VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CREDIT DISTRIBUTION

B.Tech CSE (Software Engineering)										
Credits Per Semester										
S. No	**Course Category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total Credits**
1	HSC	7	3	2	2	-	-	2	-	16
2	BSC	10	3	3	3	3	-	-	-	22
3	ESC	8	12	-	-	-	-	-	-	20
4	PCC	-	-	16	15	18	8	8	-	65
5	PEC	-	-	-	-	-	6	8	-	14
6	OEC	-	-	-	-	6	6	3	4	19
7	Project	-	-	-	-	-	-	-	14	14
8	MC	3	-	-	-	-	-	-	-	3
	TOTAL	**28**	**18**	**21**	**20**	**27**	**20**	**21**	**18**	**173**

HSC	Humanities and Social Science Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
MC	Mandatory Courses

VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)

(MINIMUM CREDITS TO BE EARNED: 173)

CURRICULUM

B.TECH CSE (SOFTWARE PRODUCT ENGINEERING)								
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
SEMESTER I								
ESC	Front-end web development	3	-	2	4	40	60	100
HSC	Critical thinking	4	-	-	4	40	60	100
BSC	Discrete Mathematics	3	1	-	4	40	60	100
HSC	Professional skills for the workplace	3	-	-	3	40	60	100
BSC	The Breadth of computer science I	3	-	-	3	40	60	100
ESC	Problem solving using programming	3	-	2	4	40	60	100
BSC	Design for developers	3	-	-	3	40	60	100
MC	Student Induction Program	-	-	-	-	-	-	100
MC	Universal Human Values	3	-	-	3	-	-	100
		25	**1**	**4**	**28**			
SEMESTER II								
HSC	Learning how to learn	3	-	-	3	40	60	100
BSC	The Breadth of computer science II	3	-	-	3	40	60	100
ESC	Back-end Web Development	3	-	2	4	40	60	100
ESC	Databases	3	-	2	4	40	60	100
ESC	Full Stack Web Development	3	-	2	4	40	60	100
MC	Constitution of India	2	-	-	-	-	-	100
		17	**-**	**6**	**18**			
SEMESTER III								
HSC	Economics, Politics and Rural Society Development	2	-	-	2	40	60	100
BSC	Mathematical thinking	2	1	-	3	40	60	100
PCC	Database Management Systems	3	-	-	3	40	60	100
PCC	Object Oriented Programming	3	-	-	3	40	60	100
PCC	Object Oriented Programming - Lab	-	-	2	1	40	60	100

PCC	Database Management Systems Lab	-	-	2	1	40	60	100
PCC	Software Product Engineering - I	-	-	8	4	40	60	100
PCC	Internship - I	-	-	8	4	40	60	100
MC	Basic Life Skills	2	-	-	-	-	-	100
		12	**1**	**20**	**21**			
SEMESTER IV								
HSC	Understanding human languages	2	-	-	2	40	60	100
BSC	Principles of Science	3	-	-	3	40	60	100
PCC	Operating Systems	3	-	-	3	40	60	100
PCC	Data Structure and Algorithms	3	-	-	3	40	60	100
PCC	Data Structure and Algorithms - Lab	-	-	2	1	40	60	100
PCC	Software Product Engineering - II	-	-	8	4	40	60	100
PCC	Internship -II	-	-	8	4	40	60	100
MC	Gender Inclusion and Society	2	-	-	-	-	-	100
		13	**-**	**18**	**20**			
SEMESTER V								
OEC	Open elective I	3	-	-	3	40	60	100
OEC	Open elective II	3	-	-	3	40	60	100
PCC	Computer Organization & Architecture	3	-	-	3	40	60	100
PCC	Formal Language & Automata Theory	3	-	-	3	40	60	100
PCC	Design & Analysis of Algorithms	3	-	-	3	40	60	100
PCC	Design & Analysis of Algorithms - Lab	-	-	2	1	40	60	100
BSC	Environmental science and Engineering	1	-	-	1	40	60	100
PCC	Software Product Engineering - III	4	-	4	6	40	60	100
PCC	Internship - III	6	-	4	8	40	60	100
		26	**-**	**10**	**31**			

SEMESTER VI								
OEC	Open elective III	3	-	-	3	40	60	100
OEC	Open elective IV	3	-	-	3	40	60	100
PEC	Professional Elective course - I	4	-	-	4	40	60	100
PEC	Professional Elective course - II	4	-	-	4	40	60	100
PCC	Software Product Engineering - IV	4	-	4	6	40	60	100
PCC	Internship - IV	6	-	4	8	40	60	100
		24	**-**	**8**	**28**			
SEMESTER VII								
HSC	Introduction to philosophy	4	-	-	4	40	60	100
OEC	Open elective V	3	-	-	3	40	60	100
PEC	Professional Elective course - III	4	-	-	4	40	60	100
PEC	Professional Elective course - IV	4	-	-	4	40	60	100
PCC	Software Product Engineering - V	4	-	4	6	40	60	100
PCC	Internship - V	6	-	4	8	40	60	100
		11	**-**	**8**	**29**			
SEMESTER VIII								
OEC	Open Elective course - VI	4	-	-	4	40	60	100
Project	Internship VI	-	-	28	14	40	60	100
		4	**-**	**28**	**18**			

ELECTIVES

Open Electives

1. Open Elective I - English communication skills (Semester 5)
2. Open Elective II - Tools and techniques for creative thinking (Semester 5)
3. Open Elective III - Discovering Self (Semester 6)
4. Open Elective IV - Fundamentals of Business Management (Semester 6)
5. Open Elective V -
   a. Human Mind and Behaviour (Semester 7)
   b. Organization Behaviour (Semester 7)
   c. Design Thinking 101 (Semester 7)
6. Open Elective VI -
   a. Unix Programming (Semester 8)
   b. AWS and AWS Security (Semester 8)
   c. Data Modeling and Visualization (Semester 8)

Professional Electives

1. Professional Elective Course I - Compiler Design (Semester 6)
2. Professional Elective Course II - Computer Networks (Semester 6)
3. Professional Elective Course III (Semester 7) -
   a. Cloud computing
   b. Distributed systems
   c. Data Mining and Warehousing
4. Professional Elective Course IV (Semester 7) -
   a. Cryptography
   b. Internet of Things
   c. System Design

Program Outcomes and Program Specific Outcomes

Program Outcomes (POs)

1. **Engineering Knowledge:** Apply comprehensive computer science and engineering fundamentals to analyze, design, and develop complex software systems and solutions.
2. **Problem Analysis:** Utilize critical thinking and advanced methodologies to identify, frame, and solve complex problems in computing, drawing on a deep understanding of computer science disciplines.
3. **Design and Development:** Engineer innovative, efficient, and sustainable computing systems, components, or processes to meet specific requirements, incorporating societal, health, safety, and environmental considerations.
4. **Investigation:** Conduct thorough investigations into complex computing issues, employing advanced research methods to analyze and interpret data, leading to substantiated conclusions.
5. **Modern Tool Usage:** Apply appropriate modern computing tools, techniques, and strategies, including simulation and modeling, to solve complex engineering problems, acknowledging their limitations.
6. **The Engineer and Society:** Evaluate the societal, environmental, and global impact of computing solutions, emphasizing sustainable development and ethical practices, as well as building solutions for real-world problems.
7. **Environment and Sustainability:** Design computing solutions with a keen awareness of their impact on the environment and society, promoting sustainable practices.
8. **Ethics:** Uphold the highest standards of professional ethics, responsibilities, and norms associated with computing practice.
9. **Teamwork and Communication:** Excel in teamwork and communication, functioning effectively as both team members and leaders in diverse, multidisciplinary settings.
10. **Project Management and Finance:** Demonstrate knowledge of project management and financial principles as they relate to computing projects, ensuring efficiency and economic viability.
11. **Lifelong Learning:** Commit to lifelong learning and professional development to stay abreast of emerging technologies and advancements in the computing field.
12. **Technological Adaptability:** Adapt to rapid technological changes and innovations in computing, maintaining a forward-thinking approach to technology solutions.

Program Specific Outcomes (PSOs)

1. Develop and integrate software solutions leveraging advanced knowledge in areas such as web development, mobile applications, artificial intelligence, data analytics and other technology areas to address real-world problems and meet industry needs. Achieve this through sufficient industry exposure during the course of the program.
2. Exhibit professionalism, ethical responsibility, and communication skills in a technological environment, understanding the societal and environmental impacts of computing solutions and promoting sustainable practices.

LIST OF ALL HUMANITIES AND SOCIAL SCIENCES COURSES

S.NO	COURSE TITLE
1	Critical thinking
2	Professional skills for the workplace
3	Learning how to learn
4	Economics, Politics and Rural Society Development
5	Understanding human languages
6	Introduction to philosophy

LIST OF ALL BASIC SCIENCE COURSES

S.NO	COURSE TITLE
1	Discrete Mathematics
2	The breadth of computer science I
3	Design for developers
4	The breadth of computer science II
5	Mathematical thinking
6	Principles of science
7	Environmental science and Engineering

LIST OF ALL PROFESSIONAL CORE COURSES

S.NO	COURSE TITLE
1	Database management system
2	Database management system - Lab
3	Object Oriented Programming
4	Object Oriented Programming - Lab
5	Software Product Engineering - I
6	Internship - I
7	Operating Systems
8	Data structure and Algorithms
9	Data structure and Algorithms - Lab
10	Software Product Engineering - II
11	Internship - II
12	Computer Organization & Architecture
13	Formal Language & Automata Theory
14	Design & Analysis of Algorithms
15	Design & Analysis of Algorithms - Lab
16	Software Product Engineering - III
17	Internship - III
18	Software Product Engineering - IV
19	Internship - IV
20	Software Product Engineering - V
21	Internship - V
22	Internship - VI

LIST OF ALL ENGINEERING SCIENCE COURSES

S.NO	COURSE TITLE
1	Front-end web development
2	Problem solving using programming
3	Back end web development
4	Databases
5	Full Stack web development

LIST OF ALL PROFESSIONAL ELECTIVE COURSES

S.NO	COURSE TITLE
	PROFESSIONAL ELECTIVE
1	Compiler Design
2	Computer Networks
3	Cloud computing
4	Distributed systems
5	Data Mining and Warehousing
6	Cryptography
7	Internet of things
8	System design
9	Unix Shell Programming
10	AWS and AWS Security
11	Data Modeling and Visualization

LIST OF ALL OPEN ELECTIVE COURSES

S.No	COURSE TITLE
1	Human mind and behaviour
2	Organization behaviour
3	Foreign languages (Global options provided such as French/German/Spanish/Japanese etc.)
4	Design thinking 101
5	English communication skills
6	Tools and techniques for creative thinking
7	Discovering Self
8	Fundamentals of Business Management

LIST OF ALL MANDATORY COURSES

S.No	COURSE TITLE
1	Student Induction program
2	Universal Human Values
3	Constitution of India
4	Basic Life skills
5	Gender Sensitivity Related concerns

SEMESTER I

CSE SPE	**Front-end Web development**	**3**	**0**	**2**	**4**

Course Objectives

- To learn the fundamentals of front-end web development, including HTML, CSS, JavaScript, and React JS.
- To learn how to create responsive and dynamic web pages, as well as develop their problem-solving and critical thinking skills.
- Focus on hands-on projects and exercises to give students practical experience in front-end web development.

Unit I - HTML, CSS & JS first steps (15 Hours)

Environment set up, Introduction to HTML, HTML Block Elements, HTML Inline Elements, HTML Forms, Introduction to CSS, CSS Font & Text, CSS Selectors, CSS Inheritance, CSS Colors, Box Model, Flex Box, JS DOM, Introduction to JS, JS Variables, JS Data Types, Basics of JS Operators, Basics of JS Strings, Basics of JS Conditional Statements, Basics of JS Control Statements, Basics of JS Arrays, Basics of JS Functions, Basics of JS Objects

Unit II – HTML, CSS & JS Deep dive Part 1 & Part 2 (15 Hours)

CSS Advanced Selectors, CSS Positioning, Advanced Flexbox, CSS Grids, Responsive Design, JS Operators, JS Strings, JS Conditional Statements, JS Control Statements, JS Arrays & Functions, JS Objects

JS Advanced Functions, JS Nested Data Structures, JS Higher Order Functions, JS Event Handling, Object Oriented JS, JS Closure, JS Storage, CSS Transition, CSS Animation

Unit III - JS the hard parts (15 Hours)

JS Prototypal Inheritance, JS Async, JS Callbacks, JS Promises, JS APIs, JS Axios, Unit testing in JS, Deployment

Unit IV - React first steps (15 Hours)

Environment set up, Introduction to React, Props & State, Components, React App using Babel, Rendering lists of data, JSX, Hooks, Additional Hooks, Event Handling, Component Lifecycle, Class based components, Routing

Unit V - React deep dive (15 Hours)

React Forms, Fetching Data from API, Redux, React Redux, Redux Toolkit, React CSS Library, Material-ui

Total Hours: 75

Text Books

T1: Web development: This book includes: Web development for Beginners in HTML + Web design with CSS + Javascript basics for Beginners; Andy Vickler; Ladoo Publishing LLC (24 May 2021)

T2: The Road to Learn React: Your Journey to Master Plain Yet Pragmatic React.Js; Robin Wieruch; Zaccheus Entertainment (1 January 2018)

Reference Books

R1: HTML, CSS, and JavaScript All in One; Julie C. Meloni & Jennifer Kyrnin; Pearson Education; Third edition

R2: React and React Native: A complete hands-on guide to modern web and mobile development with React.js; Adam Boduch & Roy Derks; Packt Publishing Limited; 3rd edition

COURSE OUTCOMES

At the end of this course the students will be able to,

CO1	To develop proficiency in HTML, CSS, and JavaScript, and apply them to the development of interactive and responsive web pages.	K3
CO2	To design and implement web pages that are accessible, user-friendly, and optimized for search engines	K3
CO3	To create and use reusable code components to improve productivity and maintainability.	K6
CO4	To demonstrate an understanding of the principles of web design and user experience, and apply them to front-end development.	K2
CO5	To use debugging tools and techniques to identify and fix errors in web applications.	K4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	3	2	2	3	1	1	1	3	2	2	1	3	1
CO 2	2	3	2	2	3	1	1	1	3	2	2	1	3	1
CO 3	2	3	2	2	3	1	1	1	3	-	2	1	3	2
CO 4	2	3	2	2	3	1	1	1	3	2	2	1	3	1
CO 5	2	3	2	2	3	1	1	1	3	2	2	1	3	2

CSE SPE	**CRITICAL THINKING**	**4**	**0**	**0**	**4**

Course Objectives

- To introduce students to the concepts of reasoning and decision-making, and to the cognitive biases and heuristics that can impede accurate and rational thinking.
- Based on the seminal book "Thinking, Fast and Slow" by Daniel Kahneman, the course will equip students with the skills to recognize and avoid common thinking errors, and to think more critically and effectively.

Unit-I: The two systems of thinking **(12 Hours)**

Why think critically, The two systems of thinking, The mental power unit, The lazy system, The marvels of priming, Cognitive ease, Norms, surprises and ease, How judgements work, Jumping to conclusions

Unit-II: Heuristics and biases **(12 Hours)**

The law of small numbers, Anchoring effect, Availability bias, Representativeness bias, Conjunction fallacy, Survivorship bias, Sunk cost fallacy, Confirmation bias, Google effect and other common biases

Unit III: Biases **(12 Hours)**

Availability bias, Representativeness bias, Survivorship bias, Sunk cost fallacy, Confirmation bias. Google effect and other common biases

Unit-IV Critical thinking in action **(12 Hours)**

Assignments on identifying biases in the news, creating fake news, writing an unbiased review, alien travel guide

Unit-V: Critical thinking in action II **(12 Hours)**

Facts vs opinion, worst case scenarios, hypothetical scenarios

Total Hours: 60 Hours

Textbooks:

1. Thinking, Fast and Slow; Daniel Kahneman; Penguin 2012 edition

Reference books:

1. Critical Thinking; Jonathan Haber; The MIT Press; Illustrated edition (7 April 2020).

Course Outcome

CO1:	To describe the cognitive biases and heuristics that can affect human reasoning, and explain how they can lead to thinking errors.	K2
CO2:	To recognize and identify common thinking errors and fallacies in everyday situations.	K2
CO3:	To apply critical thinking skills to analyze and evaluate arguments and evidence.	K3
CO4:	To synthesize ideas and perspectives from different sources to develop reasoned and well-supported arguments.	K6
CO5:	To evaluate the reliability and validity of different sources of information and evidence.	K5

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	3
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**DISCRETE MATHEMATICS**	**3**	**1**	**0**	**4**

Course Objectives

- To introduce the students to the mathematical concepts and techniques essential to computer science.
- The course covers topics such as logic, sets, functions, relations, combinatorics, graph theory, and number theory.
- It emphasizes problem-solving, critical thinking, and effective communication of mathematical ideas.
- To provide the mathematical foundation for further study in algorithms, data structures,and other areas of computer science.

Unit I - Proofs **(12 Hours)**
Introduction and Proofs, Induction, Strong Induction, Number Theory

Unit II Structures **(12 Hours)**
Graph theory and Colouring, Matching Problems, Minimum Spanning Tree, Communication Networks, Directed graphs, Relations and partial orders, State machines

Unit III Counting - Part 1 & Part 2 **(12 Hours)**
Sums, asymptotics, Divide and Conquer Recurrences, Linear Recurrences
Counting Rules, Generating functions, Infinite sets

Unit IV Probability Part 1 **(12 Hours)**
Introduction to Probability, Conditional Probability, Independence, Random variables

Unit V Probability Part 2 **(12 Hours)**
Expectations, Deviations, Random Walks

Total Hours: 60 Hours

Text Books:
T1: Mathematics for Computer Science; Eric Lehman, F Thomson Leighton, Albert R Meyer; 12th Media Services (5 June 2017)

Reference book(s

R1: Discrete Mathematics and Its Application; Kenneth H Rosen & Dr Kamala Krithivasan; McGraw Hill; 8th edition
R2: A Textbook on Discrete Mathematics; CV Sastry and Rakesh Nayak; Wiley (1 October 2020)

COURSE OUTCOMES

CO1:	To explain the fundamental concepts and principles of discrete mathematics, including logic, sets, functions, and relations.	**K2**
CO2:	To apply discrete mathematics concepts to solve problems in computer science.	**K3**
CO3:	To analyze and evaluate the correctness and efficiency of algorithms, and the validity and soundness of logical arguments.	**K5**
CO4:	To synthesize discrete mathematics concepts to create mathematical models for real-world problems, such as scheduling and network optimization.	**K6**
CO5:	To synthesize discrete mathematics concepts to create mathematical models for real-world problems, such as scheduling and network optimization.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2	1	2	2	1	1	1	2	1	1	1	2	1
CO 2	2	3	1	2	2	1	1	1	2	1	1	1	2	1
CO 3	3	2	1	3	2	1	1	1	2	1	-	1	2	1
CO 4	3	2	2	3	2	1	1	1	2	1	1	1	2	1
CO 5	2	3	1	3	1	1	1	1	1	1	1	1	2	1

CSE SPE	**PROFESSIONAL SKILLS FOR WORKPLACE**	**3**	**0**	**0**	**3**

Course Objectives

➢ Professional Skills for the Workplace is a course designed to help students develop the human skills they need to succeed in the modern workplace.

➢ The course is based on the Human Skills Matrix, developed by MIT JWEL, and covers four key quadrants: thinking, leading, interacting, and managing oneself.

➢ Students will learn practical strategies for improving their communication, collaboration, problem-solving, and self-management skills.

Unit I – Managing ourselves **(9 Hours)**

Self-awareness, Adaptability, Managing emotions, Accountability, Professionalism, Taking initiative, Persistence, Planning and organizing, Integrity

Unit II – Interacting I **(9 Hours)**

Writing good emails & reports, Use of communication tools, Negotiation skills

Unit III – Interacting II **(9 Hours)**

Use of project management tools, Curating relationships on social media through professional networking sites, Presentation skills

Univ IV – Thinking **(9 Hours)**

Ethical dilemmas, being an intrapreneur, Building a growth mindset, Systems thinking

Unit V – Leading **(9 Hours)**

Empowering others, Having a strategic vision, Project management, Performance management

Total Hours: 45 Hours

Text Books

T1: COMMUNICATION SKILLS FOR PROFESSIONALS AND STUDENTS: An Occupational Therapist's Perspective; Dr. Amitabh Kishor Dwivedi; Notion Press; 1st edition

Reference Books

R1: The Communication Book: 44 Ideas for Better Conversations Every Day; Mikael Krogerus & Roman Tschäppeler; Portfolio Penguin (19 April 2018)

COURSE OUTCOME

At the end of this course the students will be able to,

CO1	To explain the four quadrants of the Human Skills Matrix and how they relate to success in the workplace.	**K2**
CO2	To apply critical thinking skills to solve complex problems and make effective decisions.	**K3**
CO3	To lead and collaborate effectively with others, including managing teams and facilitating group discussions.	**K3**
CO4	To communicate clearly and persuasively in various professional contexts, including written, verbal, and nonverbal communication.	**K3**
CO5	To manage time and prioritize tasks effectively, including setting goals and developing strategies for self-motivation and self-improvement.	**K3**

MAPPING COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	3
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**THE BREADTH OF COMPUTER SCIENCE 1**	**3**	**0**	**0**	**3**

Course Objective:

➢ This course provides students with a unique opportunity to build a modern computer system from scratch.

➢ The course will let students start with Nand gates, build their way up to a fully functioning computer with an operating system, and gain a deep understanding of how computers work.

Unit I: Boolean functions, Gate Logic, Boolean arithmetic and the ALU (9 Hours)

Boolean logic and functions synthesis, Logic gates and HDL, Hardware simulation and multi-bit buses, Binary numbers and binary addition, Negative numbers and ALU, Boolean arithmetic and ALU

Unit II: Memory, Machine language and Computer architecture and Assembly languages (9 Hours)

Memory and ML - Sequential logic and flip flops, Memory units and counters, Building registers/ RAM/ Program counter, Overview and elements, The Hack Computer and Machine language, Input/ Output, Hack Programming, Writing assembly level code

Computer architecture and Assembly languages - Von Neumann Architecture and the Fetch-Execute Cycle, CPU, The Hack computer, Memory implementation, CPU implementation, Introduction to Assembly language and assemblers, Hack assembly language, Handling instructions, Handling symbols, Developing a Hack assembler

Unit III: Virtual machine – Stack arithmetic & Program control (9 Hours)

Recap on program compilation, Stack, Memory segments, VM emulator, VM implementation on Hack, VM translator, Program control, Branching, Abstraction, Function Call and Return: Implementation Preview, Function Call and Return: Run-time simulation, Function Call and Return Implementation, VM Implementation on the Hack Platform, VM Translator : Proposed Implementation, Building the VM translator

Unit IV: High level language (9 Hours)

The Jack Language in a nutshell, Object-Based Programming, List Processing, Jack Language Specification: Syntax and Data Types, Jack Language Specification: Classes, Jack Language Specification: Methods, Developing Apps using the Jack language and OS,A Sample Jack App: Square Dance, Graphics Optimization, Syntax Analysis & Lexical Analysis, Grammars

Unit V: Compiler – Syntax Analysis and Operating systems (9 Hours)

Compiler – Syntax Analysis - Parse Trees & Parse Logic, The Jack Grammar, The Jack Analyzer, The Jack Analyzer: Proposed Implementation, Building a syntax Analyzer, Code Generation, Handling Variables, Handling Expressions

Operating System - Operating System, Efficiency Matters, Mathematical Operations, Memory Access, Heap Management, Graphics, Line Drawing, Handling Textual Output

Total Hours: 45 Hours

Text Books:

T1: The Elements of Computing Systems: Building a Modern Computer from First Principles by Noam Nisan and Shimon Schocken, published by MIT Press. Latest edition: 2nd edition (August 2019).

Reference Books:

R1: Computer Organization and Design: The Hardware/Software Interface by David A. Patterson and John L. Hennessy, published by Elsevier. Latest edition: 5th edition (October 2013).

R2: Digital Design and Computer Architecture by David Money Harris and Sarah L. Harris, published by Morgan Kaufmann. Latest edition: 3rd edition (June 2021).

COURSE OUTCOMES

CO1	To demonstrate knowledge of basic computer architecture principles.	**K**
CO2	To work with Boolean algebra and logic design.	**K**
CO3	To implement basic combinational and sequential circuits.	**K**
CO4	To write assembly language programs to control hardware components	**K**
CO5	To design and implement a fully functional computer system.	**K**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	1	1	1	2	1	1	1	2	1	1	1	2	2
CO 2	2	1	1	1	2	1	1	1	2	1	1	1	2	2
CO 3	3	2	1	2	2	1	1	1	2	1	1	1	2	2
CO 4	3	1	2	2	2	1	1	1	2	1	1	1	2	2
CO 5	2	2	1	1	1	1	1	1	1	1	1	1	2	2

CSE SPE	PROBLEM SOLVING USING PROGRAMMING	3	0	2	4

COURSE OBJECTIVES:

➢ Problem Solving using Programming is an introductory course that teaches fundamental programming concepts and techniques using C++ and Python.

➢ After learning this course, students will easily be able to learn more programming languages and use this course for practicing.

➢ The course emphasizes problem-solving skills and computational thinking, and equips students with the skills necessary to tackle real-world problems using programming

Unit I Algorithms (15 Hours)

Computational thinking, Decomposition, Abstraction, Pattern recognition, Algorithms, Writing pseudocode and translating it to code, Looping (While and do-while loops), Variables (Scope, lifetime and initialization), Data Types (Structures, classes, enums)

Unit II Variables (15 Hours)

Review of variables and their uses, including how to declare and initialize variables; Arithmetic operators, Relational operators, Logical operators, Bitwise operators & Assignment operators; Introduction to strings and advanced string manipulation techniques, such as concatenation, substring extraction, searching, and replacing; Introduction to characters including ASCII and Unicode encoding, character classification functions, and character mapping; Typecasting; Using constants to represent fixed values in code; local and global variables, and their uses and limitations; operator precedence, order of evaluation, and short-circuiting

Unit III Control basics & Advanced (15 Hours)

If, If else, for loop & while loop; using boolean expressions to control program flow and evaluate conditions; using switch statements to select one of many possible code paths based on a value or condition; advanced topics such as nested loops, loops with multiple variables, and using loops to iterate. Nested if, Nested if elseif, Else, for loop, while loop in arrays and strings; Exception handling; using recursive functions to solve problems that can be broken down into smaller sub-problems; advanced techniques for using loops, such as using loop counters, loop flags, and sentinel values; using advanced branching techniques such as the ternary operator and conditional expressions

Unit IV Modularity (15 Hours)

Organizing code into modules, classes, and functions to improve code structure and reusability; Function parameters; Function return value; reviewing recursion and its use in function design and implementation; Libraries and APIs

Unit V Program development **(15 Hours)**

Game development using a programming language, debugging, basic game design principles, user interface design, performance optimization.

Total Hours: 75 Hours

TEXT BOOKS:

T1: Think Like a Programmer: An Introduction to Creative Problem Solving by V. Anton Spraul, Released August 2012, published by No Starch Press

REFERENCE BOOKS:

R1: Programming in Python 3: A Complete Introduction to the Python Language; Mark Summerfield; Pearson Education; Second edition

R2: C++ Programming Language; Bjarne Stroustrup; Pearson Education; 4th edition

COURSE OUTCOMES

CO1:	To explain fundamental programming concepts, including data types, control structures, and functions.	**K2**
CO2:	To apply programming constructs to solve simple problems and algorithms in C++ and Python.	**K3**
CO3:	To analyze and evaluate the efficiency and correctness of algorithms and programs	**K4**
CO4:	To synthesize programming constructs to develop larger programs that solve complex problems.	**K6**
CO5:	To evaluate the strengths and weaknesses of different programming constructs and choose appropriate solutions for different problems.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	3	3	3	2	1	2	2	1	1	1	3	1
CO2	1	3	3	3	3	2	1	2	2	1	1	2	3	1
CO3	1	3	3	3	3	2	1	2	2	1	1	1	3	1
CO4	1	3	3	3	3	2	1	2	2	1	1	1	3	1
CO5	1	3	3	3	2	2	1	2	2	1	1	1	3	1

CSE SPE	DESIGN FOR DEVELOPERS	3	0	0	3

COURSE OBJECTIVES:

Design for Developers is a course designed to introduce students to the fundamental principles of user interface (UI) and user experience (UX) design, with a focus on the needs of developers. The course covers topics such as visual design, user-centered design, usability testing, and accessibility, and provides hands-on experience with design tools and techniques.

Unit 1 How to approach design as a developer (9 Hours)

Why design for developers, Getting started with design education, Getting started with Figma, Labs on Figma

Unit 2 UX Design for Developers- I (9 Hours)

Understanding design sprints, Understanding the user, Information architecture, Accessibility in design,

Unit 3 UX Design for Developers- II (9 Hours)

How to build good digital products, Psychology in UX design, User research, User journey mapping, Wireframing, Prototyping

Unit 4 UI Design for Developers - I (9 Hours)

Visual design principles, Visual hierarchy, Working with text, Layouts and spacing,

Unit 5 UI Design for Developers - II (9 Hours)

Working with colours, Working with images, Creating depth in design, Working with components

Total Hours: 45 Hours

Text Books:

T1: About Face; Alan Cooper, Robert Reimann, Christopher Noessel and David Cronin; Wiley Publishing.

Reference Books:

R1: Hands-on UX design for developers; Elvis Canziba; Packt, 2018
R2: Refactoring; Adam Wathan and Steve Shog

Course Outcomes

CO1	To explain the basic principles of user-centered design, and how they apply to software development.	**K2**
CO2	To evaluate and critique the design of existing software applications, and identify areas for improvement in terms of user experience and usability.	**K5**
CO3	To apply visual design principles and techniques, such as typography, color theory, and layout, to create effective user interfaces.	**K3**
CO4	To conduct usability testing and other evaluation methods to measure the effectiveness and usability of software applications.	**K3**
CO5	To synthesize different design concepts and techniques to create well-designed and user-friendly software interfaces.	**K6**

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Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	1	3	1	3	1	1	1	2	1	1	1	3	2
CO 2	2	1	3	1	3	1	1	1	2	1	1	1	3	2
CO 3	3	2	3	2	3	1	1	1	2	1	1	1	3	2
CO 4	3	1	2	2	2	1	1	1	2	1	1	1	3	2
CO 5	2	2	3	1	1	1	1	1	1	1	1	1	3	2

CSE SPE	Universal Human Values	3	0	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I **(9 Hours)**

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II Understanding Harmony in the Human Being - Harmony in Myself **(9 Hours)**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs To ensure Sanyam and Health

UNIT III **(9 Hours)**

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to worldfamily!.

UNIT IV **(9 Hours)**

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Coexistence

(*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V **(9 Hours)**

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics:

a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Total Hours: 45 Hours

Course Outcome:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Coexistence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics Excel Books, New Delhi, 2010

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins,USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs,Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

SEMESTER II

CSE SPE	**Learning how to learn**	**3**	**0**	**0**	**3**

Course Objectives

- Learning How to Learn is a course designed to help students master the concepts and techniques of effective learning, with a focus on online and remote learning environments.
- The course covers topics such as the science of learning, memory techniques, metacognition, and overcoming procrastination, and provides practical strategies for improving learning outcomes in any subject area

Unit I: How learning works **(9 Hours)**

Introduction to Focus and Diffuse Modes, the role of Practice in learning, Introduction to Memory & Sleep in learning, Procrastination on learning, case studies to end the unit (on learning languages, creativity, problem solving and much more – how learning happens for these skills)

Unit II: Chunking **(12 Hours)**

Introduction to Chunking, how to form a Chunk, Illusions of Competence, the pitfalls of overlearning & choking

Unit III: Procrastination, Memory and Learning **(12 Hours)**

Avoiding rut thinking, strategies and techniques to tackle procrastination while learning, Process vs. Product, Deep-dive into memory, Long-term memory, Being a life-long learner, The Memory Palace technique

Unit IV: Being a better learner **(12 Hours)**

Creating Visual metaphors, creating analogies for learning, Importance of checklists, Learning vs. Prepping for tests, Case studies

Total Hours: 45 Hours

Text books:

T1: Learning How to Learn: How to Succeed in School Without Spending All Your Time Studying; A Guide for Kids and Teens; Barbara Oakley and Terrence Sejnowski; Tarcher Perigree 2018

T2: Make it Stick: The Science of Successful Learning; Peter C Brown, Henry L. Roediger III & Mark A. McDaniel; Harvard University Press; 1st edition

Reference books:

R1: Mindshift: Break Through Obstacles to Learning and Discover Your Hidden Potential; Barbara Oakley, Penguin, 2017
R2: How we learn: The surprising truth about when, where and why it happens; Benedict Carey, Random House, 2014
R3: Ultralearning: Accelerate Your Career, Master Hard Skills and Outsmart the Competition; Scott H Young, Harper Collins, 2019

COURSE OUTCOMES

CO1	To explain the key principles and processes involved in effective learning, and how they can be applied to any subject area.	**K2**
CO2	To apply a variety of memory techniques, such as spaced repetition and visualization, to improve retention and recall of information.	**K3**
CO3	To practice metacognitive strategies, such as self-reflection and self-assessment, to monitor and improve learning progress.	**K3**
CO4	To identify and overcome common obstacles to effective learning, such as procrastination and distractions.	**K4**
CO5	To synthesize different learning techniques and apply them to real-world learning challenges, such as preparing for exams or learning new skills.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	3
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**THE BREADTH OF COMPUTER SCIENCE - 2**	**3**	**0**	**0**	**3**

Course Objective:

➢ In this course, students will continue the journey of building a modern computer system from first principles.
➢ Starting with the CPU, they will design and implement an assembler, a compiler, and an operating system.
➢ By the end of the course, students will have built a complete, fully functional computer system.

Unit I: Virtual Machine I: Stack Arithmetic (9 Hours)
Introduction to virtual machines (VMs); Stack operations and the stack architecture, Stack arithmetic; Memory segments: local, argument, this, that; Program flow control; Function calling conventions

Unit II: Virtual Machine II: Program Control (12 Hours)
Program flow control, Labeling commands and program flow control, Conditional and unconditional branching, Function calling and return, Implementing function calls using VM operations, Recursive function calling

Unit III: High-Level Language and Compiler I: Syntax and Parsing (12 Hours)
Overview of high-level programming languages, Language grammar and syntax, Formal language theory,
Parsing and its various techniques, Top-down and bottom-up parsing, Implementation of a Jack compiler

Unit IV: High-Level Language and Compiler II: Code Generation and Optimization (12 Hours)
Code generation and its challenges, Compilation of expressions, statements and control structures, Memory management, Symbol table management, Intermediate representations, Optimizations and their techniques

Total Hours: 45 Hours

Text Books

T1: The Elements of Computing Systems: Building a Modern Computer from First Principles by Noam Nisan and Shimon Schocken, published by MIT Press. Latest edition: 2nd edition (August 2019).

Reference Books

R1:Computer Architecture: A Quantitative Approach by John L. Hennessy and David A. Patterson, published by Elsevier. Latest edition: 6th edition (June 2021).

R2: Compilers: Principles, Techniques, and Tools by Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, published by Pearson. Latest edition: 2nd edition (September 2006).

Course Outcome:

CO1	To design and implement a simple CPU.	**K6**
CO2	To write an assembler to translate assembly language code into machine code.	**K6**
CO3	To write a compiler to translate high-level language code into assembly language code.	**K6**
CO4	To design and implement a simple operating system.	**K6**
CO5	To analyze and optimize the performance of software and hardware components.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	1	1	1	2	1	1	1	2	1	1	1	2	2
CO 2	2	1	1	1	2	1	1	1	2	1	1	1	2	2
CO 3	3	2	1	2	2	1	1	1	2	1	1	1	2	2
CO 4	3	1	2	2	2	1	1	1	2	1	1	1	2	2
CO 5	2	2	1	1	1	1	1	1	1	1	1	1	2	2

CSE SPE	BACK END WEB DEVELOPMENT	3	0	2	4

Course Objectives

- Master Backend Development Concepts: Understand the fundamental concepts of backend web development, including APIs, databases, and server-side scripting.
- Understand Application Lifecycle: Gain insights into the development and deployment lifecycle of backend applications, emphasizing RESTful API functionality and database integration.
- Practical Tool Configuration: Theoretically configure and utilize development tools and environments for backend application creation, including API setup with Express and database connectivity.
- Codebase Analysis Skills: Develop the ability to analyze and critique backend codebases, identifying key components like routing, middleware, and database schema design.
- Design and Evaluate Backend Systems: Synthesize knowledge to theoretically design comprehensive backend systems, focusing on security, performance, and advanced features like user authentication and data validation

Unit I : Back end essentials **(15 Hours)**

Creating the first API and page - an introduction to Express, Deploying APIs: from development to production environments, API testing with clients and initial database integration, Advanced API features: Authentication and security practices.

Unit II : Database Integration and Schema Design **(20 Hours)**

Database setup and connection with Express, CRUD operations through API endpoints, Writing and implementing Mongoose schemas, Relations between entities in a database model.

Unit III : Security and Data Management **(20 Hours)**

Adding users to the database and implementing validation logic, Securely managing passwords and sensitive user information, Secure and insecure practices in handling cookies and sessions, Advanced database management techniques.

Unit IV : Deployment and Testing **(20 Hours)**

Deploying backend services to production, Ensuring backend performance and security, Testing strategies for backend applications, Continuous integration and deployment practices.

Total hours: 75

Text Books:

T1: Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js; Shama Hoque; Packt Publishing Limited; 2nd edition

Reference Books:

R1: Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App; Greg Lim

R2: Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Vasan Subramanian; Apress; 2nd edition

COURSE OUTCOMES

CO1:	To recall and list the fundamental concepts of backend web development, including the roles of APIs, databases, and server-side scripting.	**K1**
CO2:	To demonstrate an understanding of the development and deployment lifecycle of backend applications, including the purpose and functionality of RESTful APIs and the significance of database integration.	**K2**
CO3:	To apply their knowledge to configure and use development tools and environments for creating backend applications, demonstrating the ability to set up a basic API using Express and connect it to a database.	**K3**
CO4:	To analyze and dissect backend codebases to identify components of API development, including routing, middleware, and error handling, as well as understand the structure and design of database schemas relevant to backend processes.	**K4**
CO5:	To evaluate the security and performance aspects of backend applications, critiquing and suggesting improvements for database interactions, API security practices (such as authentication and authorization), and data validation methods.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	3	1	1	1	3	1	1	1	1	1	1	1	2	2
CO 2	3	2	2	3	3	1	1	1	1	1	1	1	2	2
CO 3	2	2	2	3	3	1	1	1	1	1	1	1	2	2
CO 4	3	1	2	1	3	1	1	1	1	1	1	1	2	2
CO 5	1	2	2	1	3	1	1	1	1	1	1	1	2	2

CSE SPE	**DATABASES**	**3**	**0**	**2**	**4**

Course Objectives

- Understand NoSQL Fundamentals: Grasp the core principles, types, and use cases of NoSQL databases, distinguishing them from traditional relational databases.
- Architectural Insights: Gain a comprehensive understanding of the architectural differences between NoSQL and relational databases, and the scenarios in which NoSQL is preferred.
- Design Theoretical NoSQL Schemas: Apply theoretical knowledge to design NoSQL database schemas for given scenarios, selecting appropriate database types for specific needs.
- Analyze Database Performance: Assess the strengths, limitations, scalability, and performance of various NoSQL databases, understanding their impact on data models and application requirements.
- Innovate with NoSQL Solutions: Synthesize course concepts to propose theoretical, innovative solutions using NoSQL databases for addressing complex data challenges.

Unit I : Introduction to Databases **(15 Hours)**

Setting up databases for web applications, Understanding schema design and data modeling, Implementing relations between entities, Basic database operations and CRUD fundamentals.

Unit II : Advanced Database Operations **(20 Hours)**

Modifying and managing data through APIs, Advanced schema design with Mongoose, Integrating database services with backend applications, Database security and user management.

Unit III : Performance and Optimization **(20 Hours)**

Optimizing database queries for performance, Managing database connections and pools, Data indexing strategies and best practices, Analyzing and improving database performance.

Unit IV : Security and maintenance **(20 Hours)**

Securely managing user data and passwords, Implementing authentication and authorization in databases, Database backup and recovery strategies, Ensuring data integrity and security.

Total hours: 75

Text Books:

T1: Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js; Shama Hoque; Packt Publishing Limited; 2nd edition

Reference Books:

R1: Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App; Greg Lim

R2: Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Vasan Subramanian; Apress; 2nd edition

COURSE OUTCOMES

CO1:	To identify and recall the core principles of NoSQL databases, including the types of NoSQL databases (document, key-value, wide-column, and graph databases) and their primary use cases.	**K1**
CO2:	To explain the architectural differences between NoSQL and traditional relational databases, understanding when and why NoSQL databases are chosen over relational databases for certain applications.	**K2**
CO3:	To apply theoretical knowledge to design NoSQL database schemas for hypothetical scenarios, demonstrating an ability to choose the appropriate NoSQL database type based on specific requirements.	**K3**
CO4:	To analyze the strengths and limitations of different NoSQL databases, assessing their scalability, performance, and suitability for various data models and application needs.	**K4**
CO5:	To critically evaluate case studies of NoSQL database implementations, discussing the impact of database design decisions on application performance, scalability, and maintainability.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	3	1	1	1	1	1	1	1	1	1	1	1	2	2
CO 2	3	1	2	2	2	1	1	1	1	1	1	1	2	2
CO 3	2	3	2	2	3	1	1	1	1	1	1	1	2	2
CO 4	1	1	3	3	1	1	1	1	1	1	1	1	2	2
CO 5	1	2	3	3	1	2	2	1	2	1	1	1	2	2

CSE SPE	**FULL STACK WEB DEVELOPMENT**	**3**	**0**	**2**	**4**

Course Objectives

- Comprehensive Understanding of Full Stack Technologies: Students will gain a thorough understanding of full stack web development, including the architecture, technologies, and interactions between the front-end, back-end, and databases.
- Database Design and Management with MongoDB: Students will learn to theoretically design and develop database schemas with MongoDB, understanding data modeling, index creation, and query writing to support web applications.
- Development of RESTful APIs: Through theoretical exploration, students will learn to create RESTful APIs using Node.js and Express, focusing on handling HTTP methods, middleware integration, and database interactions.
- Front-end Development with React: Students will understand the principles of developing user interfaces using React, including component-based architecture, state management, and event handling for dynamic web applications.
- Integration and Project Design: Students will conceptualize the integration of front-end and back-end components to build fully functional web applications, culminating in a theoretical project where they design, develop, and test a unique full stack application based on user requirements.

Unit I : Environment setup **(15 Hours)**

Creating a project and understanding project structures, Using GitHub for version control and project sharing, Setting up the development environment for Full Stack development, Launching a project.

Unit II : Building and Deploying the Backend **(20 Hours)**

Making the first API and understanding REST principles, Deploying APIs to local and production environments, Testing APIs with an API client and initial database setup, Writing Mongoose schemas for application entities.

Unit III : Integrating Database with Backend **(20 Hours)**

Setting up a database and connecting it to the Express server, Modifying database records through APIs, Understanding relations between entities and their implementation in schemas, Adding users in the database and handling validations.

Unit IV : Frontend Development and Integration **(20 Hours)**

Setting up a simple React application with Vite, Deploying the Front-end and understanding deployment strategies, Designing and using components for CRUD operations in React, Implementing user authentication and session management with cookies.

Total Hours: 75

Text Books:

T1: Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js; Shama Hoque; Packt Publishing Limited; 2nd edition

Reference Books:

R1: Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App; Greg Lim

R2: Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Vasan Subramanian; Apress; 2nd edition

COURSE OUTCOMES

CO1:	To describe the architecture and components of a full stack web application, including front-end and back-end technologies and their interactions.	**K2**
CO2:	To design and develop a database schema using MongoDB, including defining data models, creating indexes, and writing queries.	**K6**
CO3:	To create RESTful APIs using Node.js and Express, including handling HTTP requests and responses, and interacting with the database	**K6**
CO4:	To implement front-end user interfaces using React, including using React components, managing state, and handling user input.	**K3**
CO5:	To integrate front-end and back-end components to create a fully functional full stack web application, including using asynchronous communication and handling errors and exceptions.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	3	2	2	3	1	1	1	3	2	2	1	3	3
CO 2	2	3	2	2	3	1	1	1	3	2	2	1	3	3
CO 3	2	3	2	2	3	1	1	1	3	2	2	1	3	3
CO 4	2	3	2	2	3	1	1	1	3	2	2	1	3	3
CO 5	2	3	2	2	3	1	1	1	3	2	2	1	3	3

CSE SPE	CONSTITUTION OF INDIA	2	0	0	0

COURSE OBJECTIVES:

- The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
- To help students be familiar with the historical and significant aspects of the constitution of India.
- To make students aware of their fundamental duties and rights.
- To know about central and state government functionalities in India.

UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNIT II FUNDAMENTAL RIGHTS

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNIT V AMENDMENT AND EMERGENCY PROVISIONS

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

COURSE OUTCOME:

At the end of this course the students will be able to,

CO1: Elaborate the constitution of India and its salient features.
CO2: Know the fundamental rights and duties.
CO3: Discuss the Parliamentary Form of Government in India.
CO4: Recognize the Directive Principles of State Policy.
CO5: Understand and abide by the rules of the Indian constitution and to appreciate different cultures among the people.

TEXT BOOKS:

1. V.N. Shukla, Constitutional Law of India
2. D.D. Basu, Commentary on the Constitution of India
3. J.N. Pandey, Constitution of India
4. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
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7. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

1. V.D. Mahajan, Constitutional Law of India
2. H.M. Seervai, Constitution of India
3. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
4. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
5. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

SEMESTER III

CSE SPE	ECONOMICS, POLITICS AND RURAL SOCIETY DEVELOPMENT	2	0	0	2

COURSE OBJECTIVES:

- ➢ This course is designed to provide CS engineers with an understanding of basic economics, politics, and rural development and how these three fields are interconnected.
- ➢ Students will learn about the principles of economics, the functioning of political systems, and the challenges and opportunities in rural development.
- ➢ Through this course, students will develop a multidisciplinary perspective, enabling them to identify and contribute to solutions that benefit both society and the economy.

Unit I: Fundamentals of Economics (6 HOURS)

Introduction to economics, demand and supply, market equilibrium, macroeconomic concepts including GDP, inflation, and unemployment, fiscal and monetary policies, applications of economics in the technology industry.

Unit II: Political Systems and Governance (6 HOURS)

Overview of political ideologies including democracy, authoritarianism, and socialism, political institutions and governance structures, public policy and economic impact, role of technology in modern political processes including social media and big data analytics.

Unit III: Rural Economy and Development (6 HOURS)

Characteristics of rural economies, challenges in rural development including poverty, education, and healthcare, technology-driven rural development including e-governance, e-commerce, and digital literacy, government policies and rural development initiatives.

Unit IV: Technology and Sustainable Development (6 HOURS)

Sustainable development goals (SDGs) and rural upliftment, role of ICT and innovation in economic and political development, case studies on digital transformation in rural areas, ethical considerations in economic and political decision-making.

Unit V: Interdisciplinary Case Studies and Policy Analysis (6 HOURS)

Integrative approach to economic, political, and rural development issues, critical analysis of national and global policies, case studies on successful rural development initiatives, policy recommendations and future trends.

TOTAL HOURS: 30

TEXT BOOKS:

T1: Economics: Principles, Problems, and Policies by Campbell McConnell, Stanley Brue, and Sean Flynn. (Latest edition, published by McGraw-Hill Education India)
T2: Politics: An Introduction by Andrew Heywood. (Latest edition, published by Palgrave Macmillan India)
T3: Rural Development: Principles, Policies and Management by B. P. Vani and K. Sivaramane. (Latest edition, published by SAGE Publications India Pvt Ltd

REFERENCE BOOKS:

R1: Rural Development: Putting the last first; Robert Chambers; Pearson Education India; 2nd Edition (2010)
R2: Economic Development of Rural Areas: An Analysis of Problems and Prospects; L. P. Singh; Sage Publications India Pvt Ltd; 2nd Edition (2011)

Course Outcomes

CO1:	To explain core economic concepts and apply them to analyze market behaviors.	**K3**
CO2:	To examine the impact of political systems and governance structures on economic policies and societal development.	**K4**
CO3:	To assess the challenges and opportunities in rural economic development and propose viable solutions using technology.	**K5**
CO4:	To develop innovative strategies integrating technology for sustainable economic and political progress.	**K6**
CO5:	To critically analyze policy frameworks and design recommendations for improving economic and rural development.	**K5**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	-	1	3	2	1	2	2	-
CO 2	-	-	1	-	-	2	-	2	2	2	1	1	-	2
CO 3	-	-	1	-	-	3	1	1	3	1	1	1	3	3
CO 4	-	-	1	-	-	3	1	2	2	3	1	1	3	3
CO 5	-	-	1	-	-	2	-	1	3	2	1	1	-	3

CSE SPE	MATHEMATICAL THINKING	2	1	0	3

Course Objectives

- ➢ This course is designed to provide CS Engineers with a foundation in basic mathematical concepts relevant to aptitude tests and problem-solving in the tech industry.
- ➢ Students will learn topics such as number systems, ratios, proportions, averages, profit and loss, time and work, time, speed and distance, permutations, percentages, simple and compound interest, statistics, and geometry.

Unit 1: What is Mathematical Thinking? (9 HOURS)

Inquiry-Based Learning, Introduction to Mathematical Thinking, Precision of language in Mathematics

Unit 2: Logical and Language Analysis-I (9 HOURS)

The Logical Combinators- Conjunction, Disjunction, Negation, Implication, Biconditional, Truth Tables, Implication- Role of Causality, Truth Table

Unit 3: Logical and Language Analysis-II (9 HOURS)

Logical Equivalence- Verification of logically equivalent sentences, De Morgan Law, Quantifiers- Existential Quantifier and Universal Quantifier, Combining Quantifiers, Negating Quantifiers

Unit 4: Mathematical Proofs (9 HOURS)

Proof-Meaning, Components of Proof, Characteristics of a good proof, Proof by Contradiction, Proof by Quantifiers (Proving Existential Quantifier and Universal Quantifier)

Unit 5: Advanced Topics in Mathematical Thinking (9 HOURS)

Number Theory- Fundamental Theorem of Arithmetic, The Division Theorem, Hilbert's paradox, Basic Properties of Divisibility, Real Analysis- Completeness Theory, Sequences, Convergence of Sequence.

Total Hours: 45

Text Books:

T1: Quantitative Aptitude for Competitive Examinations; R.S. Aggarwal; S. Chand Publishing;2021

Reference Books:

R1: How to Prepare for Quantitative Aptitude for CAT; Arun Sharma; McGraw Hill Education; 2022

R2: The Pearson Guide to Quantitative Aptitude for Competitive Examinations; Dinesh Khattar; Pearson Education; 2021

Course Outcome

CO#	Course Outcome	Knowledge Level
CO1	To describe the fundamentals of mathematical thinking and explain the role of precision in mathematical language.	K2
CO2	To analyze logical combinators, truth tables, and the role of causality in logical reasoning.	K4
CO3	To verify logical equivalence, apply De Morgan's Laws, and manipulate quantifiers in logical expressions.	K3
CO4	To construct valid mathematical proofs using contradiction and quantifier-based reasoning.	K5
CO5	To explore advanced mathematical concepts including number theory, real analysis, and sequence convergence.	K6

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	-	-	-	-	1	-	-	2	-
CO 2	-	-	1	-	-	-	-	-	-	1	-	-	2	2
CO 3	-	-	1	-	-	-	-	-	-	1	-	-	3	3
CO 4	-	-	1	-	-	-	2	-	-	-	-	-	3	-
CO 5	-	-	1	-	-	-	-	-	-	-	2	-	2	2

CSE SPE	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

Course Objectives

- This course is designed to teach students the fundamental concepts and principles of Database Management Systems (DBMS) and how to effectively design, implement, and manage databases.
- Students will learn various database models and acquire hands-on experience in using popular DBMS tools.

Unit I – Introduction to DBMS **(9 HOURS)**

The Evolution of Database Systems- Overview of a Database Management System-Outline of DatabaseSystem Studies-The Entity-Relationship Data Model: Elements of the E/R Model-Design Principles-The Modeling of Constraints-Weak Entity Sets.

Unit II – The Relational data model and Algebra **(9 HOURS)**

Basics of the Relational Model-From E/R Diagrams to Relational Designs-Converting Subclass Structures to Relations-Functional Dependencies-Rules About Functional Dependencies-Design of Relational Database Schemas – Multi valued Dependencies- Relational Algebra: Relational operations-Extended Operators of Relational Algebra- Constraints on Relations.

Unit III – SQL **(9 HOURS)**

Simple Queries in SQL-Sub queries-Full-Relation Operations-Database Modifications-Defining a Relation Schema-View Definitions- Constraints and Triggers: Keys and Foreign Keys-Constraints on Attributes and Tuples-Modification of Constraints-Schema-Level Constraints and Triggers -Java Database ConnectivitySecurity and User Authorization in SQL

Unit IV – Index structures and query processing **(9 HOURS)**

Index Structures:Indexes on Sequential Files-Secondary Indexes-B-Trees-Hash Tables-Bitmap Indexes-Query Execution: Physical-Query-Plan Operators-One-Pass , two-pass & index based Algorithms, Buffer Management, Parallel Algorithms-Estimating the Cost of Operations-Cost-Based Plan Selection -Order for Joins-Physical-Query-Plan

Unit V – Failure recovery and concurrency control **(9 HOURS)**

Issues and Models for Resilient Operation -Undo/Redo Logging-Protecting against Media FailuresConcurrency Control: Serial and Serializable Schedules-Conflict-Serializability-Enforcing Serializability by Locks-Locking Systems With Several Lock Modes-Concurrency Control by Timestamps, validation transaction management: Serializability and Recoverability-View Serializability-Resolving DeadlocksDistributed Databases: commit & lock.

TOTAL HOURS: 45

Text Books:

T1: Database Systems: Models, Languages, Design And Application Programming By Ramez Elmasri, Shamkant B. Navathe, Pearson 6th edition

COURSE OUTCOMES

CO1	To understand the fundamental concepts of database management systems including data models, data normalization, and database design.	**K2**
CO2	To be able to design and implement a relational database using SQL.	**K6**
CO3	To be able to use a popular DBMS tool such as MySQL to create and manage databases.	**K3**
CO4	To be able to use SQL to query and manipulate data stored in a database.	**K6**
CO5	To be able to apply database management concepts to real-world scenarios and problem-solving.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	2	2
CO 2	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO 3	2	1	2	-	3	-	-	-	-	-	1	1	3	3
CO 4	3	2	2	-	3	-	-	-	-	-	1	1	3	3
CO 5	2	3	2	-	3	-	-	-	1	-	2	2	3	3

Course Objectives

- ➢ SQL Proficiency: Develop proficiency in SQL by writing and executing queries to retrieve, manipulate, and manage data stored in relational databases.
- ➢ Database Design Skills: Gain practical experience in designing and implementing normalized relational databases, adhering to normalization principles and best practices.
- ➢ Advanced SQL Knowledge: Acquire advanced knowledge of SQL concepts such as joins, subqueries, views, triggers, and stored procedures, enabling complex data manipulation and management tasks.
- ➢ Transaction Management Competence: Understand and apply transaction management concepts, including the maintenance of ACID properties, concurrency control, and locking mechanisms.
- ➢ Database Administration Abilities: Learn essential database administration tasks such as backup and recovery, user management, and performance tuning to ensure the reliability, security, and efficiency of database systems.

List of Experiments

1. Database Design & ER Diagrams
    - ER diagrams for a University Database & Airline Reservation System.
2. SQL Schema Implementation & Normalization
    - Implement schema & apply Normalization (3NF & beyond).
3. Basic SQL Operations & Data Analysis
    - SELECT, INSERT, UPDATE, DELETE queries.
    - Retrieve average student grades & high-paying e-commerce customers.
4. Joins & Views in SQL
    - INNER JOIN, LEFT JOIN, RIGHT JOIN, SELF JOIN, CROSS JOIN.
    - Create & use Views.
5. Indexing & Query Optimization
    - Implement Indexing techniques & analyze Query Optimization.
6. Transactions & Role-Based Access Control
    - TCL commands (COMMIT, ROLLBACK, SAVEPOINT).
    - User privileges & role-based access control.
7. PL/SQL Programming – Functions, Procedures & Triggers
    - Write Stored Procedures, Triggers, & User-Defined Functions (UDFs).
8. Recursive Queries & Event Scheduling
    - Recursive Queries using CTEs & SQL Event Schedulers.
9. Backup, Restore & Partitioning
    - Database Backup & Restore & Partitioning techniques.
10. NoSQL Databases & MongoDB CRUD Operations
    - SQL vs NoSQL, perform CRUD operations in MongoDB.
11. JSON Data Handling & Sharding in Databases
    - Store & query JSON data, explore Sharding & Replication.
12. Deadlock Detection & Prevention
    - Simulate & prevent deadlocks in SQL.

TOTAL HOURS: 30 Hour

Text Books:

T1: Database Systems: Models, Languages, Design And Application Programming By Ramez Elmasri, Shamkant B. Navathe, Pearson 6th edition

COURSE OUTCOMES

CO1	To develop practical skills in database design and implementation using SQL, focusing on real-world applications and industry standards.	**K3**
CO2	To design and implement normalized relational databases using SQL, ensuring data integrity, efficiency, and scalability.	**K3**
CO3	To utilize popular DBMS tools like MySQL to create, manage, and optimize databases, gaining hands-on experience in database administration tasks.	**K6**
CO4	To master SQL querying techniques to extract, manipulate, and manage data stored in relational databases efficiently, enhancing data retrieval and analysis capabilities.	**K4**
CO5	To develop functional, database-driven web applications by applying database management concepts to practical scenarios, showcasing proficiency in database integration and application development.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	3	3
CO 2	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO 3	2	1	2	-	3	-	-	-	-	-	1	1	3	3
CO 4	3	2	2	-	3	-	-	-	-	-	1	1	2	3
CO 5	2	3	2	-	3	-	-	-	1	-	2	2	3	3

CSE SPE	OBJECT ORIENTED PROGRAMMING	3	0	0	3

Course Objectives

- This course teaches the principles of Object-Oriented Programming (OOP), which is a key concept in modern programming paradigms.
- The course is language-agnostic, but students can choose to implement their projects in either C++ or Python.

Unit I Introduction to Object-Oriented Programming (9 HOURS)

Basics of OOP, Objects and Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Programming vs OOP

Unit II Advanced Concepts in OOP (9 HOURS)

Templates, Overloading, Exception Handling, Operator Overloading, Inheritance and Polymorphism, Advanced Topics in Inheritance

Unit III Object-Oriented Design Principles (9 HOURS)

SOLID Principles, Design Patterns, Design for Reuse, Design for Testability.

Unit IV Software Engineering Practices (9 HOURS)

Agile Development, Waterfall Model, Software Development Life Cycle (SDLC), Version Control, Code Reviews, Testing and Debugging.

Unit V (9 HOURS)

Advanced Topics in OOP Multithreading, Concurrency, Networking, GUI Programming, Database Programming, Best Practices for OOP

Total Hours : 45 Hours

Text Books:

T1: Object-Oriented Programming with C++; E Balagurusamy; McGraw Hill; Eighth edition
T2: Python Object-Oriented Programming; Steven F. Lott & Dusty Phillips; Packt Publishing Limited; 4th edition
T3: Java The Complete Reference; Herbert Schildt; McGraw Hill; Eleventh edition

Reference Books:

R1: Object Oriented Programming C++; Robert Lafore; Pearson Education India; 4th edition
R2: OOPS with C++ and Java; Balagurusamy; McGraw Hill Education 2014 edition
R3:Python 3 Object-Oriented Programming; Dusty Phillips; Packt 3rd edition

COURSE OUTCOMES

CO1:	To explain the fundamental concepts and principles of OOP, such as encapsulation, inheritance, and polymorphism.	**K2**
CO2:	To apply OOP concepts to develop software applications in C++ and Python.	**K3**
CO3:	To design and implement complex data structures and algorithms using OOP concepts.	**K6**
CO4:	To develop and manage large-scale software projects using OOP design patterns and software engineering practices.	**K3**
CO5:	To analyze and evaluate the performance and efficiency of OOP-based programs.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	2	3
CO 2	2	2	2	-	3	-	-	-	-	-	-	-	3	2
CO 3	2	1	2	-	3	-	-	-	-	-	1	1	3	-
CO 4	3	2	2	-	3	-	-	-	-	-	1	1	3	3
CO 5	2	3	2	-	3	-	-	-	1	-	2	2	3	2

CSE SPE	OBJECT ORIENTED PROGRAMMING - LAB	0	0	2	1

Course Objectives

- Application: To apply OOP concepts practically to develop software applications in C++ and Python.
- Synthesis: To design and implement complex data structures and algorithms using OOP principles.
- Collaboration: To collaborate effectively in a team environment to develop and maintain OOP-based software projects.
- Evaluation: To evaluate the performance and efficiency of OOP-based programs through practical experimentation and analysis.
- Problem-solving: To troubleshoot and debug OOP-based software applications effectively

List Of Experiments :

1. Encapsulation & Data Hiding
    - Implement Student Class & Bank Account Class with private attributes & getters/setters.
2. Constructors & Destructors
    - Define Constructors & Destructors in Student, Person, & Book classes.
3. Inheritance Concepts
    - Implement Single, Multilevel, & Hierarchical Inheritance.
4. Multiple & Hybrid Inheritance
    - Demonstrate Multiple Inheritance using Interfaces & Hybrid Inheritance.
5. Polymorphism in OOP
    - Implement Method Overriding in a Shape Hierarchy.
6. Class Hierarchies & Employee System
    - Develop an Employee Hierarchy (Manager, Intern, etc.).
7. Abstraction & Interfaces
    - Implement Database Connector Class with abstraction.
8. SOLID Principles - Part 1
    - Apply Single Responsibility & Open-Closed Principles.
9. SOLID Principles - Part 2
    - Demonstrate Liskov Substitution, Interface Segregation & Dependency Inversion Principles.
10. Online Banking System (SOLID Principles)
    - Apply SOLID design principles to develop an Online Banking System.
11. Library Management System (SOLID Principles)
    - Implement a Library Management System following SOLID principles.
12. Shape Hierarchy & Object Sorting
    - Extend Shape Hierarchy & implement a Sortable class.

TOTAL HOURS: 30 Hours

Text Books:

T1: Object-Oriented Programming with C++; E Balagurusamy; McGraw Hill; Eighth edition
T2: Python Object-Oriented Programming; Steven F. Lott & Dusty Phillips; Packt Publishing Limited; 4th edition
T3: Java The Complete Reference; Herbert Schildt; McGraw Hill; Eleventh edition

Reference Books:

R1: Object Oriented Programming C++; Robert Lafore; Pearson Education India; 4th edition
R2: OOPS with C++ and Java; Balagurusamy; McGraw Hill Education 2014 edition
R3:Python 3 Object-Oriented Programming; Dusty Phillips; Packt 3rd edition

COURSE OUTCOMES

CO1:	To apply OOP principles practically to develop software applications in C++ and Python, demonstrating proficiency in implementation.	**K3**
CO2:	To design and implement complex data structures and algorithms using OOP concepts, emphasizing practical problem-solving skills.	**K6**
CO3:	To collaborate effectively in a team environment to develop and maintain OOP-based software projects, showcasing teamwork and communication skills..	**K6**
CO4:	To evaluate the performance and efficiency of OOP-based programs through practical experimentation and analysis.	**K5**
CO5:	To troubleshoot and debug OOP-based software applications effectively, demonstrating problem-solving abilities.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO 2	2	2	2	-	3	-	-	-	-	-	-	-	3	-
CO 3	2	1	2	-	3	-	-	-	-	-	1	1	2	3
CO 4	3	2	2	-	3	-	-	-	-	-	1	1	3	2
CO 5	2	3	2	-	3	-	-	-	1	-	2	2	3	3

CSE SPE	**BASIC LIFE SKILLS**	**2**	**0**	**0**	**0**

COURSE OBJECTIVE:

1. To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I PHYSICAL HEALTH

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalbhati, Makarasana Part I, Makarasana Part II, Body Massage, Acupressure, Relaxation exercises - Benefits.Yoga Asanas: Pranamasana – HasthaUttanasana - PadaHastasana – AswaSanjalana Asana – ThuvipathaasvaSanjalana asana – AstangaNamaskara - Bhujangasana–AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana–HasthaUttanasana - Pranamasana.Pranayama: Naddi Suddi - Clearance Practice - Benefits.

UNIT II LIFE FORCE

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds).Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III MENTAL HEALTH

Mental Frequencies - Beta, Alpha, Theta and Delta wave - Agna Meditation explanation - benefits.

Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation – Benefit.Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV VALUES

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – ModestyTolerance - Adjustment - Sacrifice – ForgivenessPurity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual puritySocial Values:Non-violence– ServicePatriotism – EqualityRespect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V MORALITY (VIRTUES)

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

COURSE OUTCOME:

At the end of this course the students will be able to,

CO1: Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.

CO2: Demonstrate foundational standing, sitting, balance postures with proper alignment andMaintain youthfulness through kaya kalpa practice.

CO3: Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.

CO4: Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values.

CO5: Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense of relaxation through meditation to keep up morality in life.

TEXT BOOKS/ REFERENCE BOOKS:

1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,
8. K. R. Dhanalakshmi and N. S. Raghunathan, " Personality Enrichment, Margham Publications
9. Dr. V. M. Selvaraj, "Personality Development" Bhavani Publications
10. R. S. Agarwal, "Quantitative Aptitude".
11. A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.

SEMESTER IV

CSE SPE	**UNDERSTANDING HUMAN LANGUAGES**	**2**	**0**	**0**	**2**

Course Objective:

➢ In this course, students will explore the fundamental concepts of human language, including phonetics, syntax, semantics, and pragmatics.
➢ The course will provide an overview of the structure and function of human language and explore how language is processed in the brain.

Unit 1: Introduction to Language and Linguistics (6 hours)
Overview of Linguistics and its sub-fields, Phonetics and Phonology, Morphology

Unit 2: Syntax and Semantics (6 hours)
Syntax and Syntactic Structures, Semantics and Semantic Structures, Language Typology

Unit 3: Language Acquisition and Language Change(6 hours)
First and Second Language Acquisition, Language Change and Language Contact, Historical Linguistics

Unit 4: Sociolinguistics and Applied Linguistics (6 hours)
Sociolinguistics and Language Variation, Language Policy and Planning, Language and Identity, Language and Technology

Unit 5: Language in Context (6 hours)
Language and Culture, Language and Gender, Language and Power, Language and Globalization

Total Hours : 30 Hours

TEXTBOOKS:

T1: How Languages Work: An Introduction to Language and Linguistics by Carol Genetti; Cambridge University Press; 2nd edition

REFERENCE BOOKS:

R1: How Language Works; David Crystal; Penguin UK (2007 edition)

Course Outcome:

CO1	Understand the basic concepts of human language, including phonetics, syntax, semantics, and pragmatics.	**K2**
CO2	Explore the structure and function of human language, including the sound systems of languages, grammatical structures, and the meanings of words and sentences.	**K5**
CO3	Understand the social and cultural dimensions of language use, including language variation and change, multilingualism, and language attitudes.	**K2**
CO4	Understand how language is processed in the brain, including the neural mechanisms of language comprehension and production.	**K2**
CO5	Analyze the ways in which language reflects and shapes cultural and social identities.	**K4**

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	-	-	-	-	-	2	3	-	1	-	3	2
CO 2	-	-	-	-	-	-	-	2	2	1	1	-	2	-
CO 3	-	-	-	-	-	2	-	2	3	1	1	-	-	3
CO 4	-	-	-	-	-	2	-	2	3	-	1	-	2	-
CO 5	-	-	-	-	-	2	-	2	3	1	1	-	-	3

CSE SPE	**PRINCIPLES OF SCIENCE**	**3**	**0**	**0**	**3**

Course Objective:

- ➢ The Principles of Science course provides a foundation in natural science principles and their application to computer science.
- ➢ The course will develop critical thinking and scientific communication skills and help students appreciate the relationship between science, technology, and society.

Unit I: Introduction to Science and Technology (9 HOURS)

Definition and characteristics of science; Relationship between science and technology; Historical development of science and technology; Ethical considerations in science and technology

Unit II: Physics Principles in Computer Science (9 HOURS)

Mechanics: motion, forces, work, energy, momentum; Electromagnetism: electric fields, magnetic fields, electromagnetic waves; Thermodynamics: laws of thermodynamics, heat transfer, phase transitions; Applications of physics principles to computer science problems; Understanding of the relationship between physics and computer science

Unit III: Chemistry Principles in Computer Science (9 HOURS)

Atomic structure: electrons, protons, neutrons, periodic table; Chemical reactions: stoichiometry, acids and bases, oxidation and reduction; Thermodynamics: enthalpy, entropy, free energy; Applications of chemistry principles to computer science problems; Understanding of the relationship between chemistry and computer science

Unit IV: Biology Principles in Computer Science (9 HOURS)

Genetics: DNA, RNA, protein synthesis, inheritance patterns; Cell biology: structure and function of cells, cellular processes; Evolution: mechanisms of evolution, natural selection, speciation; Applications of biology principles to computer science problems; Understanding of the relationship between biology and computer science

Unit V: Earth and Environmental Science Principles in Computer Science (9 HOURS)

Geology: plate tectonics, minerals, rocks; Meteorology: weather patterns, climate change; Ecology: ecosystems, biodiversity, conservation; Applications of Earth and environmental science principles to computer science problems; Understanding of the relationship between Earth and environmental science and computer science

Total Hours : 45 Hour

Textbooks:

T1: Principles of Science by Donald E. Simanek and John R. Erickson (Pearson Education India, 2019)
T2: The Sciences: An Integrated Approach by James Trefil and Robert M. Hazen (published by John Wiley & Sons, latest edition)

Reference Books:

R1: Science Matters: Achieving Scientific Literacy by Robert M. Hazen and James Trefil (Penguin Random House India, 2017)
R2: Science and Technology in World History: An Introduction by James E. McClellan III and Harold Dorn (Johns Hopkins University Press, 2018)
R3: Physics for Scientists and Engineers by Randall D. Knight (published by Pearson, latest edition)
R4:Chemistry: The Central Science by Theodore E. Brown, H. Eugene LeMay, Bruce E. Bursten, Catherine J. Murphy, and Patrick M. Woodward (published by Pearson, latest edition)
R5: Biology: Concepts and Connections by Neil A. Campbell, Jane B. Reece, Martha R. Taylor, and Eric J. Simon (published by Pearson, latest edition)
R6: Earth Science by Edward J. Tarbuck, Frederick K. Lutgens, and Dennis Tasa (published by Pearson, latest edition)
R7: Research Methods in Computer Science by E. Lesk (published by Springer, latest edition)

COURSE OUTCOMES

CO#	**Course Outcome**	**Knowledge Level**
CO1	To explain the fundamental concepts of science and technology, including their historical development and ethical considerations.	K2
CO2	To apply physics principles, including mechanics, electromagnetism, and thermodynamics, to computer science problems.	K3
CO3	To analyze chemical principles such as atomic structure, reactions, and thermodynamics in relation to computer science applications.	K4
CO4	To evaluate biological concepts, including genetics, cell biology, and evolution, and their applications in computer science.	K5
CO5	To integrate Earth and environmental science principles, including geology, meteorology, and ecology, into computational and technological contexts.	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	-	2
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	3	2
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	3	-
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	2	2
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	-	3

CSE SPE	**OPERATING SYSTEMS**	**3**	**0**	**0**	**3**

Course Objectives

- This course introduces the concepts and principles of operating systems, including process management, memory management, file systems, and device management.
- Students will learn about various scheduling algorithms and memory allocation techniques used in operating systems.
- They will also be introduced to different types of operating systems and will learn about the trade-offs involved in designing and implementing these systems.
- Through practical assignments and projects, students will gain hands-on experience in implementing basic operating system functionalities.
- By the end of the course, students will have a solid understanding of the security and privacy issues in modern operating systems.

Unit I - Computer Arithmetic & Processor Organisation (9 HOURS)

Computer Registers, Classification of Instruction – Size: three, two, one and zero instruction, Addressing Mode. Arithmetic and Logic Circuit Design. Instruction execution cycle: Sequencing of control signals, hardwired control, micro-programmed control, control signals, microinstructions, microprogram sequencing, prefetching microinstructions. Introduction to graphical processing unit (GPU).

Unit II - Memory Organization (9 HOURS)

Memory hierarchy, Main memories chip architectures, memory address map, memory assembly to CPU. Auxiliary memory: magnetic tapes, disks (magnetic and SSDs). Associate memory: hardware organization, match logic, read and write operations. Cache memory. Memory interleaving technique.

Unit III - Parallel Processing (9 HOURS)

Parallel processing, examples of parallel processing machines. Classification of parallel processing: Handler classification – pipeline processing, vector processing and array processing, Flynn's classification – SISD, SIMD, MISD, MIMD. Pipeline conflicts.

Unit IV - Introduction to Operating Systems and Process Management (9 HOURS)

Introduction to operating systems. Process Management: what is a Process?, Process state, Process control block. Threads. Cooperating processes. Inter-process communication. CPU scheduling algorithms: First come first serve, shortest job first – primitive & non primitive, Round Robin. Deadlock: Necessary conditions for occurrence of deadlocks, Deadlock detection – Resource Allocation Graph. Deadlock Avoidance Algorithms: Banker Algorithm and Safety Algorithm.

Unit V - Memory Management **(9 HOURS)**

Memory allocation techniques: Continues (Multiprogramming with fixed number of tasks), Non-continues (Multiprogramming with variable number of tasks), Paging, Demand paging. Page replacement algorithms: First in first out, Least frequently used, Most frequently used, Optimal page replacement. Virtual memory concepts.

Total Hours : 45 Hours

Text Books:

T1: Operating Systems Concepts, Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Wiley, 2012.

Reference Books:

R1: The Design of the Unix Operating System, Maurice Bach, Pearson; 1st edition
R2: Operating systems concepts; Avi Silberschatz, Peter Baer Galvin, Greg Gagne; Wiley; Ninth edition

COURSE OUTCOMES

CO1:	To understand the fundamental concepts of operating systems such as processes, threads, synchronization, and memory management..	**K2**
CO2:	To analyze the performance of various scheduling and memory allocation algorithms.	**K4**
CO3:	To compare and contrast different types of operating systems, such as batch, multi-programmed, and real-time systems.	**K5**
CO4:	To develop an understanding of device management, file systems, and virtualization.	**K2**
CO5:	To gain practical experience in implementing basic operating system functionalities.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO 1	2	2	2	-	-	-	-	-	-	-	-	-	2	3
CO 2	2	2	2	-	3	-	-	-	-	-	-	-	3	-
CO 3	2	1	2	-	3	-	-	-	-	-	1	1	-	2
CO 4	3	2	2	-	3	-	-	-	-	-	1	1	3	-
CO 5	2	3	2	-	3	-	-	-	1	-	2	2	3	3

CSE SPE	**DATA STRUCTURES AND**	**3**	**0**	**0**	**3**

	ALGORITHMS				

Course Objectives

- ➢ This course is focused on the study of data structures and algorithms, which are fundamental to computer science.
- ➢ It is designed to provide a deep understanding of the theory behind data structures and algorithms, as well as practical implementation techniques.
- ➢ The course is practice-heavy, and students will develop skills in algorithm design and analysis, problem-solving, and programming.

Unit I: Getting Started with DSA (9 HOURS)

Introduction to DSA, foundational mathematics for DSA, time and space complexity, deep dive into complexity analysis, sieve of Eratosthenes, introduction to arrays, common programming patterns.

Unit II: Algorithm Essentials (9 HOURS)

Overview of sorting techniques, binary search (introduction, lower bound, upper bound), sorting-based assignments (intersection of two arrays, top-k frequency, 3-sum closest), key algorithmic techniques including Kadane's algorithm, Boyer-Moore's voting algorithm, Dutch National Flag algorithm.

Unit III: Recursion and Linked Lists (9 HOURS)

Introduction and deep dive into recursion, recursion-based assignments (quick sort, merge sort, subsequence patterns), linked list concepts (singly, doubly, circular linked lists), linked list assignments (design a linked list, implementation of doubly linked list, slow and fast pointer technique, Josephus problem).

Unit IV: Stacks, Queues, and Trees (9 HOURS)

Introduction to stacks and queues, monotonic stacks and queues, assignments (infix to postfix, infix to prefix, next greater element, shortest subarray length), introduction to trees, tree traversals (recursive and iterative), binary tree operations (insertion, deletion, general operations).

Unit V: BST and Graphs (9 HOURS)

Introduction to BST, BST-based assignments (quest for the hidden integer, pair product check, sorted array from BST), introduction to graphs, graph representations, traversal algorithms (BFS, DFS), cycle detection in graphs, assignments (possible nodes in lexicographical order, number of islands, detecting cycles in a character grid, topological sort).

Total Hours : 45 Hours

Text Books:

T1: Data Structures and Algorithms Made Easy; Narasimha Karumanchi; CareerMonk Publications; 5th edition

Reference Books:

R1: Introduction to Algorithms; Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein; PHI Learning Pvt. Ltd. (Originally MIT Press); Third edition

COURSE OUTCOMES

CO1	To understand the fundamental concepts of DSA, including mathematical foundations and complexity analysis.	**K2**
CO2	To apply sorting, searching, and fundamental algorithmic techniques to solve computational problems efficiently.	**K3**
CO3	To analyze recursive patterns, linked list operations, and algorithmic optimizations in real-world problem-solving.	**K4**
CO4	To evaluate and implement data structures such as stacks, queues, trees, and their applications in problem-solving.	**K5**
CO5	To create optimized solutions for graph-based problems using advanced algorithmic techniques and problem-solving strategies.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	3	1	-	-	1	1	2	2	3	-
CO2	3	3	3	2	3	1	-	-	2	1	2	2	3	-
CO3	3	3	3	2	3	1	-	-	2	1	2	2	3	-
CO4	3	3	3	3	3	2	-	-	2	2	3	2	3	-
CO5	3	3	3	3	3	2	2	-	3	3	3	3	3	-

CSE SPE	DATA STRUCTURES AND ALGORITHMS - LAB	0	0	2	1

Course Objectives

- ➢ This course is focused on the study of data structures and algorithms, which are fundamental to computer science.
- ➢ It is designed to provide a deep understanding of the theory behind data structures and algorithms, as well as practical implementation techniques.
- ➢ The course is practice-heavy, and students will develop skills in algorithm design and analysis, problem-solving, and programming.

List Of Experiments :

1. Sorting Algorithms
    - Implement Quick Sort & Merge Sort.
2. Searching & Array Operations
    - Binary Search, Intersection of Two Arrays, & Top K Frequency Elements.
3. Greedy Algorithms & Optimization
    - Solve Coco's Banana Eating Problem & Job Sequencing with Deadlines.
4. Dynamic Programming
    - Implement Longest Increasing Subsequence (LIS) & 0/1 Knapsack Problem.
5. Kadane's Algorithm & Maximum Subarray
    - Find maximum consecutive ones & maximum subarray sum.
6. Linked List Implementations
    - Singly & Doubly Linked List (Insertion, Deletion, Search).
7. Slow & Fast Pointer Techniques
    - Solve cycle detection & Josephus Problem.
8. Stack & Expression Conversions
    - Convert Infix to Postfix & Infix to Prefix using stacks.
9. Next Greater Element & Shortest Subarray
    - Find Next Greater Element & smallest subarray with sum condition.
10. Tree Traversals & Operations
    - Perform Recursive & Iterative Tree Traversals, Insertion & Deletion in Trees.
11. Graph Algorithms
    - Implement Dijkstra's Algorithm & Floyd-Warshall Algorithm.
12. String Matching & Pattern Searching
    - KMP Algorithm & Rabin-Karp Algorithm.

Total Hours: 30 Hours

Text Books:

T1: Data Structures and Algorithms Made Easy; Narasimha Karumanchi; CareerMonk Publications; 5th edition

Reference Books:

R1: Introduction to Algorithms; Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein; PHI Learning Pvt. Ltd. (Originally MIT Press); Third edition

COURSE OUTCOMES

CO1	To understand the fundamental concepts of DSA, including mathematical foundations and complexity analysis.	**K2**
CO2	To apply sorting, searching, and fundamental algorithmic techniques to solve computational problems efficiently.	**K3**
CO3	To analyze recursive patterns, linked list operations, and algorithmic optimizations in real-world problem-solving.	**K4**
CO4	To evaluate and implement data structures such as stacks, queues, trees, and their applications in problem-solving.	**K5**
CO5	To create optimized solutions for graph-based problems using advanced algorithmic techniques and problem-solving strategies.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	3	1	-	-	1	1	2	2	3	-
CO2	3	3	3	2	3	1	-	-	2	1	2	2	3	-
CO3	3	3	3	2	3	1	-	-	2	1	2	2	3	-
CO4	3	3	3	3	3	2	-	-	2	2	3	2	3	-
CO5	3	3	3	3	3	2	2	-	3	3	3	3	3	-

CSE	**GENDER INCLUSION AND SOCIETY**	**2**	**0**	**0**	**0**

Course Objective:

The course helps the student to understand concepts of social justice and gender justice. It provides the student with the knowledge of various institutions functioning worldwide which aim to eradicate discrimination against women. The course further aids students in understanding feminism and gender in relation to the society and to study the basic constitutional remedies available to women.

UNIT – I

Social Justice and Gender Justice – Theories relating to Social Justice – Theories relating to Gender Justice – Interrelationship between Gender justice and Social Justice

UNIT – II

International Conventions for Protection of Women – Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) – National Commission for Women – Constitutional remedies available for women under Indian Constitution.

UNIT – III

United Nations Entity for Gender Equality and the Empowerment of Women (UN Women) - Association for Women's Rights in Development (AWID) –Womankind worldwide – Centre for reproductive rights - Women's Environment and Development Organization (WEDO) - Global Fund for Women

UNIT – IV

International Center for Research on Women (ICRW) - European Institute for Gender Equality (EIGE) – Promundo - International Alliance of Women (IAW) - International Women's Development Agency (IWDA).

UNIT – V

World Health organisation – Sex and Gender – Feminism – Theories relating to Feminism – Gender and society

TEXT BOOKS

1. Law relating to Women and children, Mamta Rao
2. Gender, Politics and Institutions: Towards a Feminist Institutionalism, by Mona Lena krook and Fiano Mackay,2010
3. Gender Justice and Feminist Jurisprudence, Dr.Sheetal Kanwal,2015
4. Narain's Gender and society, P.Jain

REFERENCE BOOKS

1. Gender Justice and feminist Jurisprudence by Dr.Ishitha Chatterjee
2. Gender and Institutions, Moira Gatens and Alison Mackkinon

SUGGESTED READINGS:

1. Women and Gender : Society and Community , Siddhartha Sarkar

COURSE OUTCOMES:

After the completion of this Course, the student would be able to:

CO 1: Understand the Concept of Social Justice and Gender Justice.
CO 2: Learning the International Conventions and constitutional remedies available for women.
CO 3: Identify the various gender Institutions and its functions for the development of women.
CO 4: Assessing the International agencies.
CO 5: Summarising the study on feminism and relation of gender and society.

SEMESTER V

CSE SPE	**OPEN ELECTIVE I** **ENGLISH COMMUNICATION SKILLS**	**3**	**0**	**0**	**3**

Course Objectives

- ➢ This is a course aimed at developing the four pillars of Technical English communication: Listening, Speaking, Reading and Writing.
- ➢ The course is designed to benchmark against the CEFR framework, and is tailored to focus on business and technical communication

Unit I: Listening, Speaking, and Reading (9 Hours)

Introduction to listening and speaking skills, Understanding different accents and intonation, Developing active listening skills, Participating in discussions and debates, Introduction to reading skills, Skimming and scanning for information, Identifying main ideas and supporting details

Unit II: Advanced Reading and Writing (9 Hours)

Understanding tone and purpose in reading, Reading for inference and implication, Introduction to writing skills, Planning and organizing written work, Writing effective emails, Writing memos, Writing reports, Writing proposals, Writing for specific audiences and purposes

Unit III: Grammar, Vocabulary, and Writing for Specific Purposes (9 Hours)

Introduction to grammar and vocabulary, Understanding verb tenses and sentence structures, Building vocabulary through context and word roots, Using idioms and phrasal verbs in communication, Writing for specific audiences and purposes

Unit IV: Business and Technical Communication (9 Hours)

Introduction to business and technical communication, Writing effective resumes and cover letters, Conducting effective interviews, Understanding and writing technical documents, Professional communication with clients and colleagues

Unit V: Test Preparation, Practice, and Final Review (9 Hours)

Introduction to the CEFR framework, Practice tests and quizzes for assessment, Review and feedback on written and spoken communication, Goal setting for further improvement, Final project or presentation

TOTAL HOURS: 45 HOURS

Text Books:

T1: Professional English: for AKTU, Meenakshir Raman and Sangeetha Sharma, Oxford Publication 1st edition

Reference Books:

R1: Word Power Made Easy; Norman Lewis; Penguin Random House India; Latest edition 2015

COURSE OUTCOMES

CO1:	To develop the ability to comprehend, analyze, and interpret spoken and written communication effectively in diverse contexts.	**K3**
CO2:	To analyze and construct well-structured written communication tailored to different purposes and audiences.	**K4**
CO3:	To demonstrate proficiency in grammar and vocabulary usage to enhance clarity, coherence, and effectiveness in communication.	**K3**
CO4:	To create professional and technical documents, including resumes, reports, and business correspondence, demonstrating industry-relevant communication skills.	**K5**
CO5:	To assess and refine communication skills through self-evaluation and feedback, applying strategies for continuous improvement.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	1	-	2	1	-	3	1	1	3	2	2	-	2
CO 2	-	1	2	2	2	-	2	2	1	1	1	2	-	2
CO 3	-	1	3	-	3	-	2	1	2	1	3	2	3	1
CO 4	1	1	2	3	1	-	3	2	3	2	1	1	2	3
CO 5	-	1	-	2	2	-	1	2	2	3	1	1	-	3

CSE SPE	OPEN ELECTIVE II TOOLS AND TECHNIQUES FOR CREATIVE THINKING	3	0	0	3

COURSE OBJECTIVES:

- ➢ This course introduces students to a variety of tools and techniques for generating creative ideas and solving problems.
- ➢ Students will learn strategies for brainstorming, mind mapping, idea generation, and critical thinking.
- ➢ The course will focus on developing practical skills for creative thinking that can be applied in a variety of contexts.

Unit I: Foundations of Creativity (9 Hours)

Introduction to creativity, Mother and father of innovation, Levels of creativity, Creative environments, The value of diversity in creativity, Principles of various thinking styles

Unit II: Creativity Tools & Techniques (9 Hours)

Creativity tools and brainstorming techniques, Principles of brainstorming, Flip chart, Post-it, Alphabet brainstorming, Brainwriting, Grid brainstorming, Design thinking, Different thinking styles in practice

Unit III: Advanced Creativity Methods (9 Hours)

Principles of morphological analysis, Group application of plotline MA, TRIZ theory: Principles and discussion, Contradiction matrix, TRIZ parameters and principles

Unit IV: SCAMPER & Creative Problem-Solving (9 Hours)

SCAMPER for architecture, Team innovation using SCAMPER, Use of different thinking styles, Creative problem-solving approaches, Double diamond model

Unit V: Integrated Innovation Strategies (9 Hours)

Using creativity tools in combination, Circle brainstorming steps, E-tivity: B-link, Application of learned techniques in real-world scenarios

TOTAL HOURS: 45 HOURS

TEXT BOOKS:

T1:Lateral Thinking: A Textbook of Creativity; Penguin; 2016 edition

REFERENCE BOOKS:

R1: "Cracking Creativity: The Secrets of Creative Genius" by Michael Michalko (2001); Ten Speed Press; Revised ed. edition (26 June 2001)
R2: "A Whack on the Side of the Head: How You Can Be More Creative" by Roger von Oech (2008); Grand Central Publishing; Special edition (5 May 2008)

COURSE OUTCOME:

CO1:	To explain the fundamental principles of creativity, including the role of innovation, levels of creativity, creative environments, and the impact of diverse thinking styles.	**K2**
CO2:	To apply various creativity tools and brainstorming techniques, including Flip chart, Post-it, Alphabet brainstorming, Brainwriting, Grid brainstorming, and Design Thinking, to generate innovative ideas.	**K3**
CO3:	To analyze and compare advanced creativity methods such as morphological analysis and TRIZ theory, including the contradiction matrix and TRIZ parameters, for structured problem-solving.	**K4**
CO4:	To implement SCAMPER techniques and creative problem-solving models such as the Double Diamond model in various innovation-driven scenarios.	**K4**
CO5:	To evaluate and integrate multiple creativity tools, including Circle Brainstorming and E-tivity: B-link, for solving real-world challenges effectively.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	3
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**COMPUTER ORGANIZATION AND ARCHITECTURE**	**3**	**0**	**0**	**3**

Course Objectives

- ➢ This course provides an introduction to computer organization and architecture, which deals with the physical components of a computer system and how they work together to execute instructions.
- ➢ Topics covered include CPU design, memory hierarchy, I/O systems, and assembly language programming.

Unit I - Basic Components of Computer Systems (9 Hours)

Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction sets of some common CPUs.

Unit II - Data Representation and Computer Arithmetic (9 Hours)

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - non-restoring and restoring techniques, floating point arithmetic.

Unit III - CPU Control and Memory Design (9 Hours)

CPU control unit design: hardwired and microprogrammed design approaches, Case study - design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Unit IV - Process Management (9 Hours)

Peripheral devices and their characteristics: Input-output subsystems, I/O transfers - program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes - role of interrupts in process state transitions.Performance enhancement techniques.

Unit V - Pipelining and Performance Enhancement (9 Hours)

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs block size, mapping functions, replacement algorithms, write policy.

Total Hours : 45 Hours

Text Books:

T1: Computer Organization and Design; Patterson; Elsevier; 6th edit

Reference Books:

R1**:** Computer Architecture, Berhooz Parhami; Oxford University Press (19 April 2012)
R2: Computer System Architecture; Mano M Morris; Pearson 3rd edition

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	To explain the fundamental functional blocks of a computer system, including the CPU, memory, input-output subsystems, and instruction set architecture.	**K2**
CO2	To apply various data representation techniques and arithmetic operations to perform integer and floating-point calculations.	**K3**
CO3	To analyze different CPU control unit design approaches and memory system architectures to evaluate their impact on system performance.	**K4**
CO4	To demonstrate process management techniques, including I/O mechanisms and interrupt handling, to optimize system performance.	**K3**
CO5	To examine pipelining techniques and memory hierarchy concepts to analyze their effect on computational efficiency and performance improvement.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	1	3	1	1	-	-	-	2	1	3	-
CO2	3	3	2	2	3	1	-	-	-	-	2	2	3	1
CO3	3	3	3	2	3	2	2	-	1	-	2	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**FORMAL LANGUAGE AND AUTOMATA THEORY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- Formal language and automata theory is a branch of computer science that studies the theoretical foundation of computer science, including the formal languages that computers can recognize and the automata that can recognize those languages.
- This course is designed to give students an understanding of formal languages, grammars, and automata, and how to use them to solve practical problems.

Unit I: Automata and Regular Languages (9 Hours)

Introduction to formal proof, Additional forms of proof, Inductive proofs, The central concepts of Automata theory, Deterministic finite automata, Nondeterministic finite automata, Finite automata with Epsilon transitions, Regular expressions and their applications, Algebraic laws for regular expressions

Unit II: Properties and Minimization of Regular Languages (9 Hours)

Proving languages not to be regular, Closure properties of regular languages, Decision properties of regular languages, Equivalence and minimization of finite automata, Text search and its applications, Introduction to Context Free Grammars (CFG), Parse trees and their applications

Unit III: Context-Free Grammars and Pushdown Automata (9 Hours)

Ambiguity in context-free grammars, Pushdown Automata (PDA) and their languages, Equivalence of PDA and CFG, Deterministic PDA, Applications of PDA

Unit IV: Turing Machines and Computability (9 Hours)

Problems that computers cannot solve, The Turing Machine: Model and working, Programming techniques for Turing machines, Extensions to the basic Turing machine

Unit V: Complexity and Intractable Problems (9 Hours)

Undecidability and its implications, Introduction to computational complexity: P and NP, NP-complete problems and their significance, A restricted satisfiability problem, Additional NP-complete problems

Total Hours : 45 Hours

TEXT BOOKS:

T1: Automata Theory Language & Computation; Hopcraft; Pearson 3rd edition

REFERENCE BOOKS:

R1: Theory of Computer Science: Automata, Languages and Computation; KLP Mishra; Prentice Hall India Learning Private Limited; 3rd edition

R2: Switching and Finite Automata Theory; Jha; Cambridge University Press; South Asian edition (8 June 2

COURSE OUTCOME:

Course Outcome	Description	Knowledge Level
CO1	To explain the fundamental concepts of automata theory, construct finite automata for regular languages, and apply regular expressions for pattern matching.	**K2**
CO2	To analyze and apply properties of regular languages, determine whether a language is regular using closure properties and decision techniques, and minimize finite automata.	**K3**
CO3	To design context-free grammars for different languages, analyze parse trees for derivations, and construct pushdown automata for context-free languages.	**K3**
CO4	To examine the capabilities of Turing machines, analyze their computational power, and explore the limitations of algorithmic computation.	**K4**
CO5	To evaluate problems based on computational complexity classes, differentiate between P, NP, and NP-complete problems, and assess the feasibility of solving computationally hard problems.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	1	3	1	1	-	-	-	2	1	3	-
CO2	3	3	2	2	3	1	-	-	-	-	2	2	3	1
CO3	3	3	3	2	3	2	2	-	1	-	2	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**DESIGN AND ANALYSIS OF ALGORITHMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- ➢ This course provides an in-depth understanding of fundamental algorithms, algorithm design techniques, and algorithm analysis.
- ➢ Students will gain experience in designing and analyzing algorithms, which will help them solve computational problems more efficiently.

Unit I: Fundamentals of Algorithms and Mathematical Foundations (9 Hours)

Problem and algorithm definitions, Mathematics for algorithms (Sets, Functions, Relations), Combinations, Vectors, Matrices, Linear inequalities, Linear equations, Orders of Magnitude (Asymptotic notations), Growth rates, Common bounds

Unit II: Algorithm Analysis and Recurrence Relations (9 Hours)

Average and worst-case analysis, Analyzing control statements, Recurrence Relations (Substitution, Change of variables, Master's method), Selection sort, Bubble sort, Insertion sort, Sorting in linear time, Count sort

Unit III: Searching and Divide and Conquer Algorithms (9 Hours)

Linear search, Binary search, Binary search tree, Quick sort (worst and average case complexity), Merge sort, Matrix multiplication

Unit IV: Greedy Algorithms and Their Applications (9 Hours)

General characteristics of greedy algorithms, Problem-solving using Greedy methods, Activity selection problem, Minimum Spanning Tree (MST), The Knapsack problem

Unit V: String Matching and Advanced Algorithmic Concepts (9 Hours)

The naive string matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, Introduction to algorithmic optimizations, Real-world applications of algorithms

Total Hours : 45 Hours

TEXT BOOKS:

T1: "Algorithm Design" by Jon Kleinberg and Éva Tardos (Pearson, 2006)

REFERENCE BOOKS:

R1: "The Design of Approximation Algorithms" by David P. Williamson and David B. Shmoys (Cambridge University Press, 2010)

R2: "Computational Complexity: A Modern Approach" by Sanjeev Arora and Boaz Barak (Cambridge University Press, 2009)

COURSE OUTCOME:

MAPPING OF

CO1	To explain fundamental algorithmic concepts and mathematical foundations required for algorithm design and analysis.	**K2**
CO2	To analyze the efficiency of algorithms using asymptotic notations and recurrence relations.	**K4**
CO3	To apply searching and divide-and-conquer techniques to solve computational problems efficiently.	**K3**
CO4	To evaluate and implement greedy algorithm techniques for optimization problems.	**K5**
CO5	To design and implement string matching algorithms for pattern recognition and text processing.	**K6**

COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	1	3	1	1	-	-	-	2	1	3	-
CO2	3	3	2	2	3	1	-	-	-	-	2	2	3	1
CO3	3	3	3	2	3	2	2	-	1	-	2	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**DESIGN AND ANALYSIS OF ALGORITHMS LAB**	**0**	**0**	**2**	**1**

COURSE OBJECTIVE:

- ➢ This course provides an in-depth understanding of fundamental algorithms, algorithm design techniques, and algorithm analysis.
- ➢ Students will gain experience in designing and analyzing algorithms, which will help them solve computational problems more efficiently.

LIST OF EXPERIMENTS :

1. Backtracking Techniques
    - K-th Permutation Sequence
    - N Queens Problem
    - Sum of Subset Problem
    - Introduction to Backtracking
2. Graph Algorithms – Shortest Path
    - Dijkstra's Algorithm
    - Bellman-Ford Algorithm
    - Floyd-Warshall Algorithm
3. Minimum Spanning Tree Algorithms
    - Prim's Algorithm
    - Kruskal's Algorithm
4. Dynamic Programming in Optimization Problems
    - 0/1 Knapsack Problem (DP)

- Fractional Knapsack Problem
- Travelling Salesperson Problem (DP Approach)

5. String Matching Algorithms
    - KMP Algorithm
    - Rabin-Karp Algorithm
    - Introduction to String Matching
6. Greedy Algorithms in Scheduling and Optimization
    - Job Sequencing with Deadlines
    - Greedy Approach in Knapsack Problems
7. Subset Sum and Matrix Chain Multiplication
    - Subset Sums
    - Matrix Chain Multiplication using DP
8. Graph Theory – Traversals and Coloring
    - Graph Coloring Problem
    - Finding Critical Connections
9. Heap and Priority Queue Applications
    - Heapsort Algorithm
    - K-th Largest Element in an Array

10. Dynamic Programming in String Processing

- Longest Common Subsequence (LCS)

- String Matching Techniques

11. Travelling Salesperson Problem Variants

- Brute Force Approach for TSP
- DP Approach for TSP

12. Algorithmic Approaches for Maximum Subarray Sum

- Kadane's Algorithm for Maximum Subarray Problem

Total Hours : 30 Hours

TEXT BOOKS:

T1: "Algorithm Design" by Jon Kleinberg and Éva Tardos (Pearson, 2006)

REFERENCE BOOKS:

R1: "The Design of Approximation Algorithms" by David P. Williamson and David B. Shmoys (Cambridge University Press, 2010)

R2: "Computational Complexity: A Modern Approach" by Sanjeev Arora and Boaz Barak (Cambridge University Press, 2009)

COURSE OUTCOME:

CO1	To explain fundamental algorithmic concepts and mathematical foundations required for algorithm design and analysis.	**K2**
CO2	To analyze the efficiency of algorithms using asymptotic notations and recurrence relations.	**K4**
CO3	To apply searching and divide-and-conquer techniques to solve computational problems efficiently.	**K3**
CO4	To evaluate and implement greedy algorithm techniques for optimization problems.	**K5**
CO5	To design and implement string matching algorithms for pattern recognition and text processing.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	1	3	1	1	-	-	-	2	1	3	-
CO2	3	3	2	2	3	1	-	-	-	-	2	2	3	1
CO3	3	2	3	2	3	2	2	-	1	-	2	2	3	-
CO4	3	3	2	3	3	2	3	1	2	2	3	2	3	2
CO5	3	2	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**1**	**0**	**0**	**1**

Course Objectives

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future
- To provide understanding of component of environment, their function, quality, issues related to environment, effect of quality degradation on human beings and their solutions

UNIT I - ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY (3 Hours)

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Bio-geographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity. Field Study of Common Plants, Insects and Birds.Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II- ENVIRONMENTAL POLLUTION (3 Hours)

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES (3 Hours)

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their groundwater – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles. Field study of local areas to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT (3 Hours)

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT (3 Hours)

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – Environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

Total Hours : 15 Hours

Text Books:

1.Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education (2004).

2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw- Hill,NewDelhi, (2006).

Reference Books

1.R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, Enviro Media.

2.Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.

3.Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

4.Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_ge16/preview
2. https://ggn.dronacharya.info/APSDept/Downloads/QuestionBank/ENVIRONMENTAL-STUDIES/NPTEL-Link.pdf
3. http://eagri.org/eagri50/ENVS302/pdf/lec14.pdf
4. https://onlinecourses.nptel.ac.in/noc19_ge22/preview

COURSE OUTCOMES

CO1	To explain the structure, function, and significance of ecosystems and biodiversity, and analyze conservation strategies	K2
CO2	To analyze different types of pollution, their causes, effects, and control measures, and evaluate disaster management strategies.	K4
CO3	To assess the impact of natural resource exploitation on the environment and propose sustainable resource management strategies.	K5
CO4	To examine various social and environmental issues and assess the role of policies, ethics, and organizations in addressing them.	K4
CO5	To evaluate the relationship between population growth, human health, and environmental sustainability, and recommend technological solutions.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3

CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	2
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

SEMESTER VI

CSE SPE	**OPEN ELECTIVE III** **DISCOVERING SELF**	**3**	**0**	**0**	**3**

Course Objective:

- *Discovering Self* is a course designed to help students explore and develop their personal identity, emotional intelligence, and communication skills.
- Through a variety of activities and exercises, students will gain insights into their own strengths and weaknesses, and develop strategies for personal growth and development.

Unit I: Self-Awareness and Values (9 Hours)

Definition and importance of self-awareness, techniques for introspection and self-reflection, identifying personal values, beliefs, and biases, understanding how values and beliefs impact decision-making and behavior, developing an ethical framework for decision-making, understanding and respecting cultural differences, managing cognitive biases and heuristics, developing self-compassion and self-acceptance.

Unit II: Emotional Intelligence and Communication (9 Hours)

Definition and importance of emotional intelligence, understanding emotions and their role in communication, developing empathy and social awareness, managing emotions and stress, developing emotional regulation and resilience, definition and importance of effective communication, verbal and nonverbal communication skills, active listening and responding skills, overcoming communication barriers.

Unit III: Assertiveness and Conflict Resolution (9 Hours)

Developing assertiveness in communication, conflict resolution strategies, handling difficult conversations, emotional intelligence in conflict situations, building positive relationships through effective communication, managing interpersonal differences, role of emotional regulation in conflict management, overcoming resistance and defensive behavior, practicing negotiation and persuasion.

Unit IV: Problem-Solving and Decision-Making (9 Hours)

Definition and importance of problem-solving and decision-making, analyzing problems and identifying root causes, generating and evaluating alternative solutions, making effective decisions, implementing and evaluating decisions, managing cognitive biases in decision-making, developing

critical thinking skills, ethical considerations in problem-solving, real-life decision-making applications.

Unit V: Personal Growth and Development (9 Hours)

Definition and importance of personal growth and development, identifying personal strengths and weaknesses, developing strategies for personal growth and development, setting goals and creating action plans, cultivating a growth mindset, building resilience and adaptability, learning from failures and setbacks, long-term career and personal development planning, sustaining motivation and self-improvement.

Total Hours : 45 Hours

TEXT BOOKS:

T1: Emotional Intelligence 2.0 by Travis Bradberry and Jean Greaves, TalentSmart (2015)

REFERENCE BOOKS:

R1: Crucial Conversations: Tools for Talking When Stakes Are High by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler, McGraw-Hill Education (2011)

R2: The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change by Stephen R. Covey, Simon & Schuster (2013)

R3: Mindset: The New Psychology of Success by Carol S. Dweck, Ballantine Books (2007)

R4: Thinking, Fast and Slow by Daniel Kahneman, Farrar, Straus and Giroux (2011)

COURSE OUTCOMES

CO1:	To analyze personal values, beliefs, and biases to develop self-awareness and ethical decision-making.	**K4**
CO2:	To apply emotional intelligence principles to enhance communication, empathy, and interpersonal relationships.	**K3**
CO3:	To demonstrate assertive communication and conflict resolution strategies to manage interpersonal challenges effectively.	**K3**
CO4:	To evaluate problems critically and implement effective decision-making strategies in various contexts.	**K5**
CO5:	To create a personal development plan by identifying strengths, setting goals, and applying growth strategies.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	3
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	2
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**OPEN ELECTIVE IV** **FUNDAMENTALS OF BUSINESS MANAGEMENT**	**3**	**0**	**0**	**3**

Course Objectives

- ➢ This course provides an introduction to the key principles and practices of modern business management.
- ➢ It is designed to equip students with the foundational knowledge and skills needed to manage people, resources, and processes effectively, and to develop a strategic mindset that enables them to make sound business decisions in a dynamic and complex environment.

Unit I: Business Management and Marketing (9 Hours)

How businesses operate, branding, customer centricity, go-to-market strategies, different modes of marketing, motivation and reward, tasks, jobs and system of work, making good and timely decisions.

Unit II: Financial and Managerial Accounting (9 Hours)

Balance sheet, accrual accounting, income sheet, cash flows, ratio analysis, designing and changing the organization's architecture, financial decision-making for businesses, cost analysis.

Unit III: Entrepreneurship and its Economic Impact (9 Hours)

Theories of entrepreneurship, activity scope and role in modern society, effects of entrepreneurial activity on economic systems, contributions and benefits of entrepreneurial activity, problems faced by small firms, types of entrepreneurs and innovators, entrepreneurship in Oman.

Unit IV: The Entrepreneurial Mindset and Characteristics (9 Hours)

The individual in terms of psychology, personality and trait theories, motivation and achievement theories, behavior and characteristics theories, differentiated entrepreneur typologies, leadership in entrepreneurship, risk-taking and decision-making.

Unit V: Business Ideation and Planning (9 Hours)

Models for new ventures, idea generation, screening ideas, business analysis, feasibility studies, purpose and benefits of a business plan, design and content of a business plan, targeting recipients, approaching potential investors.

Total Hours : 45 Hours

TEXT BOOK:

T1: "Principles of Management" by Peter F. Drucker (HarperCollins, 2017)

T2: "Fundamentals of Management" by Stephen P. Robbins and David A. DeCenzo (Pearson, 2017)

REFERENCE BOOKS:

R1: "The Lean Startup" by Eric Ries (Crown Business, 2011)
R2: "Blue Ocean Strategy" by W. Chan Kim and Renée Mauborgne (Harvard Business Review Press, 2015)
R3: "The 7 Habits of Highly Effective People" by Stephen R. Covey (Simon & Schuster, 2013)
R4: "Good to Great" by Jim Collins (Harper Business, 2001)

Course Outcomes:

Course Outcome	Description	Knowledge Level
CO1	To explain how businesses operate and apply marketing strategies, including branding, customer centricity, and go-to-market approaches, to enhance business success.	**K2**
CO2	To apply financial accounting principles such as balance sheets, accrual accounting, cash flows, and ratio analysis to assess business financial performance and decision-making.	**K3**
CO3	To analyze the role of entrepreneurship in economic systems, evaluating its contributions, challenges, and the impact of entrepreneurial activity on business and society.	**K4**
CO4	To evaluate entrepreneurial traits, motivation theories, and leadership styles to assess their influence on entrepreneurial success and decision-making.	**K4**
CO5	To develop a comprehensive business plan by integrating business ideation models, feasibility studies, and strategic planning to attract potential investors and ensure venture success.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	2	-	2	1	2	3	2	1	2	3	3
CO 2	-	-	1	2	-	2	1	3	2	2	1	1	1	2
CO 3	-	-	1	2	-	3	1	2	3	1	1	1	2	3
CO 4	-	-	1	2	-	3	1	2	3	3	1	1	1	2
CO 5	-	-	1	2	-	2	1	3	3	2	1	1	2	2

CSE SPE	**Professional Elective course - I** **COMPILER DESIGN**	**3**	**0**	**0**	**3**

Course Objectives

- The Compiler Design course is designed to teach students the principles and techniques used in building compilers for programming languages.
- Students will learn how compilers work and how to build a simple compiler from scratch.

Unit I: Introduction to Compilers and Lexical Analysis (9 Hours)

Language processors, structure of a compiler, evolution of programming languages, the science of building a compiler, applications of computer technology, syntax-directed translation, parsing, a translator for simple expressions, lexical analysis, symbol tables, intermediate code generation, the role of lexical analyzer, input buffering, tokens, lexical-analyzer generator, finite automata, design of a lexical-analyzer generator

Unit II: Syntax Analysis and Parsing Techniques (9 Hours)

The role of parser, context-free grammar, writing a grammar, top-down parsing, bottom-up parsing, LR parsing, parser generators, evaluation order for SDDs, applications of syntax-directed translation, syntax-directed translation schemes, implementing L-attributed SDDs

Unit III: Intermediate Code Generation and Type Checking (9 Hours)

Variations of syntax trees, three-address code, types and declaration, translation of expressions, type checking, control flow, backpatching, switch statements, basic blocks and flow graphs, optimization of basic blocks

Unit IV: Code Generation and Optimization (9 Hours)

Issues in the design of a code generator, the target language, addresses in the target code, a simple code generator, peephole optimization, dynamic programming code-generation, runtime environments

Unit V: Advanced Compilation Techniques (9 Hours)

Advanced code optimization techniques, register allocation, instruction scheduling, memory management strategies, garbage collection, just-in-time compilation, modern compiler architectures, case studies of compiler implementations

Total Hours : 45 Hours

Text Books:

T1:Compilers: Principles Techniques and Tool; Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman; Pearson 2nd edition

Reference Books:

R1: "Engineering a Compiler" by Keith D. Cooper and Linda Torczon (2nd Edition, 2011, Morgan Kaufmann)
R2: "Modern Compiler Implementation in Java" by Andrew W. Appel (2nd Edition, 2002, Cambridge University Press)
R3: "Introduction to Compiler Construction" by Thomas W. Parsons (2001, Addison-Wesley)
R4: "Language Implementation Patterns: Create Your Own Domain-Specific and General Programming Languages" by Terence Parr (2010, Pragmatic Bookshelf)
R5: "Writing Compilers and Interpreters: A Software Engineering Approach" by Ronald Mak (3rd Edition, 2009, Wiley)

COURSE OUTCOMES

CO1:	To explain the fundamental concepts of compilers, including their structure, role, and various phases, while demonstrating an understanding of lexical analysis and syntax-directed translation.	**K2**
CO2:	To apply parsing techniques by constructing and analyzing context-free grammars, implementing top-down and bottom-up parsing methods, and utilizing syntax-directed translation schemes.	**K3**
CO3:	To generate intermediate code representations, including three-address code and syntax trees, while implementing type checking, control flow mechanisms, and optimization techniques.	**K3**
CO4:	To analyze and evaluate code generation strategies by examining runtime environments, code optimization techniques, and the impact of peephole optimization on execution efficiency.	**K4**
CO5:	To assess and compare advanced compilation techniques such as register allocation, instruction scheduling, and memory management strategies, demonstrating their role in modern compiler architectures.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	2	2	3	1	1	-	1	-	2	2	3	-
CO2	3	3	3	2	3	1	-	-	-	-	2	2	3	1
CO3	3	3	3	3	3	2	2	-	1	-	3	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course - II** **COMPUTER NETWORKS**	**3**	**0**	**0**	**3**

Course Objectives:

- This course will cover the fundamental concepts and principles of computer networks, including network architecture, protocols, and services.
- Students will learn about various network technologies, such as LAN, WAN, and wireless networks, and their applications in different contexts.
- The course will also address network security and management issues.
-

Unit I: Internetworking and Routing (9 Hours)

Internet architecture, Unicast IP forwarding and routing, Internet routing protocols, Internet routing in-the-wild (measurement techniques), Big fast routers: architecture and scalability, Security issues in Internet architecture, Network robustness and fault tolerance

Unit II: Resource Management (9 Hours)

End-to-end congestion control, Router-assisted congestion control, Active queue management techniques, Scheduling algorithms, Congestion control modeling and measurement, Adaptive applications and Internet QoS, Traffic shaping and policing

Unit III: Network Services (9 Hours)

Wireless and mobile networking, Domain Name System (DNS), Peer-to-peer networking, Distributed hash tables, Overlay routing, Multicast protocols, Network protection mechanisms, Reliable transport and congestion control

Unit IV: Advanced Networking Concepts (9 Hours)

Unicast routing techniques, Traffic engineering, Flow modeling, Wireless networking protocols, Web caching, Content distribution networks, Network virtualization and SDN, Future networking trends

Unit V: Performance and Security Considerations (9 Hours)

Scalability and performance challenges, Network monitoring tools, Security threats in network architectures, Intrusion detection and prevention, Resilient network design, Data privacy and encryption, Emerging security challenges in wireless networks

Total Hours : 45 Hours

Text Book:

T1: A S Tanenbaum, Computer Networks, 5th Ed., Pearson, 2010.

T2: B.A. Forouzan, TCP/IP Protocol Suite, 4th Ed., TMH, 2010.

REFERENCE BOOKS:

R1: TCP/IP illustrated, Volume 1: The Protocols, W.R. Stevens, 2nd Ed., Addison-Wesley, 2015.

R2:Internetworking with TCP/IP Principles, Protocols and Architecture, D E. Comer, 6th Ed., Pearson, 2013.

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	To apply principles of Internet architecture and routing to analyze and troubleshoot network forwarding and security challenges.	**K3**
CO2	To analyze congestion control mechanisms and resource management strategies for optimizing network performance and quality of service (QoS).	**K4**
CO3	To implement and evaluate network services such as DNS, peer-to-peer networking, multicast, and transport protocols for efficient communication.	**K3**
CO4	To examine traffic engineering, network modeling, and virtualization techniques to enhance network efficiency and scalability.	**K4**
CO5	To evaluate network security threats, intrusion detection methods, and resilience strategies to ensure secure and robust network architectures.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	1	2	2	3	1	1	-	1	-	2	2	3	-
CO2	3	2	3	2	3	1	-	-	-	-	2	2	3	1
CO3	3	2	3	3	3	2	2	-	1	-	3	2	3	-
CO4	2	3	2	3	3	2	3	1	2	2	3	2	3	2
CO5	3	2	2	3	3	2	3	2	3	3	3	3	3	2

SEMESTER VII

CSE SPE	**INTRODUCTION TO PHILOSOPHY**	**2**	**0**	**0**	**2**

Course Objectives:

- In this course, students will be introduced to fundamental concepts in philosophy such as logic, ethics, epistemology, metaphysics, and aesthetics.
- They will learn about the major philosophical ideas of historical and contemporary thinkers and explore various philosophical arguments.

Unit I: Morality **(6 Hours)**

The status of morality, Objectivism, Relativism, Emotivism

Unit II: What is knowledge? **(6 Hours)**

The basic constituents of knowledge, the classical account of knowledge, The Gettier problem, Choices

Unit III: Free will **(6 Hours)**

Determinism, Libertarianism, Compatibilism, Hard determinism, Free will and do we have it?

Unit IV: Obligation to obey the law **(6 Hours)**

The grounds of political obligation, Consent, Fairness, Gratitude and Benefit

Unit V: Should you believe what you hear? **(6 Hours)**

Reid's challenge to Hume, Reid's Argument, Enlightenment, Intellectual Autonomy.

TEXT BOOKS:

T1: Philosophy Made Slightly Less Difficult; Garrett J. Deweese & J. P. Moreland; IVP Academic; Second edition

Total Hours : 30 Hours

REFERENCE BOOKS:

R1: The Big Questions: A Short Introduction to Philosophy by Robert C. Solomon and Kathleen M. Higgins, published by Wadsworth Publishing (2011).
R2: Think: A Compelling Introduction to Philosophy by Simon Blackburn, published by Oxford University Press (2001).
R3: Philosophy: The Basics by Nigel Warburton, published by Routledge (2012).
R4: The Story of Philosophy by Will Durant, published by Pocket Books (1991).
R5:An Introduction to Indian Philosophy; Satishchandra Chatterjee; Rupa & Co 2012 edition

COURSE OUTCOMES

CO1	To analyze different perspectives on morality, including Objectivism, Relativism, and Emotivism, and evaluate their implications in ethical reasoning.	**K4**
CO2	To examine the fundamental constituents of knowledge, assess the classical account of knowledge, and critique the Gettier problem.	**K4**
CO3	To differentiate between various theories of free will, including Determinism, Libertarianism, and Compatibilism, and assess their philosophical significance.	**K4**
CO4	To evaluate the philosophical justifications for political obligation, including consent, fairness, gratitude, and benefit.	**K5**
CO5	To critically assess Reid's challenge to Hume and explore the role of intellectual autonomy in Enlightenment thought.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	-	-	1	-	-	2	1	2	3	2	1	2	1	3
CO 2	-	-	1	-	-	2	1	3	2	2	1	1	1	2
CO 3	-	-	1	-	-	3	1	2	3	1	1	1	1	3
CO 4	-	-	1	-	-	3	1	2	3	3	1	1	1	3
CO 5	-	-	1	-	-	2	1	3	3	2	1	1	1	2

CSE SPE	**Open elective V HUMAN MIND AND BEHAVIOUR**	**3**	**0**	**0**	**3**

Course Objectives:

- This course explores the complexities of the human mind and behavior, delving into psychological theories, principles, and research findings.
- Students will examine cognitive processes, emotional responses, developmental stages, and social influences on behavior.
- The course aims to provide a foundational understanding of how psychological factors shape human actions and interactions.

Unit 1: Introduction to Psychology (9 Hours)

Definition and scope of psychology, Historical perspectives, Research methods in psychology, Ethical considerations in psychological research

Unit 2: Cognitive Processes (9 Hours)

Perception and attention, Memory systems and processes, Learning theories and applications, Language and thought

Unit 3: Emotion and Motivation (9 Hours)

Theories of emotion, Biological bases of emotion, Motivation theories, Stress and coping mechanisms

Unit 4: Social and Cultural Influences (9 Hours)

Social cognition and perception, Attitudes and behavior, Group dynamics and intergroup relations, Cultural influences on behavior

Unit 5: Developmental Psychology (9 Hours)

Stages of human development, Cognitive and emotional development, Social and moral development, Psychological disorders across the lifespan

Total Hours : 45 Hours

Text Book:

T1: "Psychology" by David G. Myers, Worth Pub, 2011 edition

REFERENCE BOOKS:

R1:"The Developing Person Through the Life Span" by Kathleen Stassen Berger, Worth Pub, 11th edition

R2: "The Social Animal" by Elliot Aronson, Worth Publishers Inc.,U.S., 2018 edition

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Explain the definition, scope, historical perspectives, and research methods in psychology, including ethical considerations in psychological research.	**K2**
CO2	Apply cognitive theories to analyze perception, memory, learning, and language in real-life scenarios.	**K3**
CO3	Analyze various theories of emotion and motivation, including their biological bases and their role in stress and coping.	**K4**
CO4	Examine the impact of social cognition, attitudes, group dynamics, and cultural influences on individual and group behavior.	**K4**
CO5	Evaluate theories and concepts of human development, including cognitive, emotional, social, and moral development, as well as psychological disorders across the lifespan.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	-	2	1	1	1	1	2	1	-	-	2	1	3	-
CO2	-	3	2	2	2	2	3	1	1	-	2	2	3	-
CO3	-	3	3	2	3	1	2	1	2	1	3	2	3	-
CO4	-	3	2	3	2	1	3	1	2	2	3	2	3	2
CO5	-	3	3	3	3	2	3	1	3	2	3	2	3	3

CSE SPE	**Open elective V** **ORGANIZATION BEHAVIOUR**	**3**	**0**	**0**	**3**

Course Objectives:

- This course examines the behaviour of individuals and groups within organizational settings.
- Students will explore theories and concepts related to motivation, leadership, team dynamics, organizational culture, and communication.
- The course aims to provide insights into how human behaviour impacts organizational effectiveness and how organizations can be managed to promote positive outcomes.

Unit 1: Introduction to Organizational Behaviour (9 Hours)

Definition and scope of organizational behaviour, Historical foundations, Research methods in organizational behaviour, Ethical issues in organizational behaviour

Unit 2: Individual Behavior in Organizations (9 Hours)

Personality and individual differences, Perception and attribution, Motivation theories and applications, Job satisfaction and work attitudes

Unit 3: Group Behavior and Team Dynamics (9 Hours)

Group formation and development, Teamwork and collaboration, Group decision-making, Conflict and negotiation

Unit 4: Leadership in Organizations (9 Hours)

Leadership theories and styles, Power and politics in organizations, Leadership and organizational change, Emotional intelligence and leadership effectiveness

Unit 5: Organizational Culture and Communication (9 Hours)

Components of organizational culture, Creating and sustaining culture, Communication processes and barriers, Strategies for effective organizational communication

Total Hours : 45 Hours

Text Book:

T1: Organizational Behaviour: Improving Performance and Commitment in the Workplace" by Jason A. Colquitt, Jeffery A. LePine, and Michael J. Wesson, McGraw-Hill Education, 4th edition

T2: "Organizational Behaviour" by Stephen P. Robbins and Timothy A. Judge, Pearson Education, 18th edition

REFERENCE BOOKS:

R1: "Organizational Culture and Leadership" by Edgar H. Schein, John Wiley & Sons, 4th edition

R2: "The Fifth Discipline: The Art & Practice of The Learning Organization" by Peter M. Senge, Doubleday, 2006 edition

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Explain the definition, scope, historical foundations, research methods, and ethical considerations in organizational behavior.	**K2**
CO2	Apply theories of personality, perception, motivation, and job satisfaction to analyze individual behavior in workplace settings.	**K3**
CO3	Analyze the processes of group formation, teamwork, decision-making, and conflict resolution in organizations.	**K4**
CO4	Examine different leadership theories, power dynamics, and their impact on organizational change and effectiveness.	**K4**
CO5	Evaluate organizational culture and communication strategies to enhance workplace effectiveness and collaboration.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	-	2	1	1	1	1	2	1	-	-	2	1	3	-
CO2	-	3	2	2	2	2	3	1	1	-	2	2	3	-
CO3	-	3	3	2	3	1	2	1	2	1	3	2	3	-
CO4	-	3	2	3	2	1	3	1	2	2	3	2	3	2
CO5	-	3	3	3	3	2	3	1	3	2	3	2	3	3

CSE SPE	Open elective V DESIGN THINKING 101	3	0	0	3

Course Objectives:

- This course introduces the principles and practices of design thinking, a human-centered approach to problem-solving and innovation.
- Students will learn to empathize with users, define problems, generate creative ideas, prototype solutions, and test them iteratively.
- The course emphasizes collaboration, experimentation, and the application of design thinking across various disciplines and industries.

Unit 1: Introduction to Design Thinking (9 Hours)

Overview of design thinking, Key principles and mindsets, The design thinking process (Empathize, Define, Ideate, Prototype, Test), Case studies of design thinking in action

Unit 2: Understanding Users (9 Hours)

Understanding the user, Conducting interviews and observations, Building empathy maps, Synthesizing user insights

Unit 3: Defining the Problem (9 Hours)

Defining the problem, Creating problem statements, Identifying user needs and challenges, Framing design challenges

Unit 4: Creative Ideation and Concept Generation (9 Hours)

Brainstorming techniques, Encouraging creativity and divergent thinking, Generating a wide range of ideas, Selecting and prioritizing ideas

Unit 5: Prototyping and Testing (9 Hours)

Prototyping methods (low-fidelity and high-fidelity), Building and iterating on prototypes, Conducting user testing, Gathering and analyzing feedback, Refining solutions based on user input

Total Hours : 45 Hours

Text Book:

T1: "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" by Tim Brown, HarperBusiness (29 September 2009)

T2: "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems" by Michael Lewrick, Patrick Link, and Larry Leifer, Wiley; 1st edition (May 22, 2018)

REFERENCE BOOKS:

R1: "Design Thinking: Understanding How Designers Think and Work" by Nigel Cross, Bloomsbury Publishing India Private Limited (1 January 2011)

R2: "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days" by Jake Knapp, John Zeratsky, and Braden Kowitz, Simon & Schuster; Illustrated edition (8 March 2016)

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	*Explain* the key principles, mindsets, and process of design thinking with real-world case studies.	**K2**
CO2	*Apply* empathy-building techniques such as interviews and observations to gather user insights.	**K3**
CO3	*Analyze* user research data to create problem statements and define design challenges.	**K4**
CO4	*Develop* a diverse set of creative ideas using brainstorming and divergent thinking techniques.	**K5**
CO5	*Construct* and test prototypes iteratively based on user feedback to refine solutions.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	-	2	1	1	1	1	2	1	-	-	2	1	3	-
CO2	-	3	2	2	2	2	3	1	1	-	2	2	3	-
CO3	-	3	3	2	3	1	2	1	2	1	3	2	3	-
CO4	-	3	2	3	2	1	3	1	2	2	3	2	3	2
CO5	-	3	3	3	3	2	3	1	3	2	3	2	3	3

CSE SPE	Professional Elective course III CLOUD COMPUTING	3	0	2	4

Course Objectives:

- This course provides an in-depth understanding of cloud computing technologies, models, and architectures.
- Students will explore the fundamentals of cloud services, deployment models, and the impact of cloud computing on business and IT infrastructure.
- The course will also cover key topics such as virtualization, cloud security, and the management of cloud-based applications and data.

Unit 1: Introduction to Cloud Computing (15 Hours)

Definition and essential characteristics of cloud computing, History and evolution of cloud computing, Cloud service models: IaaS, PaaS, SaaS, Cloud deployment models: public, private, hybrid, community

Unit 2: Cloud Architecture and Infrastructure (15 Hours)

Cloud computing architecture, Virtualization: concepts, types, and benefits, Resource management and provisioning, Cloud storage and database solutions

Unit 3: Cloud Security and Compliance (15 Hours)

Security challenges in cloud computing, Data protection and privacy in the cloud, Identity and access management (IAM), Compliance and regulatory issues in the cloud

Unit 4: Cloud Service Providers and Platforms (15 Hours)

Overview of major cloud service providers (AWS, Azure, Google Cloud), Comparison of cloud platforms and services, Case studies of cloud adoption in various industries, Cost management and optimization in cloud computing

Unit 5: Developing and Managing Cloud Applications (15 Hours)

Designing cloud-native applications, DevOps practices for cloud computing, Monitoring and managing cloud applications, Future trends in cloud computing

Total Hours : 75 Hours

Text Book:

T1: Ronald L. Krutz, Russell Dean Vines, “Cloud Security A comprehensive Guide to secure Cloud Computing” Wiley.

REFERENCE BOOKS:

R1: John W. Rittinghouse, “Cloud Computing Implementation, Management and Security” , CRC Press.
R2: Borko Furht. Armando Escalante, “Handbook of Cloud Computing”, Springer
R3: Charles Badcock, “Cloud Revolution” , TMH

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	To explain the fundamental concepts, service models, and deployment models of cloud computing.	**K2**
CO2	To analyze cloud computing architecture, virtualization techniques, and resource management strategies.	**K4**
CO3	To evaluate security challenges, data protection mechanisms, and compliance requirements in cloud computing.	**K5**
CO4	To compare and contrast various cloud service providers, platforms, and cost optimization strategies.	**K4**
CO5	To design and implement cloud-native applications using DevOps practices and monitoring tools.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course III** **DISTRIBUTED SYSTEMS**	**3**	**0**	**2**	**4**

Course Objectives:

- ➢ This course offers a comprehensive understanding of distributed systems, focusing on the principles, design, and implementation of distributed architectures.
- ➢ Students will explore the challenges of distributed computing, including communication, synchronization, fault tolerance, and security.
- ➢ The course will also cover contemporary topics such as cloud computing, peer-to-peer networks, and distributed databases.

UNIT I Basic Concepts **(15 Hours)**

Definition of a distributed systems, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking Interprocess communication, External data representation and marshalling, Client-server and Group communication.

UNIT II Distributed Objects and Process **(15 Hours)**

Distributed objects and remote invocation, Communication between distributed objects, Remote procedure call, Events and notifications - The operating system layer, Protection, Processes and Threads, Communication and invocation, OS Architecture. Security techniques, Cryptographic algorithms, Access control, Digital signatures, Cryptography pragmatics, Needham-Schroeder, Kerberos, Securing electronics transaction, IEEE 802.11 WiFi.

UNIT III Operating System Issues **(15 Hours)**

Distributed file systems - Name services, Domain name system, Directory and discovery services, Peer to peer systems, Napster file sharing system, Peer to peer middleware routing overlays – Clocks, Events and process states Clock Synchronization - Logical clocks Global states - Distributed debugging - Distributed mutual exclusion - Elections - Multicast communication.

UNIT IV Distributed Transaction Processing **(15 Hours)**

Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery - Overview of replication, Distributed shared memory and Web services.

UNIT V Distributed Algorithms (15 Hours)

Synchronous network model - Algorithms: leader election, maximal independent set - Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network.

Total Hour : 75 Hour

Text Book:

T1: George Coulouris, Jean Dollimore, and Tim Kindberg, " Distributed Systems Concepts and Design", 5th ed., Pearson Education, 2011.

REFERENCE BOOKS:

R1: Andrew S. Tanenbaum, Maartenvan Steen, "Distributed Systems Principles and Paradigms", 2nd ed., Pearson Education, 2006.

R2: Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	To explain the fundamental concepts, models, and challenges of distributed systems, including resource sharing, interprocess communication, and architectural models.	**K2**
CO2	To analyze communication mechanisms, security techniques, and process management in distributed systems, including cryptographic algorithms and secure transactions.	**K4**
CO3	To apply distributed system techniques for file management, synchronization, mutual exclusion, and multicast communication.	**K3**
CO4	*To evaluate distributed transaction processing methods, including concurrency control, deadlock management, and recovery mechanisms.*	**K5**
CO5	To design and implement distributed algorithms for leader election, mutual exclusion, and network communication in synchronous and asynchronous models.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course III DATA MINING AND WAREHOUSING**	**3**	**0**	**2**	**4**

Course Objectives:

- This course provides an in-depth understanding of data mining techniques and data warehousing concepts.
- Students will explore methods for extracting meaningful patterns and insights from large datasets, as well as the design and implementation of data warehouses to support business intelligence and decision-making.
- The course covers a range of topics including data preprocessing, mining algorithms, OLAP, and data warehouse architecture.

UNIT I - Data Warehousing and Business Analysis (15 Hours)

Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II - Data Mining and Association Rule Mining (15 Hours)

Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT III - Classification and Prediction (15 Hours)

Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Backpropagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT IV - Cluster Analysis **(15 Hours)**

Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V - Mining Object, Spatial, Multimedia, Text and Web Data **(15 Hours)**

Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Total Hours : 75 Hours

Text Book:

T1: Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.

REFERENCE BOOKS:

R1: Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.

R2: K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

R3: G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.

R4: Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	**To** explain the components, architecture, and tools of data warehousing and analyze the role of OLAP in multidimensional data analysis.	**K2**
CO2	**To** apply data mining techniques, including preprocessing, association rule mining, and constraint-based analysis, to extract meaningful insights from data.	**K3**
CO3	**To** analyze various classification and prediction techniques, evaluate model accuracy, and implement ensemble methods for improved decision-making.	**K4**
CO4	**To** compare different clustering methods and apply appropriate techniques for partitioning, hierarchical, density-based, and high-dimensional clustering.	**K4**
CO5	**To** evaluate mining techniques for complex data objects, including spatial, multimedia, text, and web data, and assess their applications in real-world	**K5**

	scenarios.	

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course IV** **CRYPTOGRAPHY**	**3**	**0**	**2**	**4**

Course Objectives:

- This course introduces the principles and practices of cryptography, exploring various cryptographic techniques and protocols used to secure information and communications.
- Students will learn about classical and modern encryption methods, cryptographic hash functions, digital signatures, and public key infrastructure.
- The course also covers the theoretical foundations of cryptography and its practical applications in securing digital systems.

Unit 1: Introduction to Cryptography **(15 Hours)**

History of cryptography, Basic concepts and terminology, Symmetric vs. asymmetric cryptography, Applications of cryptography

Unit 2: Classical Cryptography **(15 Hours)**

Caesar cipher, Vigenère cipher, One-time pad, Transposition ciphers, Cryptanalysis of classical ciphers

Unit 3: Modern Cryptography **(15 Hours)**

Block ciphers (DES, AES), Stream ciphers (RC4), Public key cryptography (RSA, ECC), Cryptographic hash functions (SHA, MD5)

Unit 4: Cryptographic Protocols **(15 Hours)**

Digital signatures, Public key infrastructure (PKI), Key exchange protocols (Diffie-Hellman), Secure communication protocols (SSL/TLS)

Unit 5: Advanced Topics in Cryptography **(15 Hours)**

Elliptic curve cryptography, Quantum cryptography, Cryptographic standards and compliance, Case studies of cryptographic applications

Total Hours : 45 Hours

Text Book:

T1: Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.
T2: Hans Delfs, Helmut Knebl, "Introduction to Cryptography, Principles and Applications", Springer Verlag.

REFERENCE BOOKS:

R1: O. Goldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 2.
R2:Wenbo Mao, "Modern Cryptography, Theory and Practice", Pearson Education (Low Priced Edition.

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	To describe the fundamental concepts, history, and applications of cryptography, distinguishing between symmetric and asymmetric cryptographic techniques.	**K2**
CO2	To apply classical encryption techniques, including substitution and transposition ciphers, and analyze their cryptographic strength.	**K3**
CO3	To analyze modern cryptographic algorithms such as block ciphers, stream ciphers, public key cryptography, and hash functions for data security.	**K4**
CO4	To evaluate cryptographic protocols, including digital signatures, key exchange mechanisms, and secure communication protocols, for ensuring secure data transmission.	**K5**
CO5	To design and assess advanced cryptographic techniques such as elliptic curve cryptography, quantum cryptography, and compliance with cryptographic standards.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course IV** **INTERNET OF THINGS**	**3**	**0**	**2**	**4**

Course Objectives:

- ➢ This course explores the rapidly growing field of the Internet of Things (IoT), focusing on the integration of sensors, devices, and networks to collect and exchange data.
- ➢ Students will learn about the architecture, protocols, and applications of IoT systems.
- ➢ The course will cover topics such as IoT hardware, communication protocols, data management, and security considerations, providing a comprehensive understanding of the IoT ecosystem.

Unit 1: Introduction to IoT **(15 Hours)**

Definition and significance of IoT, IoT architecture and components, IoT communication models, IoT enabling technologies

Unit 2: IoT Hardware and Software **(15 Hours)**

Sensors and actuators, IoT device platforms (Arduino, Raspberry Pi), IoT operating systems, IoT programming languages and tools

Unit 3: IoT Communication Protocols **(15 Hours)**

Communication models, Wireless communication protocols (Wi-Fi, Bluetooth, Zigbee, LoRa), IoT network protocols (IPv6, 6LoWPAN, MQTT, CoAP)

Unit 4: Data Management and Analytics **(15 Hours)**

Data acquisition and storage, Cloud computing for IoT, Data processing and analytics, IoT data visualization

Unit 5: Security and Privacy in IoT **(15 Hours)**

IoT security challenges, Threat models and attack surfaces, Security protocols and best practices, Privacy considerations in IoT

Total Hours : 75 Hours

Text Book:

T1: "Internet of Things: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti, Orient Blackswan Private Limited - New Delhi, First edition

T2: "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, Wiley, First edition

REFERENCE BOOKS:

R1: The Internet of Things: Key Applications and Protocols" by Olivier Hersent, David Boswarthick, and Omar Elloumi, Wiley, First edition

R2: "Designing the Internet of Things" by Adrian McEwen and Hakim Cassimally, John Wiley & Sons Inc, Illustrated 2013 edition

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	**To** explain the fundamental concepts, architecture, communication models, and enabling technologies of IoT.	**K2**
CO2	**To** apply IoT hardware and software components, including sensors, actuators, device platforms, and programming tools, for developing IoT applications.	**K3**
CO3	**To** analyze various IoT communication and network protocols to determine their suitability for different IoT applications.	**K4**
CO4	**To** evaluate data acquisition, cloud computing, and analytics techniques for effective IoT data processing and visualization.	**K5**
CO5	**To** design security strategies and privacy mechanisms to mitigate risks and enhance IoT system resilience against cyber threats..	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Professional Elective course IV** **SYSTEM DESIGN**	**3**	**0**	**2**	**4**

Course Objectives:

- ➢ This course provides a comprehensive understanding of system design principles and practices, focusing on the creation of scalable, reliable, and maintainable software systems.
- ➢ Students will learn about various design patterns, architectural styles, and best practices for building complex systems.
- ➢ The course covers both theoretical foundations and practical approaches to system design, preparing students to tackle real-world design challenges.

Unit 1: Introduction to System Design (15 Hours)

Overview of system design, Design goals and principles, System design process, Key concepts in system design

Unit 2: Architectural Styles and Patterns (15 Hours)

Layered architecture, Client-server architecture, Microservices architecture, Design patterns (Singleton, Factory, Observer, etc.)

Unit 3: Designing for Scalability and Performance (15 Hours)

Scalability principles, Load balancing, Caching strategies, Performance optimization techniques

Unit 4: Reliability and Maintenance in System Design (15 Hours)

Fault tolerance and redundancy, Backup and disaster recovery, Monitoring and logging, Maintenance strategies

Unit 5: Case Studies and Advanced Topics (15 Hours)

Case studies of successful system designs, Emerging trends in system design, Tools and technologies for system design, Future directions

Total Hours : 75 Hours

Text Book:

T1: Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems" by Martin Kleppmann, Shroff/O'Reilly, 2017 edition

REFERENCE BOOKS:

R1: "System Design Interview – An Insider's Guide" by Alex Xu, Independently published, 2020

R2: "Patterns of Enterprise Application Architecture" by Martin Fowler, Addison-Wesley Educational Publishers Inc, 2020 edition

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	**To** explain the fundamental concepts, design goals, principles, and processes involved in system design.	**K2**
CO2	**To** apply various architectural styles and design patterns to create efficient and modular system architectures.	**K3**
CO3	**To** analyze scalability principles, load balancing, caching strategies, and performance optimization techniques to improve system efficiency.	**K4**
CO4	**To** evaluate fault tolerance mechanisms, backup strategies, and monitoring techniques to enhance system reliability and maintainability.	**K5**
CO5	**To** design robust system architectures by integrating emerging trends, tools, and best practices in system design.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	-	-	2	2	3	-
CO2	3	3	2	2	3	2	2	-	-	-	2	2	3	1
CO3	2	3	2	2	3	1	3	1	2	2	3	2	3	-
CO4	2	2	2	3	3	1	2	1	3	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

SEMESTER VIII

CSE SPE	**Open elective VI** **UNIX PROGRAMMING**	**4**	**0**	**0**	**4**

Course Objectives:

- This course provides an introduction to Unix shell programming, focusing on writing scripts to automate tasks and manage system operations.
- Students will learn about the Unix operating system, command-line utilities, shell scripting languages (such as Bash), and advanced scripting techniques.
- The course emphasizes practical skills in creating, debugging, and optimizing shell scripts to enhance productivity and streamline workflows.

Unit 1: Introduction to Unix **(12 Hours)**

Overview of Unix operating system, Unix file system structure, Basic Unix commands (ls, cp, mv, rm, etc.), File permissions and ownership

Unit 2: Shell Basics **(12 Hours)**

Introduction to shell and types of shells (Bash, Korn, C shell), Navigating the file system, Redirection and piping, Environment variables

Unit 3: Shell Scripting Fundamentals **(12 Hours)**

Writing and executing shell scripts, Variables and data types, Control structures (if, case, loops), Input and output handling

Unit 4: Advanced Shell Scripting **(12 Hours)**

Functions and modular scripting, Error handling and debugging, Regular expressions and text processing (grep, sed, awk), Scheduling tasks with cron and at

Unit 5: Practical Applications **(12 Hours)**

File and directory management scripts, Process management and automation, System monitoring and maintenance scripts, Case studies and project work

Total Hours : 60 Hours

Text Book:

T1: "Unix Shell Programming" by Stephen G. Kochan and Patrick Wood, Sams; 3rd edition (27 February 2003)

T2: "Learning the bash Shell: Unix Shell Programming" by Cameron Newham, O'Reilly Media; 3rd ed. edition (3 May 2005)

REFERENCE BOOKS:

R1: "Classic Shell Scripting" by Arnold Robbins and Nelson Beebe, O'Reilly Media (21 June 2005)

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Explain the fundamental concepts of the Unix operating system, including its file system structure, basic commands, and file permissions.	**K2**
CO2	Demonstrate proficiency in navigating the Unix file system, using shell features such as redirection, piping, and environment variables.	**K3**
CO3	Analyze and construct basic shell scripts using variables, control structures, and input/output handling techniques.	**K4**
CO4	Evaluate and optimize shell scripts by implementing modular functions, debugging techniques, regular expressions, and scheduling mechanisms.	**K5**
CO5	Develop and implement automation scripts for system administration tasks, process management, and system monitoring based on real-world scenarios.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	1	-	2	2	3	-
CO2	3	3	2	2	3	1	2	-	2	-	2	2	3	1
CO3	3	3	3	2	3	2	2	-	1	2	3	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2

CSE SPE	**Open elective VI** **AWS AND AWS SECURITY**	**4**	**0**	**0**	**4**

Course Objectives:

- ➢ This course provides an in-depth understanding of Amazon Web Services (AWS) and the principles of securing cloud environments.
- ➢ Students will learn about the core AWS services, cloud computing concepts, and best practices for designing, deploying, and managing AWS-based applications.
- ➢ The course also covers AWS security fundamentals, including identity and access management, data protection, and compliance.

Unit 1: Introduction to AWS **(12 Hours)**

Overview of cloud computing, AWS global infrastructure, Core AWS services (EC2, S3, RDS, Lambda), AWS management tools (AWS Management Console, CLI, SDKs)

Unit 2: AWS Architecture and Deployment **(12 Hours)**

Designing AWS architectures, Virtual private cloud (VPC), Load balancing and auto-scaling, Monitoring and logging with CloudWatch

Unit 3: AWS Security Fundamentals **(12 Hours)**

AWS shared responsibility model, Identity and Access Management (IAM), Secure access controls, AWS Key Management Service (KMS)

Unit 4: Data Protection and Compliance **(12 Hours)**

Data encryption and protection, AWS security services (GuardDuty, Macie, Inspector), Compliance frameworks (HIPAA, GDPR, PCI-DSS), Securing data in transit and at rest

Unit 5: Advanced AWS Security Practices **(12 Hours)**

Network security (security groups, network ACLs), Application security (WAF, Shield), Incident response and disaster recovery, Case studies and best practices

Total Hours : 60 Hours

Text Book:
T1: "AWS Certified Solutions Architect Official Study Guide: Associate Exam" by Joe Baron, Hisham Baz, Tim Bixler, et al., Sybex; Study Guide edition (29 November 2016)

REFERENCE BOOKS:
R1: "AWS Security Best Practices" by Albert Anthony, Packt Publishing (March 9, 2018)

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Explain the fundamental concepts of cloud computing and the core AWS services, including infrastructure and management tools.	**K2**
CO2	Apply AWS architecture principles to design and deploy scalable, secure, and high-availability cloud solutions.	**K3**
CO3	Implement AWS security best practices, including IAM and secure access controls, to manage cloud security responsibilities.	**K3**
CO4	Analyze AWS security services and compliance frameworks to ensure data protection and regulatory compliance.	**K4**
CO5	Evaluate advanced AWS security measures and incident response strategies to enhance cloud security and resilience.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	1	-	2	2	3	-
CO2	3	3	2	2	3	1	2	-	2	-	2	2	3	1
CO3	3	3	3	2	3	2	2	-	1	2	3	2	3	-
CO4	3	3	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	2	2

CSE SPE	**Open elective VI** **DATA MODELING AND VISUALIZATION**	**4**	**0**	**0**	**4**

Course Objectives:

- This course provides a comprehensive overview of data modeling techniques and data visualization principles.
- Students will learn how to design, implement, and analyze data models to support business intelligence and data-driven decision-making.
- The course also covers various visualization tools and techniques to effectively communicate insights from data.

Unit 1: Introduction to Data Modeling (12 Hours)

Definition and importance of data modeling, Types of data models (conceptual, logical, physical), Data modeling tools, Entity-relationship (ER) modeling

Unit 2: Relational and Dimensional Modeling (12 Hours)

Normalization and denormalization, Relational model concepts, Dimensional modeling concepts (star schema, snowflake schema), Fact and dimension tables

Unit 3: Data Visualization Principles (12 Hours)

Principles of effective data visualization, Choosing the right type of visualization, Data visualization best practices, Common pitfalls in data visualization

Unit 4: Visualization Tools and Techniques (12 Hours)

Introduction to visualization tools (Tableau, Power BI, D3.js), Creating charts and dashboards, Interactive visualizations, Advanced visualization techniques

Unit 5: Practical Applications and Case Studies (12 Hours)

Designing data models for real-world scenarios, Case studies on data modeling and visualization, Hands-on projects using visualization tools, Evaluating and presenting data insights

Total Hours : 60 Hours

Text Book:

T1: "Data Modeling Made Simple: A Practical Guide for Business and IT Professionals" by Steve Hoberman, Technics Publications, LLC; 2nd edition (1 January 2009)

T2: "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic, Wiley; 1st edition (20 November 2015)

REFERENCE BOOKS:

R1: "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross, John Wiley & Sons; 3rd edition (9 July 2013); Wiley

R2: "Data Visualization: A Practical Introduction" by Kieran Healy, Princeton University Press (18 December 2018)

COURSE OUTCOMES

Course Outcome	Description	Knowledge Level
CO1	Explain the fundamental concepts and significance of data modeling, including different types of data models and entity-relationship (ER) modeling.	**K2**
CO2	Apply normalization and dimensional modeling techniques to structure relational and dimensional databases efficiently.	**K3**
CO3	Analyze principles of effective data visualization and identify best practices for choosing appropriate visualization techniques.	**K4**
CO4	Demonstrate proficiency in using data visualization tools such as Tableau, Power BI, and D3.js to create interactive dashboards and visualizations.	**K3**
CO5	Design and evaluate data models and visualizations for real-world applications, effectively presenting data-driven insights.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	3	1	-	-	1	-	2	2	3	-
CO2	2	3	2	2	3	1	2	-	2	-	2	2	3	1
CO3	3	3	3	2	2	2	2	-	1	2	3	2	2	-
CO4	3	2	3	3	3	2	3	1	2	2	3	2	3	2
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2