	08 Hours
Propelling business with blockchain , recognizing types of market friction, information frictions, interaction frictions, innovation frictions, moving closer to friction-free business networks, reducing	

information friction, easing interaction friction, easing innovation friction, transforming ecosystems, through increased visibility. Blockchains in action: use cases of financial services, trade finance, post-trade clearing and settlement, cross-border transactions, trusted digital identity, multinational policy management, government, supply chain management, food safety, global trade, healthcare, electronic medical records, and healthcare payment preauthorization.

Key Research Issues in Blockchain Scalability, Security Common threats: 51% attack, Sybil attack, smart contract, vulnerabilities, Privacy Need for confidentiality in transactions, Interoperability Issue: Lack of communication between blockchains, Energy Efficiency Criticism of Proof-of-Work (PoW) models.

08 Hours

Text Books

1	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda	Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions,, Apress Media, 1st edition, 2018
2	Manav Gupta	Blockchain for Dummies, John Wiley & sons, 2 nd IBM Limited Edition, 2018
3	Chandramouli Subramanian , Asha A George , Abhilash K A (Author), Meena Karthikeyan	Blockchain Technology, Universities Press (India) Pvt. Ltd, 1 st edition, Paperback 2020.

Reference Books

1.	Peter Lypovonyav	Blockchain for Business, Packt Publishing Limited, 1 st Edition, 2019
2.	Debajani Mohanty	Ethereum for Architects and Developers, Apress Media, 1 st Edition, 2018

Web Links

1.	https://classroom.google.com/c/NzY5MDAwMDMyNjA2?cjc=o46kxeej
2.	https://archive.nptel.ac.in/courses/106/105/106105184/
3.	https://www.tutorialspoint.com/blockchain/index.htm
4.	https://www.guru99.com/blockchain-tutorial.html
5.	https://blockchain.cse.iitk.ac.in/slides-NPTel-BlockchainTechnologyApplications.pdf

Course Outcomes:

Upon completion of this course the student will be able to:

CO1.	Identify and review the fundamentals of Blockchain and its structure.
CO2.	Review the prerequisite concepts of Blockchain.
CO3.	Analyze the working of Bitcoin cryptocurrency.
CO4.	Analyze the working of Ethereum blockchain
CO5.	Identify the potential business use cases and key research issues of Blockchain.

Course Articulation Matrix

		Program Outcomes							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Course Outcomes	CO1	2	2			1			
	CO2	2	2			1			
	CO3	2	2			1			
	CO4	2	2			1			
	CO5	2	2			1			

1: Low, 2: Medium, 3: High