Semester 1

Engineering Mathematics

Course Code:		**Maximum marks : 100**
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**
Semester: I		
Prerequisites (if any): NA		

Introduction:

This is a foundational course for computer science students that introduces 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 emphasises problem-solving, critical thinking, and effective communication of mathematical ideas

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

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts and principles of discrete mathematics, including logic, sets, functions, and relations.	L2
CO2	Summarise mathematical ideas and solutions clearly and effectively, both orally and in writing.	L2
CO3	Outline discrete mathematics concepts to create mathematical models for real-world problems, such as scheduling and network optimization	L2
CO4	Apply MATLAB to solve systems of linear equations and compute eigenvalues/vectors of matrices	L3
CO5	Make use of discrete mathematics concepts to solve problems in computer science.	L3

Syllabus

Module-1 - 9 hours

Matrices and its Operations

Rank of a matrix, Echelon form, creating matrices in MATLAB. System of linear equations-Consistency, Solution by Gauss elimination with the help of toolbox. Eigenvalues and Eigenvectors of square matrices using inbuilt function in the tools.

Module – 2 - 9 hours

Proofs

Introduction and Proofs, Induction, Strong Induction, Number Theory

Module – 3 - 9 hours

Structures
Graph theory and Colouring, Matching Problems, Minimum Spanning Tree, Communication Networks, Directed graphs, Relations and partial orders, State machines

Module-4 - 9 hours

Counting
Sums, asymptotics, Divide and Conquer Recurrences, Linear Recurrences, Counting Rules, Generating functions, Infinite sets

Module-5 - 9 hours

Probability
Introduction to Probability, Conditional Probability, Independence, Random variables, Expectations, Deviations, Random Walks

Textbooks:

- B V Ramana; Higher Engineering Mathematics, 12th Reprint Edition, 2018.
- Mathematics for Computer Science; Eric Lehman, F Thomson Leighton, Albert R Meyer; 12th Media Services (5 June 2017)

Reference Books:

- Erwin Kreyszig; Advanced Engineering Mathematics; 9th Edition, 2012.
- Discrete Mathematics and Its Application; Kenneth H Rosen & Dr Kamala Krithivasan; McGraw Hill; 8th edition
- A Textbook on Discrete Mathematics; CV Sastry and Rakesh Nayak; Wiley (1 October 2020)

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Engineering Physics

Course Code:		**Maximum marks: 100**
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**

Semester: I

Prerequisites (if any): NA

Introduction:

Engineering Physics blends fundamental physics with engineering applications. Covering mechanics, electromagnetism, and thermodynamics, this course explores key scientific principles and their technological impacts. Students will delve into semiconductors, fibre optics, and laser technology, with practical programming exercises to simulate physical phenomena. This course equips students with the knowledge to innovate in the tech-driven world.

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

COs	Course outcomes	RBT
CO1	Explain the basic principles of physics such as mechanics, electromagnetism and thermodynamics.	L2
CO2	Interpret the relationship between physics and technology, especially in advancements such as semiconductors and optimal fibres for communication.	L2
CO3	Explain the impact of physics and technology on society.	L2
CO4	Apply concepts of physics practically in the domain of computer science.	L3
CO5	Simulate concepts of physics in coding by writing programs to simulate concepts such as mechanics and motion.	L3

Syllabus

Module-1 - 9 hours

Introduction to Science and Technology

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

Module – 2 - 9 hours

Principles of Mechanics and Electromagnetism

Mechanics: Concepts of motion, forces, work, energy, momentum; Electromagnetism: electric fields, magnetic fields, electromagnetic waves

Module – 3 - 9 hours

Principles of Thermodynamics

Laws of thermodynamics, heat transfer, phase transitions

Module-4 - 9 hours

Physics in Computer Science

Semiconductors: materials and working principle, Fibre optics and laser, Optical fibre as a dielectric waveguide, Undersea optical fibre networks, Losses associated with optical fibres, Applications of optical fibres

Module-5 - 9 hours

Simulating Concepts of Physics

Writing programs to simulate mechanics and motion, latency/speed-of-light communication, Interplanetary communication, Deep-space networks (Voyager and other mission, moon and mars missions

Textbooks:

- Halliday & Resnick Principles of Physics, Extended, 12ed; Halliday, Resnick, and Walker; Wiley India

Reference Books:

- Interplanetary flight and communication Vol1- NA Rynin

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Frontend Web Development Basics

Course Code:	**Maximum marks: 100**	
L-P-E: 1-6-0	**Total Credits: 4**	**Total Contact Hours: 105**

Semester: I

Prerequisites (if any): NA

Introduction:
In this course, students will learn the fundamentals of Frontend Web Development, including HTML, CSS and JavaScript. They will learn how to create responsive and dynamic web pages, as well as develop their problem-solving and critical thinking skills. The course will focus on hands-on projects and exercises to give students practical experience in front-end web development.

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

COs	Course outcomes	RBT
CO1	Apply debugging tools and techniques to identify and fix errors in web applications.	L3
CO2	Apply concepts of HTML, CSS and JavaScript for the development of interactive and responsive web pages.	L3
CO3	Summarize the principles of web design and user experience.	L2
CO4	Apply the principles of web design and user experience in building web pages.	L3
CO5	Design web pages that are accessible, user-friendly, and optimised for search engines	L6
CO6	Create reusable code components to improve productivity and maintainability.	L6

Syllabus

Module-1 - 21 hours

HTML, CSS Basics
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

Module – 2 - 21 hours

Javascript Basics
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

Module – 3 - 21 hours

HTML, CSS Advanced
CSS Advanced Selectors, CSS Positioning, Advanced Flexbox, CSS Grids, Box Model, Flex Box

Module-4 - 21 hours

Javascript Advanced
JS DOM, JS Advanced Functions, JS Nested Data Structures, JS Higher Order Functions, JS Event Handling, Object Oriented JS, JS Closure, JS Storage

Module-5 - 21 hours

Building a Project
Application in a project: Building a project using all concepts learnt.

Textbooks:

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

Reference Books:

- "HTML, CSS, and JavaScript All in One; Julie C. Meloni & Jennifer Kyrnin; Pearson Education; Third edition
- 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 Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Problem Solving using Programming - 1

Course Code:		**Maximum marks: 100**
L-P-E: 1-6-0	**Total Credits: 4**	**Total Contact Hours: 105**

Semester: I

Prerequisites (if any): NA

Introduction:

Problem Solving using Programming is an introductory course that teaches fundamental programming concepts and techniques using C++ and Python. The course emphasises problem-solving skills and computational thinking and equips students with the skills necessary to tackle real-world problems using programming.

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

COs	Course outcomes	RBT
CO1	Explain fundamental programming concepts, including data types, control structures, and functions	L2
CO2	Apply programming constructs to solve simple problems and algorithms in C++ and Python.	L3
CO3	Model programming constructs to develop larger programs that solve complex problem.	L3
CO4	Apply the concepts of basic data structures like arrays in solving problems.	L3
CO5	Analyse the efficiency and correctness of algorithms and programs.	L4
CO6	Simplify programming solutions clearly and effectively, both orally and in writing.	L4

Syllabus

Module-1 - 21 hours

Algorithms

Computational thinking, Decomposition, Abstraction, Pattern Recognition, Algorithms, Writing pseudocode and translating it to code, Looping (While and do-while loops)

Module – 2 - 21 hours

Basics of Programming

Variables (Scope, lifetime and Initialization), Datatypes (Structures, classes, enums), Operators (Arithmetic operators, Relational operators, Logical operators, Bitwise operators & Assignment

operators), 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

Module – 3 - 21 hours

Strings and Arrays
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

Module-4 - 21 hours

Control Flow Statements - Conditional
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

Module-5 - 21 hours

Control Flow Statements - Looping
Introduction to repetition and loops, types of loops, loops with multiple variables, nested loops, iteration and higher order functions.

Textbooks:

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

Reference Books:

- Programming in Python 3: A Complete Introduction to the Python Language; Mark Summerfield; Pearson Education; Second edition
- C++ Programming Language; Bjarne Stroustrup; Pearson Education; 4th edition.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

English LSRW

Course Code:	**Maximum marks: 100**	
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**

Semester: I

Prerequisites (if any): NA

Introduction:
This course aims to develop the four pillars of English communication: Listening, Speaking, Reading and Writing. The course is designed to benchmark against the CEFR framework and is tailored to focus on enhancing English Language proficiency in daily activities.

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

COs	Course outcomes	RBT
CO1	Demonstrate understanding of listening and speaking strategies, such as intonation and accent.	L2
CO2	Apply comprehension and analytical skills in going through reading comprehension texts.	L3
CO3	Apply grammatical rules and improve vocabulary usage in writing and speaking.	L3
CO4	Evaluate resumes and cover letters to determine their effectiveness - using the techniques taught in the course.	L5
CO5	Develop well-structured essays, reports, and other written documents.	L3

Syllabus

Module-1 - 12 hours

Listening and Speaking
Introduction to listening and speaking skills, Understanding different accents and intonation, Developing active listening skills, Participating in discussions and debates, Giving presentations and speeches.

Module – 2 - 12 hours

Reading

Introduction to reading skills, Skimming and scanning for information, Identifying main ideas and supporting details, Understanding tone and purpose, Reading for inference and implication.

Module – 3 - 12 hours

Writing

Introduction to writing skills, Planning and organizing written work, Writing effective emails and memos, Writing reports and proposals, Writing for specific audiences and purposes.

Module-4 - 12 hours

Grammar and Vocabulary

Introduction to grammar and vocabulary, Understanding verb tenses and structures, Practicing correct sentence formation, Building vocabulary through context and word roots, Using idioms and phrasal verbs in communication.

Module-5 - 12 hours

Business and Technical Communication

Introduction to business and technical communication, Writing effective resumes and cover letters, Conducting effective interviews, Understanding and writing technical documents, Communicating with clients and colleagues in professional settings.

Textbooks:

- Professional English: for AKTU, Meenakshi R Raman and Sangeetha Sharma, Oxford Publication 1st edition

Reference Books:

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

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Yoga - 1

Course Code:		**Maximum marks: 100**
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**

Semester: I

Prerequisites (if any): NA

Introduction:

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

COs	Course outcomes	RBT
CO1		
CO2		
CO3		
CO4		
CO5		

Syllabus

Module 1 -

Module 2 -

Module 3 -

Module 4 -

Module 5 -

Textbooks:

-

Reference Books:

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Constitution of India

Course Code:		**Maximum marks : 50**
L-P-E: 2-0-0	**Total Credits: 2**	**Total Contact Hours: 30**

Semester: I

Prerequisites (if any): NA

Introduction:
This course provides a comprehensive understanding of the Constitution of India. It covers the historical background, the Preamble, fundamental rights and duties, the structure and functions of the executive, legislature, and judiciary, as well as the processes of amendment and the federal structure. Students will gain insights into the legal and political framework that governs the country and its impact on society.

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

COs	Course outcomes	RBT
CO1	Outline the historical background and development of the Indian Constitution.	L2
CO2	Illustrate fundamental rights, duties, and directive principles enshrined in the Constitution.	L2
CO3	Explain the structure and functions of the executive, legislature, and judiciary in India.	L2
CO4	Analyse the federal structure and the distribution of powers between the Union and the States.	L4
CO5	List the process and significance of constitutional amendments.	L4

Syllabus

Module-1 - 6 hours

Introduction to the Constitution of India

Historical background, Making of the Constitution, Preamble and its significance, Basic structure doctrine.

Module – 2 - 6 hours

Fundamental Rights and Duties

Fundamental rights, Fundamental duties, Directive principles of state policy, Case studies on landmark judgments

Module – 3 - 6 hours

Structure and Functions of the Executive, Legislature, and Judiciary

The President and Vice-President, Parliament, State Legislature, The Prime Minister and Council of Ministers, The Judiciary - Supreme Court, High Courts, Subordinate Courts

Module-4 - 6 hours

Federal Structure and Distribution of Powers

Federalism in India, Division of powers: Union, State, and Concurrent lists, Inter-state relations, Emergency provisions

Module-5 - 6 hours

Constitutional Amendments and Their Impact

Process of amendment, Significant amendments and their implications, Judicial review and interpretation, Role of the Constitution in shaping Indian governance

Textbooks:

- "Introduction to the Constitution of India" by Durga Das Basu, LexisNexis, 23rd Edition, 2018.
- "Indian Polity" by M. Laxmikanth, McGraw Hill Education, 6th Edition, 2020.

Reference Books:

- "The Constitution of India: A Contextual Analysis" by Arun K. Thiruvengadam, Bloomsbury Professional, 1st Edition, 2017.
- "Granville Austin: The Indian Constitution - Cornerstone of a Nation" by Granville Austin, Oxford University Press, 2000.

Course Assessment:

This course will be fully graded basis CIA (Continuous Internal Assessment). It is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning.

Therefore, 100% of the grading is done basis CIA. The minimum passing marks required is 40% of the total CIA.

Semester 2

Critical Thinking

Course Code:		**Maximum marks: 50**
L-P-E: 2-0-0	**Total Credits: 2**	**Total Contact Hours: 30**
Semester: II		
Prerequisites (if any): NA		

Introduction:

Critical Thinking is a course designed 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 recognise and avoid common thinking errors, and to think more critically and effectively.

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

COs	Course outcomes	RBT
CO1	Demonstrate the cognitive biases and heuristics that can affect human reasoning.	L2
CO2	Identify common thinking errors and fallacies in everyday situations.	L3
CO3	Apply critical thinking skills to analyse and classify arguments and evidence.	L3
CO4	Develop ideas and perspectives from different sources to develop reasoned and well-supported arguments.	L3
CO5	Evaluate the reliability and validity of different sources of information and evidence.	L4

Syllabus

Module-1 - 10 hours

The two systems of thinking

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

Module – 2 - 10 hours

Heuristics and biases

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

Module – 3 - 10 hours

Critical thinking in action

Assignments on identifying biases in the news, creating fake news, writing an unbiased review, alien travel guide, facts vs opinion, worst case scenarios, hypothetical scenarios

Textbooks:

- Thinking, Fast and Slow; Daniel Kahneman; Penguin 2012 edition

Reference Books:

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

Course Assessment:

This course will be fully graded basis CIA (Continuous Internal Assessment). It is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning.

Therefore, 100% of the grading is done basis CIA. The minimum passing marks required is 40% of the total CIA.

Basics of Engineering

Course Code:	**Maximum marks: 100**	
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**

Semester: II

Prerequisites (if any): NA

Introduction:
This course focuses on helping students understand the basics of Engineering sciences. Following this, the students get a unique opportunity to build a modern computer system from scratch. Starting with NAND gate, the students build their way up to a fully functioning computer with an operating system, and gain a deep understanding of how computers work.

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

COs	Course outcomes	RBT
CO1	Demonstrate understanding of basic electrical and electronics engineering	L2
CO2	Explain basic concepts of computer architecture principles.	L2
CO3	Apply Boolean algebra and logic design to predict outputs of logic gates.	L3
CO4	Make use of combinational and sequential circuits.	L3
CO5	Construct assembly language programs to control hardware components.	L3
CO6	Build a functional computer system using the concept of HACK architecture.	L3

Syllabus

Module-1 - 11 hours

Basics of Electrical and Electronics Engineering:
Basic electrical concepts, Ohm's law, Kirchhoff's laws, AC and DC circuits, Basic instrumentation, Introduction to semiconductors, Diodes and their applications, Digital electronics fundamentals.

Module – 2 - 11 hours

Boolean Logic and Digital Design:
Introduction to digital systems and digital logic, Boolean algebra and logic gates, Combinational logic circuits, Sequential logic circuits, Building elementary logic gates using Nand gates

Module – 3 - 11 hours

Boolean Arithmetic and the CPU:
Arithmetic logic unit (ALU), Half adder and full adder, Ripple carry adder, Multi-bit addition, Multi-bit ALU, CPU components (registers, instruction memory, data memory), Microprocessors

Module-4 - 12 hours
Memory and Machine Language: Random-access memory (RAM), Memory maps, Machine language, Assembly language, The HACK computer architecture, Implementation of a simple computer using the HACK architecture

Textbooks:

- "Basic Electrical Engineering"; D.P. Kothari and I.J. Nagrath; McGraw Hill Education India

Reference Books:

- "Basic Electronics: Solid State"; B.L. Theraja; S. Chand & Company Ltd.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Problem Solving using Programming - 2

Course Code:		**Maximum marks: 100**
L-P-E: 1-6-0	**Total Credits: 4**	**Total Contact Hours: 105**

Semester: II

Prerequisites (if any): Problem Solving using Programming - 1

Introduction:
Problem Solving using Programming - 2 builds on its predecessor course in teaching students deeper concepts in Programming. This course is taught in C++ and Python. This focuses on concepts such as Advanced Control Structures, Modularity, Nested Looping etc. .

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

COs	Course outcomes	RBT
CO1	Explain programming concepts, including how functions, nested conditional and nested looping statements work.	L2
CO2	Apply programming constructs to solve problems and algorithms in C++ and Python.	L3
CO3	Compare different control statements in order to choose the right construct for different problems.	L4
CO4	Discover programming constructs to develop larger programs that solve complex problems.	L4
CO5	Evaluate the strengths and weaknesses of different programming constructs and choose appropriate solutions for different problems	L5
CO6	Illustrate principles of modular programming and its benefits in software development.	L2

Syllabus

Module-1 - 21 hours

Control Structures Advanced:
Nested if, Nested if, else if, 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

Module – 2 - 21 hours

Loops Advanced:
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

Module – 3 - 21 hours
Modularity: Organising 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.
Module-4 - 21 hours
Introduction to Data Structures: Overview of data structures, Arrays and linked lists, Stacks and queues, Trees and graphs - basic concepts along with practice problems.
Module-5 - 21 hours
Using Generative AI: Breaking down the problem to programming patterns, Prompt engineering for code, Prompt engineering for C and Python, use of AI agents in writing functionality.

Textbooks:

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

Reference Books:

- Programming in Python 3: A Complete Introduction to the Python Language; Mark Summerfield; Pearson Education; Second edition
- C++ Programming Language; Bjarne Stroustrup; Pearson Education; 4th edition

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Frontend Web Development Advanced

Course Code:		**Maximum marks: 100**
L-P-E: 1-6-0	**Total Credits: 4**	**Total Contact Hours: 105**

Semester: II

Prerequisites (if any): Frontend Web Development Basics

Introduction:

This advanced course in Front-end Web Development takes a deep dive into modern JavaScript and React.js. Starting with intricate JavaScript concepts like prototypal inheritance, async programming, and unit testing, the course moves on to foundational and intermediate React skills, including hooks, state management, and component lifecycle. Finally, it offers an in-depth exploration of advanced React features like Redux, Material-UI, and API integration. This course is designed to equip developers with the skills necessary to build robust, scalable, and responsive web applications.

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

COs	Course outcomes	RBT
CO1	Explain core concepts and advanced features of React.	L2
CO2	Develop complex user interfaces using React components and hooks.	L3
CO3	Evaluate performance of React applications using optimization techniques.	L5
CO4	Assess statement management solutions and their integration in React applications.	L4
CO5	Design an application using React concepts and robust architecture.	L6
CO6	Integrate React with various APIs and backend services for full-stack web development.	L6

Syllabus

Module-1 - 21 hours

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

Module – 2 - 21 hours
React first steps: Environment set up, Introduction to React, Props & State, Components, React App using Babel, Rendering lists of data
Module – 3 - 21 hours
React Intermediate: JSX, Hooks, Additional Hooks, Event Handling, Component Lifecycle, Class based components, Routing
Module-4 - 21 hours
React deep dive: React Forms, Fetching Data from API, Redux, React Redux, Redux Toolkit, React CSS Library, Material-ui
Module-5 - 21 hours
Integrating React with Backend Services: Fetching data with Axios and Fetch API, Handling asynchronous operations, Integrating GraphQL with React, Authentication and authorization in React applications, Real-time data with WebSockets

Textbooks:

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

Reference Books:

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

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Engineering Chemistry

Course Code:	**Maximum marks: 100**	
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**

Semester: II

Prerequisites (if any): NA

Introduction:

Engineering Chemistry provides a comprehensive understanding of chemical principles and their applications in engineering. This course covers the basics of atomic structure and chemical reactions, dives into chemical thermodynamics and equilibrium, and explores the kinetics of chemical reactions. Students will learn about the rates of reactions, mechanisms, the impact of temperature, and the role of catalysts, including enzyme catalysis. This knowledge equips students with the ability to apply chemical concepts to solve engineering problems and innovate in various technological fields.

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

COs	Course outcomes	RBT
CO1	Explain basic principles of Chemistry such as enthalpy, entropy and free energy.	L2
CO2	Examine how Chemistry is used to solve real-world problems.	L3
CO3	Apply principles of Chemistry to solve case studies involving topics like health, environmental impact and energy.	L3
CO4	Make use of Chemistry concepts to solve case studies involving Computer Science problems.	L3
CO5	Analyse the kinetics of chemical reactions to determine the factors influencing reaction rates and the mechanisms involved	L4

Syllabus

Module-1 - 9 hours

Basic Principles:

Atomic structure: electrons, protons, neutrons, periodic table; Chemical reactions: stoichiometry, acids and bases, oxidation and reduction

Module – 2 - 9 hours

Chemical Thermodynamics:
Gibbs free energy, enthalpy, entropy, free energy

Module – 3 - 9 hours

Chemical Equilibrium:
Introduction to chemical equilibrium, Le Châtelier's Principle, Solubility and Acid-Base Equilibrium.

Module-4 - 9 hours

Chemical Kinetics 1:
Rates of chemical reactions, rate expressions and rate laws, radioactive decay, second order integrated rate laws, elementary steps and molecularity.

Module-5 - 9 hours

Chemical Kinetics 2:
Investigating reaction mechanisms, effect of temperature on reaction rates, the reaction coordinate and the activation complex, introduction to catalysis, types of catalysts, catalysts of life and enzyme catalysis

Textbooks:

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

Reference Books:

- Science Matters: Achieving Scientific Literacy by Robert M. Hazen and James Trefil (Penguin Random House India, 2017)
- Science and Technology in World History: An Introduction by James E. McClellan III and Harold Dorn (Johns Hopkins University Press, 2018)
- Physics for Scientists and Engineers by Randall D. Knight (published by Pearson, latest edition)
- 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)

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried

out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

English for Professionals

Course Code:		**Maximum marks: 100**
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**
Semester: II		
Prerequisites (if any): English LSRW		

Introduction:
This course aims to develop upon the previous English LSRW. The course is designed to benchmark against the CEFR framework and is tailored to enhance English Language proficiency for professional activities.

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

COs	Course outcomes	RBT
CO1	Demonstrate understanding of key concepts in business writing - such as clarity, conciseness and coherence.	L2
CO2	Develop engaging and well-structured presentations.	L3
CO3	Apply business etiquette concepts taught in the course in professional situations.	L3
CO4	Create effective emails, reports and proposals for business correspondence.	L6
CO5	Analyse various professional communication scenarios to identify their effectiveness.	L4

Syllabus

Module-1 - 15 hours

Business Writing Fundamentals:
Business writing fundamentals (emails, reports, proposals), Effective writing techniques (clarity, conciseness, coherence), Proofreading and editing skills

Module – 2 - 15 hours

Business Presentation Skills:
Business Presentation Skills, Strategies for effective listening and responding, Techniques for leading and participating in meetings, Negotiation and conflict resolution skills

Module – 3 - 15 hours

Business Etiquette and Protocol:
Business etiquette and protocol, Networking and professional relationships, Intercultural communication and diversity, Teamwork and collaboration skills

Module-4 - 15 hours

Case Studies and Role-playing Exercises:
Case studies and role-playing exercises, Analysing and responding to professional communication challenges, Developing communication strategies for specific situations

Textbooks:

- Bovée, C. L., & Thill, J. V. (2021). Business communication today (15th ed.). Pearson.
- Guffey, M. E., & Loewy, D. (2021). Essentials of business communication (11th ed.). Cengage Learning.
- Munter, M., & Hamilton, L. (2021). Guide to managerial communication (11th ed.). Pearson.
- Hynes, G. E. (2018). Managerial communication: Strategies and applications (7th ed.). SAGE Publications.

Reference Books:

- Amartya Sen, The Argumentative Indian (1st ed.). Penguin UK

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Yoga -2

Course Code:		**Maximum Marks: 100**
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**
Semester: II		
Prerequisites (if any): NA		
Introduction:		
Course Outcomes: On completion of the course, students will be able to:		

COs	Course outcomes	RBT
CO1		L2
CO2		L2
CO3		L2
CO4		L3
CO5		L3
CO6		L3

Syllabus
Module-1 - 9 hours
Module – 2 - 9 hours
Module – 3 - 9 hours

Module-4 - 9 hours
Module-5 - 9 hours

Textbooks:

Reference Books:

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Semester 3

Mathematical Thinking

Course Code:		**Maximum Marks: 100**
L-P-E: 4-0-0	**Total Credits: 4**	**Total Contact Hours: 60**
Semester: III		
Prerequisites (if any): Engineering Mathematics		

Introduction:
Mathematical Thinking explores the fundamental concepts and approaches of mathematical thinking through an interdisciplinary lens. This course covers topics such as logical and language analysis, mathematical proofs, and advanced topics like number theory and real analysis..

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

COs	Course outcomes	RBT
CO1	Define key concepts of mathematical thinking and inquiry-based learning.	L1
CO2	Analyse logical combinators and implications in language based on the given operations (AND, OR and NOT).	L4
CO3	Evaluate logical equivalence and quantifiers in language analysis based on the logical expressions.	L5
CO4	Apply methods of mathematical proof, including proof by contradiction and proof by quantifiers.	L3

CO5	Explain advanced mathematical topics such as number theory and real analysis.	L2
CO6	Create well-structured mathematical arguments and proofs using the concepts learned in the course.	L6

Syllabus

Module-1 - 12 hours

What is Mathematical Thinking?
What is Mathematical Thinking?, What is Inquiry-Based Learning?, Introduction to Mathematical Thinking, How to Get Precise About Language?

Module – 2 - 12 hours

Logical and Language Analysis-I
Logical and Language Analysis-I, Analysis of Language – The Logical Combinators, Assignment – The Logical Combinators, Analysis of Language – Implication, Assignment – Implication

Module – 3 - 12 hours

Logical and Language Analysis-II
Logical and Language Analysis-II, Analysis of Language – Logical Equivalence, Assignment – Analysis of Language – Logical Equivalence, Analysis of Language – Quantifiers, Assignment – Analysis of Language – Quantifiers

Module-4 - 12 hours

Mathematical Proofs
Mathematical Proofs, What is Proof by Contradiction?, Assignment – What is Proof by Contradiction?, What is Proof by Quantifiers?, Assignment – What is Proof by Quantifiers?

Module-5 - 12 hours

Advanced Topics in Mathematical Thinking
Advanced Topics in Mathematical Thinking, What is Number Theory?, Assignment – Number Theory, What is Real Analysis?, Assignment – Real Analysis

Text book(s)

- The Mathematical Experience; Philip J. Davis and Reuben Hersh; Harper Paperbacks; 1999 edition

Reference book(s)

- Mathematics and the Imagination; Edward Kasner and James Newman; Dover Publications Inc; 2003 edition

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

UI and UX Design for Computer Science Engineering

Course Code:	**Maximum Marks: 100**	
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: III		
Prerequisites (if any): NA		
Introduction: This 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-centred design, usability testing, and accessibility, and provides hands-on experience with design tools and techniques.		
Course Outcomes: On completion of the course, students will be able to:		

COs	Course outcomes	RBT
CO1	Explain basic principles of user-centred design, and how they apply to software development.	L2
CO2	Evaluate design of existing software applications in order to identify areas for improvement in terms of user experience and usability.	L5
CO3	Apply visual design principles and techniques, such as typography, colour theory, and layout, to create effective user interfaces.	L3
CO4	Make use of usability testing and other evaluation methods to measure the effectiveness and usability of software applications.	L3
CO5	Synthesise different design concepts and techniques to create well-designed and user-friendly software interfaces.	L6
CO6	Evaluate accessibility of software applications through clear understanding of the importance of designing for users with diverse needs.	L5

Syllabus

Module-1 - 15 hours

How to Approach Design as a Developer
Why design for developers, Getting started with design education, Getting started with Figma, Labs on Figma

Module – 2 - 15 hours

UX Design for Developers
Understanding design sprints, Understanding the user, Information architecture, Accessibility in design, How to build good digital products, Psychology in UX design, User research, User journey mapping, Wireframing, Prototyping

Module – 3 - 15 hours

UI Design for Developers
Visual design principles, Visual hierarchy, Working with text, Layouts and spacing, Working with colours, Working with images, Creating depth in design, Working with components

Module-4 - 15 hours

Advanced Design Techniques
Responsive design, Interaction design, Animation principles, Designing for mobile interfaces, Advanced prototyping techniques, Design systems and component libraries

Module-5 - 15 hours

Evaluating and Improving Design
Usability testing methods, Gathering user feedback, Iterative design processes, Performance considerations in design, Case studies on successful design implementations, Ethical considerations in design

Text book(s)

- About Face; Alan Cooper, Robert Reimann, Christopher Noessel and David Cronin; Wiley Publishing, 2014

Reference book(s)

- Hands-on UX design for developers; Elvis Canziba; Packt, 2018
- Refactoring; Adam Wathan and Steve Shoger
    -

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Computer Organisation and Architecture

Course Code:	**Maximum Marks: 100**	
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**
Semester: III		
Prerequisites (if any): Problem Solving using Programming - 2		
Introduction: This course provides an introduction to computer organisation 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.		
Course Outcomes: On completion of the course, students will be able to:		

COs	Course outcomes	RBT
CO1	Explain basic components of computer systems and their functions at a low level, including CPU, memory, and I/O systems.	L2
CO2	Analyse performance of computer systems based on metrics such as clock rate and CPI.	L4
CO3	Implement simple CPU and memory systems using hardware description languages such as Verilog.	L3
CO4	Create assembly language programs that interact with system hardware.	L6
CO5	Evaluate the trade-offs involved in different design choices for computer systems, such as the size of the instruction set or the level of parallelism.	L5
CO6	Apply knowledge of computer organisation and architecture to optimise code for performance and minimise energy consumption.	L3

Syllabus

Module-1 - 18 hours

Foundational Blocks of Computer

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.

Module – 2 - 18 hours

Data Representation & Computer Arithmetic

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.

Module – 3 - 18 hours

CPU & Memory System Design

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

Memory system design: semiconductor memory technologies, memory organisation.

Module-4 - 18 hours

Peripheral Devices & Performance Enhancement Techniques

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

Module-5 - 18 hours

Pipelining & Memory Organisation

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Memory organisation: Memory interleaving, concept of hierarchical memory organisation, cache memory, cache size vs block size, mapping functions, replacement algorithms, write policy.

Text book(s)

- Computer Organization and Design; Patterson; Elsevier; 6th edition

Reference book(s)

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

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Operating Systems

Course Code:		**Maximum Marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**
Semester: III		
Prerequisites (if any): Problem Solving using Programming - 2		
Introduction: 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.		
Course Outcomes: On completion of the course, students will be able to:		

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts of operating systems such as processes, threads, synchronisation, and memory management.	L2
CO2	Analyse the performance of various scheduling and memory allocation algorithms.	L4
CO3	Compare different types of operating systems, such as batch, multi-programmed, and real-time systems.	L2
CO4	Develop an understanding of memory hierarchy & cache, operating systems and process management.	L3
CO5	Implement basic operating system functionalities such as Deadlock Detection & Avoidance, parallel processing techniques.	L3
CO6	List security and privacy issues in modern operating systems.	L1

Syllabus

Module-1 - 18 hours

Computer Arithmetic and Processor Organisation

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).

Module – 2 - 18 hours

Memory Organisation

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

Module – 3 - 18 hours

Parallel Processing

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.

Module-4 - 18 hours

Introduction to Operating Systems and Process Management

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.

Module-5 - 18 hours

Memory Management

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.

Text book(s)

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

Reference book(s)

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

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Yoga - 3

Course Code:	**Maximum Marks: 100**	
L-P-E: 3-0-0	**Total Credits: 3**	**Total Contact Hours: 45**
Semester: III		
Prerequisites (if any): NA		
Introduction:		
Course Outcomes: On completion of the course, students will be able to:		

COs	Course outcomes	RBT
CO1		L
CO2		L
CO3		L
CO4		L
CO5		L

Syllabus

Module-1 - 9 hours

Module – 2 - 9 hours

Module – 3 - 9 hours

Module-4 - 9 hours

Module-5 - 9 hours

Textbooks:

Reference Books:

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Environmental Sciences

Course Code:	**Maximum Marks: 50**	
L-P-E:2-0-0	**Total Credits: 2**	**Total Contact Hours: 30**
Semester: III		
Prerequisites (if any): NA		
Introduction:		

This course provides a comprehensive understanding of environmental science principles, focusing on the interactions between the natural environment and human activities. Topics include ecosystems, biodiversity, pollution, climate change, sustainable development, and environmental policies. The course aims to equip students with the knowledge and skills needed to address environmental challenges and promote sustainability.

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

COs	Course outcomes	RBT
CO1	Identify key concepts and principles of environmental science, Biodiversity and Conservation.	L3
CO2	Describe the structure and function of ecosystems and biodiversity.	L2
CO3	Explain causes and consequences of environmental pollution and climate change.	L2
CO4	Analyse environmental issues and assess their impact on ecosystems and human health.	L4
CO5	Evaluate strategies for sustainable development and environmental management.	L5

Syllabus

Module-1 - 6 hours

Introduction to Environmental Science
Definition, scope, and importance of environmental science, Interdisciplinary nature of environmental science, Structure and function of ecosystems, Energy flow and nutrient cycles

Module – 2 - 6 hours

Biodiversity and Conservation
Types of biodiversity, Importance of biodiversity, Threats to biodiversity, Conservation strategies, Protected areas and wildlife conservation

Module – 3 - 6 hours

Environmental Pollution
Types of pollution (air, water, soil, noise), Sources and effects of pollution, Pollution control measures, Case studies on pollution incidents

Module-4 - 6 hours

Climate Change and Global Warming
Causes and effects of climate change, Greenhouse gases and global warming, Mitigation and adaptation strategies, International agreements and policies

Module-5 - 6 hours

Sustainable Development and Environmental Management
Principles of sustainable development, Environmental impact assessment, Waste management and recycling, Renewable energy sources, Environmental policies and legislation

Text book(s)

- "Environmental Science: A Global Concern" by William P. Cunningham and Mary Ann Cunningham, McGraw-Hill Education, 14th Edition, 2017.

- "Living in the Environment: Principles, Connections, and Solutions" by G. Tyler Miller and Scott Spoolman, Cengage Learning, 19th Edition, 2017.

Reference book(s)

- "Environmental Science" by Daniel D. Chiras, Jones & Bartlett Learning, 11th Edition, 2019.
- "Principles of Environmental Science: Inquiry and Applications" by William P. Cunningham and Mary Ann Cunningham, McGraw-Hill Education, 8th Edition, 2015.

Course Assessment:

This course will be fully graded basis CIA (Continuous Internal Assessment). It is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning.

Therefore, 100% of the grading is done basis CIA. The minimum passing marks required is 40% of the total CIA.

Semester 4

Data Structures and Algorithms - 1

Course Code:		**Maximum marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total contact Hours : 90**

Semester: IV

Prerequisites (if any): Problem Solving using Programming - 2

Introduction:
This course introduces the fundamental data structures and algorithms used in computer science. Students will learn about arrays, linked lists, stacks, queues, trees, and hashing. The course covers the implementation and analysis of these data structures, focusing on their efficiency and use in solving computational problems.

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

COs	Course outcomes	RBT
CO1	Demonstrate properties and operations of arrays, linked lists, stacks, and queues.	L2
CO2	Explain implementation of tree data structures.	L2
CO3	Identify basic data structures and their use cases when presented with programming problems.	L3
CO4	Apply data structures such as Arrays, Linked Lists, Stacks and Queues to solve simple computational problems.	L3
CO5	Analyse the efficiency of basic data structures using the concepts of time and space complexity.	L4
CO6	Implement various data structures in programming assignments.	L4

Syllabus

Module-1 - 18 hours

Introduction to Data Structures
Basic concepts, Need for data structures, Abstract Data Types (ADTs), Complexity analysis

Module – 2 - 18 hours

Arrays and Linked Lists
Arrays: definition, operations, and applications, Singly linked lists, Doubly linked lists, Circular linked lists

Module – 3 - 18 hours

Stacks and Queues
Stack operations and applications, Queue operations and applications, Priority queues, Deques

Module-4 - 18 hours

Trees
Basic tree concepts, Binary trees, Binary search trees, Tree traversals, AVL trees

Module-5 - 18 hours

Hashing
Hash tables, Hash functions, Collision resolution techniques, Applications of hashing

Textbooks:

- "Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss, Pearson, 4th Edition, 2013.

Reference Books:

- "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press, 3rd Edition, 2009.
- "Algorithms" by Robert Sedgewick and Kevin Wayne, Addison-Wesley Professional, 4th Edition, 2011.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Object Oriented Programming

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: IV

Prerequisites (if any): Problem Solving using Programming - 2

Introduction:
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.

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

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts and principles of OOP, such as encapsulation, inheritance, and polymorphism.	L2
CO2	Apply OOP concepts to develop software applications in C++ and Python.	L3
CO3	Implement complex data structures and algorithms using OOP concepts.	L4
CO4	Evaluate the performance and efficiency of OOP-based programs.	L5
CO5	Develop a software project using OOP design patterns and software engineering practices.	L6
CO6	Evaluate the design and implementation of object-oriented software solutions to determine their efficiency, scalability, and adherence to design principles.	L5

Syllabus

Module-1 - 15 hours

Introduction to Object-Oriented Programming
Basics of OOP, Objects and Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Programming vs OOP

Module – 2 - 15 hours

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

Module – 3 - 15 hours

Object-Oriented Design Principles
SOLID Principles, Design Patterns, Design for Reuse, Design for Testability.

Module-4 - 15 hours

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

Module-5 - 15 hours
Advanced Object-Oriented Programming Advanced Topics in OOP Multithreading, Concurrency, Networking, GUI Programming, Database Programming, Best Practices for OOP

Textbooks:

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

Reference Books:

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

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Database Management Systems

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: IV

Prerequisites (if any): Problem Solving using Programming - 2

Introduction:
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.

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

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts of database management systems including data models, data normalisation, and database design.	L2
CO2	Utilise a relational database using SQL.	L3
CO3	Use a popular DBMS tool such as MySQL to create and manage databases.	L3
CO4	Use SQL to query and manipulate data stored in a database.	L3
CO5	Apply database management concepts to real-world scenarios and problem-solving.	L3
CO6	Analyse database schemas and queries to identify optimization opportunities and ensure data integrity and efficiency.	L4

Syllabus

Module-1 - 15 hours

Introduction to DBMS
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.

Module – 2 - 15 hours

The Relational Data Model and Algebra
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.

Module – 3 - 15 hours

SQL

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

Module-4 - 15 hours

Index Structures and Query Processing

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

Module-5 - 15 hours

Failure Recovery and Concurrency Control

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.

Textbooks:

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

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Introduction to Cloud Computing

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: IV

Prerequisites (if any): Operating Systems

Introduction:
This course provides a comprehensive overview of cloud computing, covering the fundamental concepts, architecture, and services offered by cloud providers. Students will learn about different cloud service models (IaaS, PaaS, SaaS), deployment models, and key technologies that enable cloud computing. The course includes practical exercises and projects to understand how to deploy and manage cloud applications effectively.

Course Outcomes: On completion of the course, student will be able to:

COs	Course outcomes	RBT
CO1	Identify key concepts and benefits of cloud computing, including cost efficiency, scalability, and flexibility.	L3
CO2	Illustrate different cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid), explaining their use cases and differences.	L2
CO3	Explain the architecture and technologies behind cloud computing, such as virtualization, storage, and networking in cloud environments.	L2
CO4	Apply cloud services to deploy and manage applications, including practical tasks like resource management, monitoring, and scaling.	L3
CO5	Analyse real-world use cases and case studies of cloud computing implementations, evaluating their success and challenges.	L4
CO6	Develop practical projects using cloud platforms like AWS, Azure, and Google Cloud, demonstrating hands-on experience with cloud technologies.	L6

Syllabus

Module-1 - 15 hours

Fundamentals of Cloud Computing
Introduction to cloud computing, Key concepts and benefits, Cloud service models (IaaS, PaaS, SaaS), Cloud deployment models (public, private, hybrid)

Module – 2 - 15 hours

Cloud Architecture and Technologies

Cloud architecture components, Virtualization, Storage and databases in the cloud, Networking in cloud environments, Key technologies enabling cloud computing (e.g., containers, microservices)

Module – 3 - 15 hours

Cloud Service Providers
Overview of major cloud service providers (AWS, Azure, Google Cloud), Comparison of services and features, Introduction to cloud platforms and tools

Module-4 - 15 hours

Deploying and Managing Cloud Applications
Deploying applications in the cloud, Managing cloud resources, Monitoring and scaling applications, Security and compliance in cloud computing

Module-5 - 15 hours

Practical Projects and Case Studies
Real-world use cases, Project-based learning, Case studies on successful cloud computing implementations, Group projects and presentations

Textbooks:

- “Cloud Computing: Principles and Paradigms" by Rajkumar Buyya, James Broberg, and Andrzej M. Goscinski, Wiley, 1st Edition, 2011.
- "Mastering Cloud Computing: Foundations and Applications Programming" by Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, McGraw Hill Education, 1st Edition, 2013.

Reference Books:

- "Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti, Universities Press, 1st Edition, 2014.
- "Amazon Web Services in Action" by Andreas Wittig and Michael Wittig, Manning Publications, 2nd Edition, 2018.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Formal Language and Automata theory

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: IV

Prerequisites (if any): Mathematical Thinking

Introduction:

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.

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

COs	Course outcomes	RBT
CO1	Interpret regular and context-free languages that a given automaton can recognize.	L2
CO2	Develop regular expressions and context-free grammars for given languages.	L3
CO3	Construct finite automata, pushdown automata, and Turing machines to recognize given languages.	L3
CO4	Apply principles of formal languages and automata to real-world problems, such as pattern matching and parsing.	L3
CO5	Examine time and space complexity of algorithms that operate on formal languages.	L4
CO6	Evaluate different models of computation and their relative strengths and weaknesses.	L5

Syllabus

Module-1 - 15 hours

Automata methods and Finite Automata

Introduction to formal proof, Additional forms of proof, Inductive proofs, The central concepts of Automata theory, Deterministic finite automata, Nondeterministic finite automata, Text search, Finite automata with Epsilon transitions

Module – 2 - 15 hours

Regular expressions and languages

Regular expressions, Applications, Algebraic laws for regular expressions, Proving languages not to be regular, Closure properties of regular languages, Decision properties, Equivalence and minimization

Module – 3 - 15 hours

Context free Grammar and Languages
Context free grammar, Parse trees, Applications, Ambiguity

Module-4 - 15 hours

Pushdown Automata
The languages of a PDA, Equivalence of PDA and CFG, Deterministic PDA

Module-5 - 15 hours

Turing machines, Undecidability and Intractable problems
Problems that computers cannot solve, The Turing machine, Programming techniques for Turing machine, Extensions to the basic Turing machine, P and NP, NP-complete problem, A restricted satisfiability problem, Additional NP-complete problems

Textbooks:

- Automata Theory Language & Computation; Hopcraft; Pearson 3rd edition

Reference Books:

- Theory of Computer Science: Automata, Languages and Computation; KLP Mishra; Prentice Hall India Learning Private Limited; 3rd edition
- Switching and Finite Automata Theory; Jha; Cambridge University Press; South Asian edition (8 June 2010)

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Coding and Computational Thinking

Course Code:		**Maximum marks: 100**
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**

Semester: IV

Prerequisites (if any): Problem Solving using Programming - 1

Introduction:
This course focuses on developing students' coding skills and enhancing their computational thinking abilities. Through hands-on practice and coding exercises, students will learn to write efficient and effective code, solve complex problems, and think algorithmically.

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

COs	Course outcomes	RBT
CO1	Summarise fundamental programming concepts and techniques in programming - such as data types, control statements and functions..	L2
CO2	Illustrate understanding of problem-solving strategies and algorithmic thinking.	L2
CO3	Apply coding skills to implement algorithms in various programming languages.	L3
CO4	Develop solutions to complex problems using advanced programming techniques.	L3
CO5	Analyse efficiency and effectiveness of different coding approaches.	L4

Syllabus

Module-1 - 12 hours

Introduction to Computational Thinking and Problem Solving
Overview of computational thinking, Problem-solving strategies, Algorithm design, Basic programming constructs

Module – 2 - 12 hours

Coding Practice - Basic Concepts
Graded practice on data types and structures, Control flow (loops, conditionals), Functions and modules, Error handling and debugging

Module – 3 - 12 hours

Coding Practice - Intermediate Concepts
Graded practice on object-oriented programming concepts, Recursion

Module-4 - 12 hours

Data structures
Arrays, Lists, Stacks, Queues, File I/O operations

Module-5 - 12 hours

Coding Practice - Advanced Concepts
Graded practice on dynamic programming, Graph algorithms, Sorting and searching algorithms, Advanced data structures (trees, hash tables)

Textbooks:

- "Python Crash Course: A Hands-On, Project-Based Introduction to Programming" by Eric Matthes, No Starch Press, 2nd Edition, 2019.
- "C++ Programming: From Problem Analysis to Program Design" by D.S. Malik, Cengage Learning, 8th Edition, 2018.

Reference Books:

- "Introduction to the Design and Analysis of Algorithms" by Anany Levitin, Pearson, 3rd Edition, 2011.
- "Effective C++: 55 Specific Ways to Improve Your Programs and Designs" by Scott Meyers, Addison-Wesley, 3rd Edition, 2005.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Semester 5

Linux Administration

Course Code:		**Maximum marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**

Semester: V

Prerequisites (if any): Operating Systems

Introduction:
This course provides a comprehensive introduction to Linux administration, focusing on essential skills for managing Linux-based systems. It helps to configure, maintain, and troubleshoot Linux servers and workstations. Practicals and real-world scenarios will enhance the ability to perform critical administrative tasks effectively.

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

COs	Course outcomes	RBT
CO1	Infer Linux commands and utilities to perform basic system administration tasks, including user management and file system operations.	L2
CO2	Determine network settings and services to ensure proper communication and security in a Linux environment.	L5
CO3	Identify software packages and updates using various package management tools to maintain system integrity and functionality.	L3
CO4	Analyse system performance and troubleshoot issues using monitoring tools and logs to optimise Linux server operations.	L4
CO5	Formulate backup strategies to ensure data protection and system recovery in case of failures.	L6
CO6	Evaluate system security by configuring firewalls, managing permissions, and applying best practices for secure administration.	L5

Syllabus

Module-1 - 18 hours
Introduction to Linux Overview of Linux operating systems, Linux distributions, Installation procedures, Basic Linux commands
Module – 2 - 18 hours
User and Group Management Creating and managing user accounts, Group management, File permissions and ownership, sudo and root access
Module – 3 - 18 hours
File Systems and Process Management File system hierarchy, Mounting and unmounting file systems, Disk management, Process management and scheduling, System monitoring
Module-4 - 18 hours
Network Configuration Basic network configuration, Managing network services, Network troubleshooting tools, Configuring SSH and remote access
Module-5 - 18 hours
Security and Troubleshooting Linux security basics, Firewall configuration, SELinux and AppArmor, Backup and recovery, Common troubleshooting techniques

Textbooks:

- Linux Yourself; Sunil K. Singh; Publication: Chapman and Hall/CRC; 31Aug, 2021.
- Linux Administration Handbook; Garth Synder; Publication: Pearson Education; 1st Jan, 2007

Reference Books:

- Linux: The Complete Reference; Richard Petersen; Publication: McGraw Hill Education; 1st July, 2017.
- Linux Administration: a beginner Guide; Publication: McGraw Hill Education, Soyinka Wale, 1st July,2017

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Data Structures and Algorithms - 2

Course Code:		**Maximum marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**
Semester: V		
Prerequisites (if any): Data Structures and Algorithms - 1		

Introduction:
This course builds on the foundational concepts introduced in Data Structures and Algorithms - 1, delving into more complex data structures and advanced algorithmic techniques. Students will explore graphs, heaps, advanced tree structures, and algorithm design strategies. The course emphasises the practical application of these concepts to solve more sophisticated computational problems.

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

COs	Course outcomes	RBT
CO1	Explain the concepts of advanced data structures and their applications, such as using B-trees for database indexing and Red-Black trees for maintaining balanced search trees.	L2
CO2	Illustrate the properties and operations of graphs and heaps, including graph representations and heap operations in binary, binomial, and Fibonacci heaps.	L2
CO3	Explain advanced tree structures like B-trees and Red-Black trees, detailing insertion, deletion, and balancing processes.	L2
CO4	Apply advanced data structures to complex computational problems, such as using Dijkstra's algorithm for shortest path finding and Fibonacci heaps for optimization.	L3
CO5	Analyse efficiency and performance of advanced data structures, comparing their time complexities and practical applications.	L4

CO6	Examine the implementation and performance of advanced data structures and algorithms in real-world applications to identify potential improvements and optimizations.	L4

Syllabus

Module-1 - 18 hours

Advanced Tree Structures
B-trees, Red-Black trees, Splay trees, Tries

Module – 2 - 18 hours

Graphs
Graph representations, Graph traversals (BFS, DFS), Shortest path algorithms (Dijkstra's, Bellman-Ford), Minimum spanning trees (Kruskal's, Prim's)

Module – 3 - 18 hours

Heaps
Binary heaps, Binomial heaps, Fibonacci heaps, Heap operations and applications

Module-4 - 18 hours

Advanced Hashing and Searching
Perfect hashing, Bloom filters, Skip lists, Advanced search algorithms

Module-5 - 18 hours

Algorithm Design Techniques
Divide and conquer, Dynamic programming, Greedy algorithms, Backtracking

Textbooks:

- "Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss, Pearson, 4th Edition, 2013.

Reference Books:

- "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press, 3rd Edition, 2009.
- "Algorithms" by Robert Sedgewick and Kevin Wayne, Addison-Wesley Professional, 4th Edition, 2011.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried

out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Back-end Web Development

Course Code:		**Maximum marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**
Semester: V		
Prerequisites (if any): Frontend Web Development Advanced		

Introduction:
This course provides a comprehensive introduction to back-end web development, focusing on building scalable and secure server-side applications. Students will learn how to use Node.js and Express to create dynamic web services and APIs. The course covers database management, server optimization, and integration with front-end technologies.

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

COs	Course outcomes	RBT
CO1	Explain fundamental concepts of server-side programming and the role of backend in web development, including the use of Node.js.	L2
CO2	Develop server-side applications using Node.js and Express, creating dynamic web services and APIs.	L3
CO3	Compare different database management systems and their use in back-end development, evaluating SQL and NoSQL solutions.	L4
CO4	Assess the performance of server-side applications, implementing performance tuning and optimization strategies.	L5
CO5	Formulate secure and scalable back-end solutions, incorporating best practices for security and scalability.	L6

CO6	Combine back-end services with front-end applications in a full-stack environment, ensuring seamless communication and data exchange.	L6

Syllabus

Module-1 - 18 hours

Introduction to Back-end Development
Fundamentals of server-side programming, Role of back-end in web development, Introduction to Node.js, Setting up a Node.js environment, Basics of JavaScript for back-end development

Module – 2 - 18 hours

Working with Express.js
Introduction to Express.js, Routing in Express, Middleware in Express, Building RESTful APIs, Handling requests and responses

Module – 3 - 18 hours

Database Management
Introduction to databases, SQL vs NoSQL databases, Working with MongoDB, Mongoose ORM, CRUD operations in MongoDB

Module-4 - 18 hours

Security and Authentication
Security best practices in web development, User authentication and authorization, Implementing JWT-based authentication, Protecting routes and data, Secure communication with HTTPS

Module-5 - 18 hours

Performance and Scalability
Performance optimization techniques, Caching strategies, Load balancing and clustering, Handling concurrent requests, Scaling applications

Textbooks:

- Beginning Node.js, Express & MongoDB Development; Greg Lim; Published by Greg Lim; 2020 edition

Reference Books:

- Learning Node.js Development: Learn the fundamentals of Node.js, and deploy and test Node.js applications on the web; Andrew Mead; Packt Publishing; 2018 edition

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Databases for Web Development

Course Code:		**Maximum marks: 100**
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**
Semester: V		
Prerequisites (if any): Frontend Web Development Advanced, Database Management Systems		
Introduction: This course covers the essential concepts of database systems, focusing on NoSQL databases, Redis, and vector databases. Students will learn to design, implement, and manage non-relational databases, using technologies like MongoDB.		
Course Outcomes: On completion of the course, students will be able to:		

COs	**Course outcomes**	**RBT**
CO1	Illustrate fundamental concepts of NoSQL databases and their differences from traditional relational databases, highlighting advantages like scalability and flexibility.	L2
CO2	Explain the architecture and data models used in MongoDB and other NoSQL databases, including key-value, document, column-family, and graph databases.	L2
CO3	Develop basic CRUD operations and queries using MongoDB, implementing create, read, update, and delete operations in a database.	L3

CO4	Analyse use cases to determine the suitability of NoSQL databases over relational databases for specific scenarios, considering factors like data structure and access patterns.	L4
CO5	Assess the performance and scalability of MongoDB in various application contexts, using metrics and profiling tools to optimise database operations.	L5

Syllabus

Module-1 - 12 hours

Introduction to NoSQL Databases
Overview of NoSQL databases, Types of NoSQL databases: Key-Value, Document, Column-Family, Graph, Comparison with relational databases, Use cases and applications

Module – 2 - 12 hours

MongoDB Basics
Introduction to MongoDB, Installation and setup, MongoDB architecture, Data models: documents, collections, and databases

Module – 3 - 12 hours

CRUD Operations in MongoDB
Creating databases and collections, Inserting, updating, and deleting documents, Querying documents using MongoDB query language, Working with BSON

Module-4 - 12 hours

Indexing and Aggregation
Understanding indexing in MongoDB, Creating and managing indexes, Aggregation framework: pipelines, stages, and operators, Examples of aggregation queries

Module-5 - 12 hours

Advanced MongoDB Features
Data replication and sharding, Transactions in MongoDB, MongoDB Atlas and cloud services, Security and authentication, Performance tuning techniques, Monitoring and profiling MongoDB, Scaling MongoDB applications, Case studies and real-world examples

Textbooks:

- NoSQL with MongoDB in 24 Hours, Sams Teach Yourself; Brad Dayley; Pearson Publication; 2015 edition

Reference Books:

- NoSQL: Database for Storage and Retrieval of Data in Cloud; Ganesh Chandra Deka; CRC Press; 2017 edition
- Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems; Martin Kleppmann; Shroff/O'Reilly; 2017 edition

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Full Stack Web Development

Course Code:	**Maximum marks: 100**	
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**
Semester: V		
Prerequisites (if any): Frontend Web Development Advanced		

Introduction:
Full Stack Web Development is a course designed to teach students how to build dynamic web applications using the MERN stack (MongoDB, Express, React, and Node.js). The course covers both backend and database development, as well as front-end technologies like HTML, CSS, and JavaScript. By the end of the course, students will have built their own unique full stack application, which they can showcase in their portfolio.

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

COs	Course outcomes	RBT
CO1	Illustrate architecture and components of a full stack web application, including front-end and back-end technologies and their interactions.	L2
CO2	Design a database schema using MongoDB, including defining data models, creating indexes, and writing queries.	L6
CO3	Create RESTful APIs using Node.js and Express, including handling HTTP requests and responses, and interacting with the database.	L6
CO4	Build front-end user interfaces using React, including using React components, managing state, and handling user input.	L6
CO5	Design a unique full stack application as a capstone project, including identifying user requirements, developing a software design, and implementing and testing the application.	L6

Syllabus

Module-1 - 12 hours

Introduction to Full Stack Web Development

Overview of full stack web development, the MERN stack and its components, setting up the development environment (using tools like Node.js, MongoDB, and VSCode), basic backend development concepts (e.g., routing, handling requests, working with databases)

Module – 2 - 12 hours

Backend Development and Databases

Designing and implementing a database schema using MongoDB, writing basic queries and data manipulation commands, creating a RESTful API using Node.js and Express, handling HTTP requests and responses, interacting with the database using Mongoose

Module – 3 - 12 hours

Front-end Development with React

Overview of React and its components, creating and managing React components, working with state and props, handling user input and events, styling with CSS and Bootstrap

Module-4 - 12 hours

Software Engineering and Project Management

Introduction to Software Engineering and SDLC, Agile and Scrum methodologies, software project management tools (like JIRA/ Trello/ GitHub), version control with Git

Module-5 - 12 hours

Integrating Front-end and Back-end Components

Asynchronous communication between front-end and back-end, handling errors and exceptions, using middleware to process requests, authentication and authorization with JWT, Design and development of a unique full stack application, identifying user requirements and developing a software design, implementing and testing the application, deployment on cloud platforms like AWS, Heroku or Netlify

Textbooks:

- 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:

- Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App; Greg Lim
- Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Vasan Subramanian; Apress; 2nd edition

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Communication Skills

Course Code:	**Maximum marks: 100**	
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**
Semester: V		
Prerequisites (if any): English LSRW		

Introduction:

This course focuses on enhancing spoken English skills, particularly for interviews and group discussions (GDs). Students will engage in activities and exercises designed to improve their fluency, pronunciation, and confidence in speaking English. The course covers key aspects such

as body language, articulation, and effective communication strategies, preparing students for professional and academic interactions.

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

COs	Course outcomes	RBT
CO1	Explain key components of effective spoken English, such as proper pronunciation, clear articulation, and appropriate use of body language.	L2
CO2	Illustrate strategies for improving pronunciation and fluency, including exercises like tongue twisters, pronunciation drills, and listening and repeating activities.	L2
CO3	Explain techniques for successful interviews and group discussions, such as preparing responses to common interview questions and understanding group dynamics.	L2
CO4	Apply communication skills in mock interviews and group discussions, practising strategies for engaging effectively and handling conflicts.	L3
CO5	Analyse own spoken English performance for identifying areas for improvement, using feedback from instructors and peers to enhance own speaking skills.	L4
CO6	Demonstrate confidence and proficiency in spoken English during professional interactions, showcasing improved fluency and communication abilities in simulated real-world scenarios.	L3

Syllabus

Module-1 - 12 hours

Fundamentals of Spoken English

Introduction to spoken English, Importance of pronunciation and fluency, Exercises to improve articulation, Role of body language in communication

Module – 2 - 12 hours

Techniques for Improving Fluency

Practising tongue twisters and pronunciation drills, Role-playing and simulations, Listening and repeating exercises, Engaging in small talk and conversations

Module – 3 - 12 hours

Interview Skills

Types of interviews, Preparing for an interview, Common interview questions and responses, Mock interview sessions with feedback

Module-4 - 12 hours

Group Discussion Techniques

Understanding group dynamics, Strategies for effective participation, Handling conflicts and disagreements, Mock group discussion sessions

Module-5 - 12 hours

Advanced Communication Strategies

Non-verbal communication, Building persuasive arguments, Effective listening skills, Giving and receiving constructive feedback, Final presentations and evaluations

Textbooks:

- “English for Interviews: Tips & Techniques" by Ethan Jacob, Cambridge University Press, 2019.
- "Speak English Like a Star: An Advanced Guide to Fluency" by John M. Stevens, Oxford University Press, 2018.

Reference Books:

- "The Art of Public Speaking" by Dale Carnegie, Simon & Schuster, Updated Edition, 2019.
- "Communicate with Confidence!" by Dianna Booher, McGraw-Hill Education, 2012.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Semester 6

Design and Analysis of Algorithms

Course Code:	**Maximum marks: 100**	
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VI

Prerequisites (if any): Data Structures and Algorithms - 2

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

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

COs	Course outcomes	RBT
CO1	Apply algorithmic problem-solving techniques using a variety of algorithm design methods.	L3
CO2	Analyse time and space complexity of algorithms and compare the efficiency of different algorithms for the same problem.	L4
CO3	Select appropriate data structures to optimise algorithms for specific problems.	L3
CO4	Demonstrate understanding of classical algorithmic techniques such as Dynamic Programming, Recursion and Greedy Algorithm.	L2
CO5	Evaluate quality of algorithmic solutions that are implemented to solve real-world problems.	L5
CO6	Estimate limitations and challenges of algorithms in various contexts and assess the implications of algorithm design.	L5

Syllabus

Module-1 - 15 hours

Fundamentals of Algorithms and mathematics
Problem, algorithm definitions, Mathematics for algorithmic sets, Functions and relations, Combinations, Vectors and matrices, Linear inequalities and linear equations

Module – 2 - 15 hours

Analysis of Algorithms
Orders of Magnitude (Asymptotic notations) Growth rates, some common bounds (constant, logarithmic, linear, polynomial, exponential) Average and worst case analysis
Analysing control statements Recurrence Relations- substitution, change of variables, master's method

Module – 3 - 15 hours

Sorting and searching algorithms
Selection sort, bubble sort, insertion sort Sorting in linear time, count sort Linear search

Module-4 - 15 hours

Divide and conquer algorithms
Quick sort, worst and average case complexity, Merge sort Matrix multiplication, Binary search, Binary search tree

Module-5 - 15 hours

Greedy algorithms and String matching

General characteristics, Problem solving using Greedy methods, Activity selection problem, MST, The Knapskack problem, The naive string matching algorithm, The Rabin-Karp algorithm, String Matching with infinite automata

Textbooks:

- Design And Analysis Of Algorithms; S Sridhar; Oxford University Press; 2014 edition

Reference Books:

- "The Design of Approximation Algorithms" by David P. Williamson and David B. Shmoys (Cambridge University Press, 2010)
- "Computational Complexity: A Modern Approach" by Sanjeev Arora and Boaz Barak (Cambridge University Press, 2009)

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

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Computer Networks

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: VI		

Prerequisites (if any): Operating Systems

Introduction:

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.

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

COs	Course outcomes	RBT
CO1	Infer different components and layers of a computer network.	L2
CO2	Explain functions of different protocols used in computer networks.	L2
CO3	Analyse performance and limitations of different network architectures.	L4
CO4	Implement basic network configurations using routers and switches.	L4
CO5	Troubleshoot common network issues with the function of various network analysis tools	L4
CO6	Appraise solutions to ensure network security post evaluation of security concerns.	L5

Syllabus

Module-1 - 15 hours

Introduction to Computer Networks

Overview of computer networks, Network types (LAN, WAN, MAN, PAN), Network topologies, Network models (OSI, TCP/IP), Basics of data communication, Transmission media

Module – 2 - 15 hours

Physical and Data Link Layers

Functions of the physical layer, Network devices (hubs, switches, routers), Data link layer protocols (Ethernet, PPP), Error detection and correction, Flow control and error control techniques, MAC addressing and ARP

Module – 3 - 15 hours

Network Layer

Functions of the network layer, IP addressing and subnetting, Routing principles and algorithms, Routing protocols (RIP, OSPF, BGP), Network layer devices, ICMP and error reporting

Module 4 - 15 hours

Transport Layer

Functions of the transport layer, Transport layer protocols (TCP, UDP), Connection establishment and termination, Flow control and congestion control, Quality of Service (QoS)

Module 5 - 15 hours

Application Layer

Overview of application layer protocols, HTTP, FTP, SMTP, DNS, DHCP, SNMP, Network security basics (encryption, authentication, firewalls), Introduction to network management

Textbooks:

- A S Tanenbaum, Computer Networks, 5th Ed., Pearson, 2010.
- B.A. Forouzan, TCP/IP Protocol Suite, 4th Ed., TMH, 2010.

Reference Books:

- TCP/IP illustrated, Volume 1: The Protocols, W.R. Stevens, 2nd Ed., Addison-Wesley, 2015.
- Internetworking with TCP/IP Principles, Protocols and Architecture, D E. Comer, 6th Ed., Pearson, 2013.

Course Assessment:

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SEE- Semester End Exam

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Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

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Compiler Design

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VI

Prerequisites (if any): Formal Language and Automata Theory

Introduction:
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.

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

COs	Course outcomes	RBT
CO1	Apply principles of formal language and automata theory in building compilers for programming languages.	L3
CO2	Implement the lexical analyser and parser for a programming language	L3
CO3	Develop intermediate code from source code using different techniques.	L3
CO4	Optimize code generation using various optimization techniques.	L4
CO5	Implement error handling and debugging mechanisms in a compiler.	L3
CO6	Compare different compiler design and optimisation techniques to evaluate their effectiveness in improving code performance and efficiency.	L5

Syllabus

Module-1 - 15 hours

Introduction and Directed Translator
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

Module – 2 - 15 hours

Lexical Analysis
The role of lexical Analyser, Input buffering, Tokens, Lexical-Analyser generator, Finite Automata, Design of a lexical-Analyser generator

Module – 3 - 15 hours

Syntax Analysis
The role of parser, Context-free grammar, Writing a grammar, Top-down parsing, Bottom-up parsing, LR parsing, Parser generators

Module-4 - 15 hours

Syntax-directed Translation and Intermediate Code Generation
Evaluation order for SDDs, Applications, Schemes, Implementing L-attributed SDDs, Variations of syntax trees, Three address code, Types and declaration, Translation of expressions, Type checking, Control flow, Backpatching, Switch statements

Module-5 - 15 hours

Run-time Environments

Issues in the design of a code generator, The target language, Addresses in the target code, Basic blocks and flow graphs, Optimization of basic blocks, A simple code generator, Peephole optimization, Dynamic Programming code-generation

Textbooks:

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

Reference Books:

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

Course Assessment:

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Principles of Virtualisation

Course Code:		**Maximum marks: 100**
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**

Semester: VI

Prerequisites (if any): Operating Systems

Introduction:

This course provides an in-depth understanding of virtualisation technologies and their applications. Students will learn about the concepts, architectures, and benefits of virtualisation, including server, storage, and network virtualisation. The course covers virtual machines, hypervisors, and containerization, as well as the impact of virtualisation on cloud computing and data centres.

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

COs	Course outcomes	RBT
CO1	Outline key concepts and components of virtualisation.	L2
CO2	Demonstrate architecture and functionalities of virtual machines and hypervisors.	L2
CO3	Explain benefits and challenges of server, storage, and network virtualisation.	L2
CO4	Apply virtualisation techniques to optimise computing resources.	L3
CO5	Analyse the impact of virtualisation on cloud computing and data centre management	L4
CO6	Implement virtualisation solutions using industry-standard tools such as VMware vSphere, Microsoft Hyper-V and Oracle VirtualBox.	L3

Syllabus

Module-1 - 18 hours

Introduction to virtualisation

Definition and history, Types of virtualisation, Benefits and challenges, virtualisation use cases.

Module – 2 - 18 hours

Virtual Machines and Hypervisors

Virtual machine architecture, Types of hypervisors, Hypervisor functionalities, Comparison of hypervisors (VMware, Hyper-V, KVM)

Module – 3 - 18 hours

Server, Storage, and Network virtualisation

Server virtualisation concepts, Storage virtualisation techniques, Network virtualisation and software-defined networking (SDN), virtualisation best practices.

Module-4 - 18 hours

Containerization and Orchestration

Introduction to containers, Docker and Kubernetes, Container orchestration, Comparing containers and virtual machines.

Module-5 - 18 hours

Virtualisation in Cloud Computing and Data Centers

Principles of Virtualisation

Course Code:		Maximum marks: 100
L-P-E: 2-4-0	**Total Credits: 4**	**Total Contact Hours: 90**

Role of virtualisation in cloud computing, Virtual data centres, Resource management and allocation, Future trends and advancements in virtualisation.

Textbooks:

- "Virtualisation Essentials" by Matthew Portnoy, Wiley, 2nd Edition, 2016.
- "Mastering VMware vSphere 6.7" by Nick Marshall, Scott Lowe, and Matt Liebowitz, Sybex, 2nd Edition, 2018.

Reference Books:

- "The VMware Virtual Machine Manager" by Scott Herold and Ron Oglesby, Prentice Hall, 2008.
- "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Prentice Hall, 2013.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

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Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Programming in Java

Course Code:		**Maximum marks: 100**
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**

Semester: VI

Prerequisites (if any): Problem Solving using Programming - 1

Introduction:
This course introduces the fundamental concepts and techniques of programming using Java. Students will learn the basics of Java syntax, object-oriented programming, and software development principles. The course covers topics such as data types, control structures, classes, objects, inheritance, and exception handling. By the end of the course, students will be able to develop simple Java applications and understand the principles of robust software design.

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

COs	Course outcomes	RBT
CO1	Explain use of primitive data types, variables, and control structures in Java programming for effective problem-solving.	L2
CO2	Explain principles of object-oriented programming in Java.	L2
CO3	Demonstrate the use of control structures and data types in Java.	L2
CO4	Analyse the use of arrays and collections in Java to handle and manipulate data efficiently.	L4
CO5	Evaluate different exception handling mechanisms and file I/O operations in Java to ensure robust and error-free code execution.	L5
CO6	Implement object-oriented programming concepts such as classes, objects, inheritance, and polymorphism to develop modular and reusable Java applications.	L3

Syllabus

Module-1 - 12 hours

Introduction to Java Programming
Java overview, Installation and setup, Basic syntax and structure, Writing and running Java programs

Module – 2 - 12 hours

Data Types and Control Structures
Primitive data types, Variables and constants, Operators and expressions, Conditional statements, Loops (for, while, do-while)

Module – 3 - 12 hours

Object-Oriented Programming
Classes and objects, Methods and constructors, Inheritance and polymorphism, Encapsulation and abstraction

Module-4 - 12 hours

Arrays and Collections

One-dimensional and multi-dimensional arrays, ArrayList and LinkedList, Iterators and for-each loops, Collections framework

Module-5 - 12 hours

Exception Handling and File I/O

Exception hierarchy, Try-catch-finally blocks, Custom exceptions, File reading and writing, BufferedReader and BufferedWriter

Textbooks:

- "Java: The Complete Reference" by Herbert Schildt, McGraw-Hill Education, 11th Edition, 2018.
- "Head First Java" by Kathy Sierra and Bert Bates, O'Reilly Media, 2nd Edition, 2005.

Reference Books:

- "Effective Java" by Joshua Bloch, Addison-Wesley, 3rd Edition, 2017.
- "Core Java Volume I--Fundamentals" by Cay S. Horstmann, Pearson, 11th Edition, 2018

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Employability Readiness Program -1

Course Code:		**Maximum Marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VI

Prerequisites (if any): Communication Skill, Coding and Computational Thinking

Introduction:

This course is designed to prepare students for the initial stages of tech company recruitment processes. It focuses on developing the skills necessary to excel in aptitude tests, coding tests, and coding interviews. The course covers quantitative, logical, and verbal reasoning, as well as programming fundamentals and problem-solving techniques. Additionally, students will learn strategies to approach coding interviews effectively.

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

COs	Course outcomes	RBT
CO1	Define key concepts in quantitative, logical, and verbal reasoning.	L1
CO2	Illustrate fundamental programming concepts and problem-solving techniques.	L2
CO3	Apply reasoning skills to solve aptitude test questions accurately.	L3
CO4	Develop solutions to coding problems using appropriate programming techniques.	L3
CO5	Analyse different types of coding interview questions and devise strategies to solve them.	L4
CO6	Develop confidence in taking aptitude and coding tests.	L3

Syllabus

Module-1 - 15 hours

Quantitative Aptitude

Arithmetic (percentages, ratios, proportions), Algebra (equations, inequalities), Geometry (angles, shapes, areas), Data interpretation and analysis

Module – 2 - 15 hours

Logical Reasoning

Patterns and sequences, Puzzles and games, Syllogisms, Critical reasoning

Module – 3 - 15 hours

Verbal Reasoning

Reading comprehension, Grammar and vocabulary, Sentence correction, Verbal analogies

Module-4 - 15 hours

Fundamentals of Programming

Basic programming constructs (variables, data types, control structures), Problem-solving techniques, Introduction to algorithms and data structures

Module-5 - 15 hours

Coding Test Practice
Practice problems on arrays, strings, linked lists, stacks, and queues, Implementing sorting and searching algorithms, Solving coding challenges on online platforms

Text book(s)

- "Cracking the Coding Interview: 189 Programming Questions and Solutions" by Gayle Laakmann McDowell, CareerCup, 6th Edition, 2015.
- "Aptitude Test Workbook: Improve Your Numerical and Verbal Reasoning Skills" by Jim Barrett, Kogan Page, 5th Edition, 2012.

Reference book(s)

- "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press, 3rd Edition, 2009.
- "How to Prepare for Quantitative Aptitude for the CAT" by Arun Sharma, McGraw Hill Education, 9th Edition, 2021.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Semester 7

Systems Design

Course Code:		**Maximum Marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: VII		
Prerequisites (if any): Computer Organization and Architecture		

Introduction:
This course explores the principles and methodologies of designing complex systems, both software and hardware. Students will learn about axiomatic design, information content, robustness, and ways to reduce complexity in engineered systems. Through case studies and real-world projects, students will gain hands-on experience and develop the ability to create robust and efficient designs.

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

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts of axiomatic design, onnection pools, caching issues at scale, and different communication paradigms.	L2
CO2	Describe the trade-offs between SQL and NoSQL databases and the principles of scaling relational databases.	L2
CO3	Apply design principles to create and manage load balancers and implement remote and distributed locks in distributed systems.	L3
CO4	Examine the effectiveness of different storage solutions, including single-node and distributed caches, and design a word dictionary without using a database.	L4
CO5	Implement social network systems by designing scalable solutions for photo uploads, private photos, and dynamic content generation.	L3
CO6	Evaluate various distributed system designs and storage solutions to determine their scalability, efficiency, and suitability for different real-world applications.	L5

Syllabus

Module-1 - 15 hours

Foundation
Introduction to Axiomatic Design, Designing Online/Offline indicator, Connection pool and its internals, Caching issues at scale and solutions, Async processing, Delegation, Kafka Essentials, Different Communication Paradigms

Module – 2 - 15 hours
Databases Understanding Databases, Pessimistic Locking on Relational DBs, Designing and Scaling SQL-backed KV Store, How to scale relational databases, NoSQL Database Trade-offs, Designing Slack's Real Time Text Communication, Scaling Websockets
Module – 3 - 15 hours
Going Distributed Distributed Systems, Designing Load Balancers, Scaling Load Balancers, Implementing Remote and Distributed Locks, Distributed ID Generators
Module-4 - 15 hours
Building Social Networks Social Network Systems, Designing and implementing Photos Upload at scale, Implementing Private Photos for Instagram, Designing Gravatar and Dynamic OG Images, Designing Concurrent HashTag Counter, Designing Message Indicators
Module-5 - 15 hours
Building Storages Storage Systems, Implementing Single-node Cache like Redis, Designing Distributed Caches, Designing a Word Dictionary without a DB, Designing Log-Structured KV Store

Text book(s)

- "Axiomatic Design: Advances and Applications" by Nam P. Suh, Oxford University Press, 2001.
- "Complexity: Theory and Applications" by Nam P. Suh, Oxford University Press, 2005.

Reference book(s)

- "Engineering Design: A Systematic Approach" by Gerhard Pahl and Wolfgang Beitz, Springer, 3rd Edition, 2007.
- "Design Structure Matrix Methods and Applications" by Steven D. Eppinger and Tyson R. Browning, MIT Press, 2012.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Programming with Prompt Engineering

Course Code:	**Maximum Marks: 100**	
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VII

Prerequisites (if any): Problem Solving using Programming - 1

Introduction:
This course introduces the concepts and techniques of prompt engineering, which is crucial for developing and fine-tuning language models and AI systems. Students will learn how to create effective prompts to guide AI behaviour, optimise performance, and achieve desired outputs. The course covers various programming languages and tools, with a focus on practical applications in real-world scenarios.

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

COs	Course outcomes	RBT
CO1	Identify fundamental principles of prompt engineering and its applications.	L3
CO2	Describe techniques for creating effective and efficient prompts avoiding AI hallucinations.	L2
CO3	Explain the impact of prompt design on AI performance and outputs.	L2
CO4	Apply prompt engineering techniques to optimise AI systems and integrate with AI Platforms.	L3
CO5	Analyse case studies and real-world examples to understand the practical applications of prompt engineering.	L4
CO6	Develop innovative solutions using prompt engineering in various AI projects.	L3

Syllabus

Module-1 - 15 hours

Introduction to Prompt Engineering
Fundamentals of prompt engineering, Importance of prompts in AI, Basic principles and best practices, Introduction to common prompting techniques

Module – 2 - 15 hours

Designing Effective Prompts
Techniques for creating effective prompts, Zero-shot prompting, Few-shot prompting, Chain-of-thought prompting, Strategies for avoiding AI hallucinations, Examples and case studies

Module – 3 - 15 hours
Tools and Languages for Prompt Engineering Overview of programming languages and tools, Implementing prompts in Python, JavaScript, and other languages, Integration with AI platforms, Using libraries and frameworks
Module-4 - 15 hours
Practical Applications and Optimization Real-world applications of prompt engineering, Techniques for optimising AI performance (e.g., temperature settings, prompt tuning), Case studies on successful implementations, Debugging and refining prompts
Module-5 - 15 hours
Advanced Topics and Future Trends Advanced prompt engineering techniques (e.g., dynamic prompting, contextual prompting), Future trends in AI and prompt engineering, Ethical considerations and best practices, Handling bias and fairness in prompts

Text book(s)

- Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs (Grayscale Indian Edition), James Phoenix , Mike Taylor, Shroff/O'Reilly Media, 2024

Reference book(s)

- The Art of Prompt Engineering with ChatGPT: A Hands-On Guide - Learn AI Tools the Fun Way! (Grayscale Indian Edition), Nathan Hunter, Shroff/Hunter, 2023

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Low-Code and No-Code Scripting

Course Code:		**Maximum Marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VII

Prerequisites (if any): Problem Solving using Programming - 1

Introduction:
This course introduces the concepts and practical applications of low code and no code development platforms. Students will learn how to leverage these tools to create applications, automate workflows, and solve business problems without extensive programming knowledge. The course covers various platforms, design principles, and best practices, emphasising real-world applications and hands-on projects.

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

COs	Course outcomes	RBT
CO1	Illustrate understanding of the fundamentals, key benefits, and limitations of low-code and no-code development platforms.	L3
CO2	Create automated workflows using no-code tools like Zapier and Microsoft Power Automate, integrating third-party services for enhanced functionality.	L3
CO3	Build basic applications using low-code platforms by leveraging drag-and-drop interfaces and data integration techniques.	L3
CO4	Describe the interfaces and functionalities of popular low-code platforms such as Appian, OutSystems, and Microsoft Power Apps.	L2
CO5	Evaluate real-world case studies and projects to assess the impact and success of low-code and no-	L5
CO6	Analyse the effectiveness of advanced customization techniques, including the use of pre-built templates, components, and custom scripts, to develop scalable and maintainable low-code and no-code solutions.	L4

Syllabus

Module-1 - 15 hours

Introduction to Low Code and No Code Development

Fundamentals of low code and no code development, Key benefits and limitations, Overview of popular platforms (e.g., Appian, OutSystems, Microsoft Power Apps)
Module – 2 - 15 hours
Designing Applications with Low Code Tools Introduction to platform interfaces, Drag-and-drop interface design, Data integration and management, Creating basic applications using low code platforms
Module – 3 - 15 hours
Automating Workflows with No Code Tools Workflow automation principles, Building automated workflows with tools like Zapier and Microsoft Power Automate, Integrating third-party services (e.g., Slack, Google Sheets), Monitoring and managing workflows
Module-4 - 15 hours
Advanced Features and Customization Advanced customization techniques, Using pre-built templates and components, Scripting for advanced functionality (e.g., custom scripts in Appian or Power Apps), Best practices for scalable and maintainable solutions
Module-5 - 15 hours
Practical Projects and Case Studies Real-world use cases, Project-based learning, Case studies on successful low code and no code implementations (e.g., automating business processes, developing customer service applications), Group projects and presentations

Text book(s)

- Low-Code Application Development with Appian, Stefan Helzle, Packt Publishing, 2022
- Low Code Development Platforms; Gerardus Blokdyk; Publisher: 5STARCooks, 13th Oct,2020

Reference book(s)

- Workflow automation with Microsoft PowerAutomate; Aaron Guilmette; Publication: Packt Publishing; 19 Aug,2022
- Building Low Code Application with Mendix; Micah McMullen & Bryan Kenneweg; Publisher: Packt Publishing; 26 Feb,2021.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Advance Programming in Java

Course Code:		**Maximum Marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: VII		

Prerequisites (if any): Programming in Java

Introduction:
This course delves into advanced topics and techniques in Java programming. Students will explore more complex aspects of the language, including object-oriented programming (OOP), design patterns, JDBC, Servlets, and JSP. The course also covers Java's standard libraries, frameworks, and tools for building robust and efficient applications.

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

COs	Course outcomes	RBT
CO1	Identify advanced features and libraries in Java.	L3
CO2	Illustrate principles and techniques of multithreaded programming.	L2
CO3	Explain the use of advanced data structures and algorithms in Java.	L2
CO4	Apply JDBC for database connectivity and management for applications developed in Java.	L3
CO5	Analyse Java applications for performance optimisation and best practices	L4
CO6	Develop web applications using Servlets and JSP	L3

Syllabus

Module-1 - 15 hours

Object-Oriented Programming (OOP)
OOP concepts, Polymorphism, Inheritance, Abstraction, Encapsulation, Interfaces and abstract classes

Module – 2 - 15 hours

Design Patterns
Introduction to design patterns, Creational patterns (Singleton, Factory), Structural patterns (Adapter, Composite), Behavioural patterns (Observer, Strategy), Best practices in using design patterns

Module – 3 - 15 hours

JDBC and Database Connectivity
Introduction to JDBC, Connecting to a database, Executing SQL queries, Handling results, Transactions and batch processing

Module-4 - 15 hours

Servlets and JSP
Introduction to Servlets, Servlet lifecycle, Handling requests and responses, Session management, JSP basics, JSP tags and expression language

Module-5 - 15 hours

Advanced Java Concepts and Tools
Generics and collections, Lambda expressions and functional interfaces, Streams and parallel streams, Java 8 and beyond features, Performance optimization, Testing and debugging tools (JUnit, Mockito)

Textbooks:

- "Effective Java" by Joshua Bloch, Addison-Wesley, 3rd Edition, 2017.
- "Java Servlet & JSP Cookbook" by Bruce W. Perry, O'Reilly Media, 1st Edition, 2004

Reference Books:

- "Head First Design Patterns" by Eric Freeman, Bert Bates, Kathy Sierra, and Elisabeth Robson, O'Reilly Media, 1st Edition, 2004.
- "Spring in Action" by Craig Walls, Manning Publications, 5th Edition, 2018.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

DevOps

Course Code:	**Maximum marks: 100**	
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: VII		
Prerequisites (if any): Back-end Web Development		

Introduction:
This course provides a comprehensive understanding of DevOps principles and practices, focusing on the integration and automation of software development and IT operations. Students will learn about continuous integration, continuous delivery, infrastructure as code, monitoring, and security in a DevOps environment.

Course Outcomes: On completion of the course, student will be able to:

COs	Course outcomes	RBT
CO1	Identify key principles and benefits of DevOps.	L2
CO2	Illustrate the components and workflows of a DevOps pipeline.	L2
CO3	Explain techniques for continuous integration and continuous delivery.	L2
CO4	Apply DevOps tools to automate infrastructure and deployment processes.	L3
CO5	Examine the impact of DevOps practices on software development and operations.	L4
CO6	Create a DevOps pipeline for a software project.	L6

Syllabus

Module-1 - 15 hours

Introduction to DevOps
Overview of DevOps, Principles and benefits of DevOps, DevOps culture and collaboration, Key practices and tools

Module – 2 - 15 hours

Continuous Integration (CI)

Fundamentals of CI, Setting up a CI environment, Tools for CI (e.g., Jenkins, Travis CI), Writing and running tests, Integrating with version control systems

Module – 3 - 15 hours

Continuous Delivery (CD)

Principles of CD, Automating the release process, Tools for CD (e.g., Jenkins, CircleCI), Deployment strategies (blue-green, canary, rolling), Monitoring and rollback

Module-4 - 15 hours

Infrastructure as Code (IaC)

Concepts of IaC, Tools for IaC (e.g., Terraform, Ansible, Puppet), Writing and managing infrastructure code, Automated provisioning and configuration management

Module-5 - 15 hours

Monitoring, Logging, and Security

Monitoring and logging practices, Tools for monitoring and logging (e.g., Prometheus, ELK Stack), Security in a DevOps environment, Continuous security testing, Incident response and management

Textbooks:

- "The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations" by Gene Kim, Patrick Debois, John Willis, and Jez Humble, IT Revolution Press, 2nd Edition, 2021.
- "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley, Addison-Wesley, 1st Edition, 2010.

Reference Books:

- "Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale" by Jennifer Davis and Katherine Daniels, O'Reilly Media, 1st Edition, 2016.
- "Learning DevOps: Continuously Deliver Better Software" by Mikael Krief, Packt Publishing, 2nd Edition, 2022.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Employability Readiness Program - 2

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**

Semester: VII

Prerequisites (if any): Employability Readiness Program - 1

Introduction:
This advanced course is designed to prepare students for the later stages of tech company recruitment processes, focusing on behavioural interviews, project interviews, and technical concepts interviews. The course covers techniques for effective communication, presentation, and professional demeanour. Students will also learn to articulate their project experiences and understand key technical concepts relevant to interviews.

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

COs	Course outcomes	RBT
CO1	Infer key behavioural interview questions and appropriate responses, such as using the STAR method to structure answers.	L2
CO2	Explain own project experiences and technical contributions clearly.	L2
CO3	Apply communication strategies to present effectively in interviews, including techniques for clear articulation and professional demeanour.	L3
CO4	Examine common technical interview questions and formulate clear and concise answers, addressing concepts like data structures and algorithms.	L4
CO5	Develop confidence in discussing technical skills and project experiences, showcasing expertise and problem-solving abilities.	L3
CO6	Evaluate own performance and identify areas for improvement in professional interactions.	L5

Syllabus

Module-1 - 15 hours
Behavioral Interview Preparation Common behavioural interview questions, STAR method (Situation, Task, Action, Result), Effective storytelling, Professional demeanour and body language
Module – 2 - 15 hours
Project Interview Techniques Articulating project experiences, Highlighting technical contributions, Discussing challenges and solutions, Preparing project presentations
Module – 3 - 15 hours
Technical Concepts Review Key technical concepts (data structures, algorithms, system design), Understanding technical questions, Formulating clear and concise answers, Explaining technical decisions
Module-4 - 15 hours
Mock Interviews and Feedback Simulated behavioural interviews, Simulated project interviews, Individual feedback and improvement plans, Peer reviews and group discussions
Module-5 - 15 hours
Advanced Communication Strategies Advanced presentation skills, Handling difficult questions, Building rapport with interviewers, Continuous improvement and self-assessment

Textbooks:

- "The Complete Software Developer's Career Guide" by John Sonmez, Simple Programmer LLC, 2017.
- "Behavioral Interview Questions and Answers: How to Face the Behavioral Interview with Confidence" by Richard Connors, 2016.

Reference Books:

- "System Design Interview – An Insider's Guide" by Alex Xu, Independently published, 2020.
- "The Art of Communicating" by Thich Nhat Hanh, HarperOne, 2013.

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

Semester 8

Software Testing

Course Code:		**Maximum marks: 100**
L-P-E: 2-2-0	**Total Credits: 3**	**Total Contact Hours: 60**
Semester: VIII		
Prerequisites (if any): Problem Solving using Programming - 2, Full Stack Web Development		

Introduction:
The Software Testing course provides a comprehensive overview of the principles, techniques, and tools used in ensuring software quality. It covers various testing methodologies, test planning, and test case design, preparing students to effectively detect and manage software defects in diverse applications.

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

COs	Course outcomes	RBT
CO1	Explain the fundamental concepts of software testing, including its importance in ensuring software quality, the different types of testing (manual and automated), and the various stages of the testing life cycle	L2
CO2	Utilize various black-box testing techniques such as equivalence partitioning and boundary value analysis, as well as white-box testing techniques like statement coverage, decision coverage, and path coverage to design comprehensive and effective test cases.	L3
CO3	Examine software requirements and specifications to identify and define relevant test scenarios.	L4

CO4	Develop detailed test plans that outline the scope, approach, resources, and schedule of testing activities.	L6
CO5	Formulate test cases using testing tools and frameworks such as Selenium, JUnit and TestNG.	L6

Syllabus

Module-1 - 12 hours

Introduction to Software Testing
Importance of software testing, software quality, types of testing (manual and automated), testing life cycle, test levels (unit, integration, system, acceptance).

Module – 2 - 12 hours

Test Case Design Techniques
Black-box testing techniques (equivalence partitioning, boundary value analysis), white-box testing techniques (statement coverage, decision coverage, path coverage), test data generation.

Module – 3 - 12 hours

Testing Strategies and Methodologies
Static and dynamic testing, functional and non-functional testing, regression testing, exploratory testing, agile testing, test-driven development (TDD), behaviour-driven development (BDD).

Module-4 - 12 hours

Test Management and Automation:
Test planning, test estimation, test metrics and measurements, defect management, introduction to test automation, selecting test tools, frameworks, and scripting.

Module-5 - 12 hours

Advanced Topics in Testing
Performance testing, security testing, usability testing, testing web applications and mobile applications, continuous integration and continuous testing, emerging trends in software testing.

Textbooks:

- Software Testing: Principles and Practices; Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, 1st Edition, 24 September 2005.
- Foundations of Software Testing: ISTQB Certification; Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black; Cengage Learning India Pvt. Ltd, 4th Edition, 1 October 2020.

Reference Books:

- Software Testing and Quality Assurance: Theory and Practice; Kshirasagar Naik, Priyadarshi Tripathy; Wiley-Spektrum, 1st Edition, 12 September 2008.
- The Art of Software Testing; Glenford J. Myers, Corey Sandler, Tom Badgett; John Wiley & Sons; 3rd Edition, 16 December 2011.

Course Assessment:
There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.

AI and ML Foundations

Course Code:		**Maximum marks: 100**
L-P-E: 3-2-0	**Total Credits: 4**	**Total Contact Hours: 75**
Semester: VIII		
Prerequisites (if any): Data Structures and Algorithms - 1		

Introduction:
This course introduces the foundational concepts of artificial intelligence (AI) and machine learning (ML), providing students with the skills to explore datasets, build models, and evaluate their performance. Students will learn about various machine learning algorithms, data preprocessing techniques, and model evaluation metrics. The course includes a hands-on project where students will explore datasets and build models.

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

COs	Course outcomes	RBT
CO1	Explain the historical context, applications, and types of machine learning, including supervised, unsupervised, and reinforcement learning.	L2
CO2	Apply data cleaning, preprocessing techniques, and feature engineering to prepare datasets for machine learning models.	L3
CO3	Analyse the performance of various supervised learning algorithms such as linear regression, logistic regression, decision trees, random forests, and support vector machines using appropriate evaluation metrics.	L4
CO4	Examine unsupervised learning techniques like K-means clustering, hierarchical clustering, Principal Component Analysis	L4

	(PCA), and association rule learning to uncover patterns and relationships in data.	
CO5	Evaluate the effectiveness of neural networks, including Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), for different types of machine learning tasks.	L5
CO6	Assess the impact of different activation functions, loss functions, and backpropagation methods on the training and performance of neural networks.	L5

Syllabus

Module-1 - 15 hours

Introduction to AI and ML

Overview of AI and ML, Historical context and applications, Types of machine learning (supervised, unsupervised, reinforcement learning), Basic terminology and concepts

Module – 2 - 15 hours

Data Exploration and Preprocessing

Understanding datasets, Data cleaning and preprocessing, Feature engineering and selection, Handling missing data, Data visualisation techniques

Module – 3 - 15 hours

Supervised Learning Algorithms

Linear regression, Logistic regression, Decision trees and random forests, Support vector machines, Evaluation metrics (accuracy, precision, recall, F1 score)

Module-4 - 15 hours

Unsupervised Learning Algorithms

Clustering techniques (K-means, hierarchical clustering), Principal Component Analysis (PCA), Association rule learning, Anomaly detection

Module-5 - 15 hours

Neural Networks and Deep Learning

Introduction to neural networks, Activation functions and loss functions, Training neural networks with backpropagation, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)

Textbooks:

- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems;Aurélien Géron; Shroff/O'Reilly; Third Edition

Reference Books:

- Pattern Recognition and Machine Learning; Christopher M. Bishop; Springer; 2016 edition

Course Assessment:

There shall be two components of grading in the assessment of each course:
CIA- Continuous Internal Assessments
SEE- Semester End Exam

CIA: - The CIA is conducted during the semester at regular intervals. This component

represents the formative assessment of students' learning. At an aggregate, CIA will carry 50 marks, after due scaling. To pass the CIA, a student must score min 40% (in other words, 20 out of 50 in CIA) in the aggregate CIA score. This score of min 40% is also required to become eligible for attending SEE.

Semester-End Examination (SEE): This component represents the summative assessment carried out in the form of an examination conducted at the end of the semester. SEE will carry 50 marks, after due scaling. To pass SEE, a student score min 40% (in other words, 20 out of 50 in SEE).

Marks obtained in CIA and SEE components have equal weightage (CIA: 50 and SEE: 50) in determining the final marks and grades obtained by a student in a Course.