Semester 1

Course Title:	Computational Mathematics – I		
Course Code:	**BMAT1001**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:1:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 15 hours Tutorial	Credits	04

Course objectives:

1. Understand Fundamental Concepts: Students will learn the basic principles of discrete mathematics, including logic, sets, functions, and relations.
2. Apply Concepts to Solve Problems: Students will apply discrete mathematics concepts to solve various problems in computer science.
3. Communicate Mathematical Ideas: Students will develop the ability to clearly and effectively communicate mathematical ideas and solutions, both orally and in writing.

Course outcomes:

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

1. Develop logical reasoning and proof techniques to analyze and construct mathematical arguments using propositional and predicate logic.
2. Apply counting principles, permutations, combinations, and recurrence relations to solve combinatorial problems efficiently.
3. Understand and manipulate sets, relations, and functions, including equivalence relations, partial orders, and function properties.
4. Analyze and implement graph structures, trees, and algorithmic solutions for spanning trees, shortest paths, and graph traversal problems.
5. Utilize probability theory, including Bayesian inference and random walks, to model and analyze uncertain events.
6. Apply mathematical structures and discrete methods to computational problems, ensuring efficiency and correctness in algorithm design.

Module-1:Basic Logic & Proof Techniques

Introduction to Propositional Logic, Truth tables, Introduction to Predicate Logic, Logical Equivalence, Rules of Inference, Limitations of Propositional Logic, Methods of proof, Induction and Strong Induction, Strong induction with multiple base case, Disproof methods, The resolution principle, The proof of theorem, Various disproof methods.

Module-2:Introduction to Counting

Introduction to Counting & Counting Rules, Inclusion-Exclusion Principle, Pigeon hole principle, Book Keeper's rule, Permutations and Combinations, Binomial Theorem, Pascal's identity, Correlation between binomial Theorem and Pascal's Triangle, Sequences & Progression, Introduction to recurrence relations, Homogeneous & Non-homogenous Relations, Solving problems using counting rules.
Module-3: Sets, Relations & Functions
Sets and Relations, Set Theory Basics, Types and Operations on Set: Set cardinality, Cartesian product, Relations and types, properties of relations, Equivalence relations, Partial Orders, Hasse diagram, Equivalence classes, Introduction to functions, Injective, surjective and bijective functions.
Module-4: Introduction to Structures
Introduction to Graphs, Graph terminologies, Types of graphs, Introduction to Trees, Trees and Graphs representation, Degree of a vertex, Paths & cycles in graphs, Traveling Salesman Problem, Connected components in graphs, Graph coloring, Rooted trees & chain letter, Tree traversal,Binary trees & postorder expressions, Asymptotic Notations, Time complexity, Spanning trees, Isomorphism, Minimum Spanning Trees, Prim's and Kruskal's algorithms.
Module-5: Discrete Probability
Introduction to probability, Introduction to events, Dependent & independent events, The Monty Hall problem, Conditional probability, Bayes Theorem, Introduction to expectations & deviations, Variance, Standard deviation, Average vs expected value, Random walks, One-dimensional (1D) vs. Two-dimensional (2D) random walks, Markov chains & random walks, The Gambler's Ruin problem.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Mathematics for Computer Science; Eric Lehman, F Thomson Leighton, Albert R Meyer; 12th Media Services (5 June 2017)

Reference Books

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

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Engineering Physics		
Course Code:	**BPHY1002**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:1:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 15 hours Tutorial	Credits	04

Course objectives:

1. To provide a foundational understanding of key physics principles such as mechanics, electromagnetism, and thermodynamics, and their relevance to technological advancements in fields like semiconductors and optical fibres.
2. To enable students to explore and interpret the interplay between physics and technology, highlighting the societal impacts of innovations and applications in various domains.
3. To equip students with the skills to practically apply physics concepts in computer science through coding exercises and simulations, fostering a deeper comprehension of physical phenomena and their digital representations.

Course outcomes:

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

1. Explain the relationship between science and technology, including its historical development, ethical considerations, and real-world applications in medicine and computer science.
2. Apply fundamental principles of mechanics, electromagnetism, and thermodynamics to analyze physical phenomena and explore their relevance in renewable energy applications.
3. Demonstrate an understanding of the intersection between physics and computer science, including computational physics, quantum computing, and algorithms inspired by physical principles.
4. Analyze the properties of materials, including their mechanical, electrical, thermal, and magnetic characteristics, and explore their applications in modern computing and nanotechnology.
5. Explore emerging technologies such as robotics, automation, nanotechnology, and energy harvesting, and understand the role of physics in sensor technology and optical computing.
6. Utilize simulation and modeling techniques to study physical systems and their applications in computing, artificial intelligence, and smart grid technologies.

Module-1: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, Case studies: Science and technology in Modern medicine, Case studies: Science and Technology in Computer science.

Module-2:Principles of Mechanics and Electromagnetism

Mechanics: Concepts of motion, forces, work, energy, momentum; Electromagnetism: electric fields, magnetic fields, electromagnetic waves, Thermodynamics and laws of heat transfer, Case studies: Physics in renewable energy.

Module-3: Physics and Computer Science

Intersection of Physics and Computer science, Computational Physics, Quantum Computing, Simulation and modeling in Physics and computer science, Case studies: Physics in Artificial Intelligence, Algorithms inspired by Physics.

Module-4: The Physics of Materials

Introduction to materials, Crystalline structures and defects, Mechanical properties of materials, Electrical properties of materials, Thermal properties of materials, Magnetic properties of materials, nanomaterials and their applications, Case studies: Materials in modern computing

Module-5: Emerging technologies and Physics

Introduction to Emerging technologies, Physics in Robotics and Automation, Nanotechnology: Principles and applications, Physics of sensors and actuators, Photonics and optical computing, Energy harvesting and smart grids.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing marks.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

1. Interplanetary flight and communication Vol1- NA Rynin

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/8-012-physics-i-classical-mechanics-fall-2008/
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Problem Solving using Programming		
Course Code:	**BPLC1003**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

1. Introduce students to structured problem-solving methodologies using basic computational thinking.
2. Develop the ability to apply programming logic for decision making, iteration, and data manipulation.
3. Build foundational skills in handling arrays and strings as problem-solving tools in programming.

Course outcomes:

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

1. Apply fundamental problem-solving strategies to formulate algorithmic solutions.
2. Write and trace simple programs involving variables, expressions, and arithmetic operations.
3. Implement control structures such as conditional and switch-case logic to guide program flow.
4. Develop programs using iterative constructs to perform repeated tasks and pattern generation.
5. Manipulate and process data using one-dimensional and two-dimensional arrays.
6. Work with strings using standard functions to perform validation, transformation, and pattern detection.

Module-1:Introduction to Problem Solving

Problem solving fundamentals, algorithmic thinking, pseudocoding, variables and data types, input and output, arithmetic operators, digit extraction and manipulation, area and perimeter calculations, ternary operator usage

Module-2: Control Structures

Conditional statements, character and numeric condition checks, nested decisions, grade computation, value comparisons, switch-case constructs, jump statements, multi-branch decisions

Module-3: Loops

Iteration with for, while, and do-while loops, generating numeric patterns, digit-wise processing, nested loops, series generation, finding factors, loop-based problem solving, pattern printing using loops

Module-4: Arrays

Introduction to arrays, traversing and modifying elements, finding statistics from array data, element swapping, counting conditions in arrays, 2D arrays and matrix input/output, matrix diagonal operations, spiral traversal, triangular matrices
Module-5: Strings
String declaration and manipulation, common string functions, string comparison and concatenation, substring operations, character count and filtering, pattern detection in strings, prefix detection, case analysis, vowel counting

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):
• https://ocw.mit.edu/collections/introductory-programming/ • www.kalvium.community/livebooks
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Quizzes • Assignments • Code-alongs

Course Title:	Basic Electronics		
Course Code:	**BESC1004A**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory	Credits	04

Course objectives:

1. To provide a foundational understanding of basic electronic principles and components, and their applications in computer systems and digital devices.
2. To enable students to analyze and design simple electronic circuits, focusing on real-world applications relevant to computing and technology.
3. To develop practical skills in using electronic tools and components for problem-solving and innovation in the domain of computer science.

Course outcomes:

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

1. Demonstrate an understanding of fundamental electrical concepts, including voltage, current, resistance, and circuit analysis using Ohm's and Kirchhoff's Laws.
2. Explain the working principles of semiconductors and diodes, and apply them in designing and analyzing basic rectifier and power supply circuits.
3. Analyze the characteristics and applications of transistors and amplifiers, including their role in switching circuits and signal amplification.
4. Design and implement digital logic circuits using Boolean algebra, logic gates, flip-flops, and fundamental digital circuit design principles.
5. Develop a foundational understanding of microcontrollers, particularly the 8051 architecture, and apply arithmetic instructions for embedded system applications.
6. Apply circuit theory, semiconductor principles, and digital logic techniques to solve real-world computing and electronics challenges.

Module-1:Basics of Electronics and Circuit Theory

Introduction to Electronics, Need for Electronics for CS Engineers, Current, Voltage, and Resistance, Ohm's Law and Kirchhoff's Laws, Series and Parallel Circuits, Basic Components: Resistors, Capacitors, Inductors, Practical Applications in Computing (e.g., Power Supplies, Filters), Superposition theorem, Mesh Analysis.

Module-2: Semiconductors and Diodes

Introduction to Semiconductors, Types of semiconductors, PN Junction Theory, Types of Diodes: Rectifier, Zener, LED, Diode Characteristics and Applications, Practical Demonstration: Using Diodes in Computer Circuits, Hands-on: Designing a Basic Power Supply Circuit

Module-3: Transistors and Amplifiers

Introduction to Transistors and Amplifiers, Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs), Amplifiers: Types, Gain, and Frequency Response, Application of Transistors in Computing (e.g., Switching Circuits).

Module-4: Digital Electronics and Logic Gates

Introduction to Digital Electronics: Binary System and Logic Levels, Basic Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Boolean Algebra and Simplification Techniques, Building Digital Circuits Using Logic Gates, Application: Designing Half Adders using Nand gates, Flip flops and its types.

Module-5: Integrated Circuits and Microcontrollers

Introduction to Integrated Circuits (ICs), 8051 Microcontroller, Architecture of 8051 Microcontroller, Arithmetic Instructions in 8051 Microcontroller, Applications of 8051 Microcontroller.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

Robert L. Boylestad, Louis Nashelsky; Electronic Devices and Circuit Theory; Pearson, 11th Edition, 2013

Reference Books

Thomas L. Floyd; Electronic Devices; Pearson, 10th Edition, 2018

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Front-end Web Development Fundamentals		
Course Code:	**BETC1005***	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

1. Develop Proficiency in HTML, CSS, and JavaScript: Students will gain a strong understanding of HTML, CSS, and JavaScript and learn to apply these technologies to create interactive and responsive web pages.
2. Design Accessible and User-Friendly Web Pages: Students will learn to design and implement web pages that are accessible, user-friendly, and optimized for search engines.
3. Use Debugging Tools and Techniques: Students will utilize various debugging tools and

techniques to identify and fix errors in web applications.

4. Collaborate Effectively in a Team Environment: Students will develop the ability to work collaboratively and effectively in a team on web development projects.

Course outcomes:

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

1. To develop proficiency in HTML, CSS, and JavaScript, and apply them to the development of interactive and responsive web pages.
2. To design and implement web pages that are accessible, user-friendly, and optimized for search engines.
3. To create and use reusable code components to improve productivity and maintainability.
4. To demonstrate an understanding of the principles of web design and user experience, and apply them to front-end development.
5. To use debugging tools and techniques to identify and fix errors in web applications.
6. To work collaboratively and effectively in a team environment on web development projects.

Module-1:HTML,CSS & JS Part I

Introduction to Front-End Web Development, Development Environment Setup and Installation, Command Line Interface and GitHub Fundamentals, Basics of HTML Structure and Elements, HTML Block and Inline Elements, Forms and Tables in HTML, Styling with CSS Selectors and Properties, CSS Box Model and Positioning, Typography and Layout Techniques, Structuring Static Web Pages, Best Practices in CSS Organization and Styling, Introduction to Blog Development

Module-2: HTML,CSS & JS Part II

JavaScript Fundamentals: Variables, Data Types, and Operators, Functions and Control Structures in JavaScript, Arrays and Object Manipulation, JavaScript Document Object Model (DOM) Interactions, CSS Flexbox and Grid for Responsive Layouts, Building Interactive Web Components, Form Validation and User Input Handling, Principles of Responsive Web Design, Implementing Advanced UI Elements, Introduction to Product Listing and Dynamic Page Design

Module-3: HTML, CSS & JS Deep Dive

JavaScript Event Handling and Interactive Elements, Advanced JavaScript Concepts: Objects, Storage, and Asynchronous Programming, Enhancing User Experience with Image Sliders and Modal Popups, Dynamic Navigation Using CSS Flexbox, Hands-On Game Development with JavaScript, Implementing Complex UI Components, Project-Based Learning Through Web Application Development, Creating Interactive Web Pages and Games Using HTML, CSS, and JavaScript

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. 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)

Reference Books

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

Web links and Video Lectures (e-Resources):

- https://www.freecodecamp.org/
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Code-alongs

Course Title:	Innovation and Design Thinking		
Course Code:	**BAEC1006A**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:0:0	Exam Hours	2
Total Hours of Pedagogy	30 hours theory	Credits	01

Course objectives:

1. To enable students to understand and apply the principles of innovation and design thinking in solving complex problems in technology and business.
2. To develop students' ability to use various tools and techniques for rapid prototyping, user-centered design, and collaborative innovation.
3. To equip students with the skills to critically evaluate and create sustainable and impactful business models and technological solutions.

Course outcomes:

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

1. Remember: Describe the fundamental concepts of innovation and different types of innovation.
2. Understand: Explain the stages of design thinking and their significance in technology development.
3. Apply: Use design thinking tools to create a basic prototype for a given problem scenario.
4. Analyze: Compare and contrast different case studies to identify key success factors in innovative projects.
5. Evaluate: Critically assess the effectiveness of a business model or technological solution in terms of innovation and sustainability.
6. Create: Design a comprehensive solution using design thinking principles to address a real-world problem in technology or business.

Module-1: Introduction to Innovation and Design Thinking

Understanding Innovation, Types of Innovation: Incremental, Disruptive, Radical, Role of Innovation in Technology and Business, Basics of Design Thinking, What is Design Thinking, Stages of Design Thinking: Empathize, Define, Ideate, Prototype, Test, Importance of Problem Identification, MVP and Prototyping in Software Development, Introduction to Prototyping Tools (e.g., Figma, Balsamiq), Case Study: Real-World Examples in Tech Startups, Group discussion on learnings from the case studies.

Module-2: Tools for Design Thinking in Digital Spaces

Design Interaction and Analysis, Tools for Collaborative Design (e.g., Miro, Google Jamboard), Real-Time Design Interaction in Agile Development, Empathy in User-Centric Design, Understanding User Personas and Needs, Storyboarding and Journey Mapping in Tech Products, Collaboration in Distributed Design, Managing Virtual Teams and Design Projects, Case Study: Open-Source Software Collaboration, Hands-on Activity: Building a Journey Map for a Software Solution.

Module-3: Design Thinking in Software Development

Design Thinking for IT Projects, Applying Design Thinking to Agile Development, Scenario-Based Prototyping for Software Solutions, Design Thinking in Business Process Modelling, Integrating Design Thinking in Business Process Automation (BPA), Case Study: Design Thinking in Enterprise Software Solutions, Prototyping for Software Development, Rapid Prototyping Techniques in Front-End and Back-End Systems, Introduction to Tools like Figma, ReactJS Prototyping, Group Activity: Creating a Prototype for a Simple App.
Module-4: Innovation for Strategic Solutions
Strategic Foresight and Change in Technology, Predicting Technological Changes and Market Trends, Value Proposition and Redefinition in Tech, Storytelling in Technology, The Role of Storytelling in Tech Branding and User Engagement, Case Study: How Apple and Microsoft use storytelling, Innovation in Business Model Design for Tech Startups, Creating Sustainable Business Models for Tech Products, Design Thinking for Rapid Prototyping and Strategic Planning, Group Project: Design a Business Model for a New Software Product.
Module-5: Design Thinking for Social Impact and Community Development
Designing Solutions for Social Challenges, Principles and Methodologies for Social Design, Design for social impact, Public Policy and Innovation, Design Thinking for Environmental Sustainability, Eco-Design,Circular Economy, Sustainable Product Development, Cradle to Cradle, Leveraging Technology for Social Impact, Role of Technology in Social Transformation,

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School by Idris Mootee, Wiley, 2013.
2. Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelley and David Kelley, Crown Business, 2013.

Reference Books

1. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown, HarperBusiness, 2009.
2. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Clayton M. Christensen, Harvard Business Review Press, 2016.
3. Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Crown Business, 2011.

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/uva-darden-design-thinking-innovation
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Communicative English		
Course Code:	**BAEC1008A**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	Exam Hours	2
Total Hours of Pedagogy	30 hours practical	Credits	01

Course objectives:

1. Enhance Listening Skills: Students will demonstrate effective listening skills in professional settings.
2. Develop Clear Speaking Techniques: Students will use clear and concise speaking techniques for business communication.
3. Analyze Written Communications with Comprehension skills: Students will interpret and analyze written business documents and communications - with good comprehension skill.

Course outcomes:

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

1. To comprehend and interpret spoken and written English at the CEFR B2 level
2. To produce spoken and written English at the CEFR B2 level
3. To develop active listening and speaking skills in order to participate in discussions, debates, and presentations
4. To improve reading speed, comprehension, and critical analysis of texts related to business and technical domains
5. To hone writing skills and produce effective business and technical documents such as emails, reports, proposals, and presentations
6. To apply effective communication strategies in a professional setting, including cultural awareness and intercultural communication.

Module-1: Essential Grammar and Vocabulary

Fundamentals of English Grammar, Advanced Grammar Concepts, Essential Vocabulary Development, Contextual Vocabulary Usage, Strategies for Effective Vocabulary Building

Module-2: Reading

Techniques for Effective Reading, Developing a Reading Habit, Analytical and Critical Reading Skills, Reading Practice and Interpretation, Discussion-Based Reading Activities

Module-3: Listening

Principles of Active Listening, Strategies for Enhancing Listening Comprehension, Identifying Key Information in Spoken Content, Practical Listening Exercises, Engaging with Different Accents and Speech Patterns

Module-4: Speaking

Developing Effective Speaking Skills, Overcoming Barriers to Communication, Structuring and Delivering Spoken Content, Practical Speaking Exercises, Enhancing Fluency and Pronunciation

Module-5: Writing

Techniques for Improving Writing Proficiency, Structuring Written Communication, Formal and Informal Writing Styles, Writing Practice and Feedback, Enhancing Clarity and Coherence in Writing

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- https://onlinecourses.swayam2.ac.in/cec24_lg08/preview
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Environmental Studies		
Course Code:	**BMNC1007A**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	-
		Total Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	0
Total Hours of Pedagogy	15 hours theory	Credits	0

Course objectives:

1. Understand how ecosystems and diversity in nature relate to digital networks and technology's role in sustainability.
2. Assess issues like e-waste, data centers' carbon footprint, and the climate impact of tech growth.
3. Propose strategies to optimize data use, manage digital resources sustainably, and integrate eco-friendly practices in tech.
4. Explore the concept of data as a resource and consider how to protect digital resources from depletion or misuse.

Course outcomes:

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

1. Understand the concept of digital ecosystems and their potential to improve network systems, drawing comparisons to natural ecosystems.
2. Evaluate the environmental consequences of technological advancements, such as the creation of e-waste, data center emissions, and energy consumption in tech.
3. Formulate strategies for integrating sustainability into technology development, ensuring that the tech industry contributes to, rather than harms, the environment.
4. Explore innovative ways to optimize data flow and storage, ensuring that data usage is energy-efficient and sustainable, similar to managing natural resources.
5. Understand and advocate for the concept of treating data like a natural resource, finding ways to recycle and reuse data to promote sustainability.

Module 1: Exploring Ecosystems and Resources in the Digital World
Enhancing Digital Networks Through Ecological Principles, Comparative Analysis of Biodiversity and Technological Diversity, Risks of Data Depletion in the Digital Age, Energy Flow Principles for Data Optimization, The Internet as a Potentially Endangered Resource, Future Challenges and Opportunities in Digital Sustainability, Critical Discussions and Case Studies
Module 2: Addressing Environmental and Digital Crises
Environmental and Digital Impact of E-Waste and Plastic Waste, Role of Data Centers in Climate Change, Technology as a Catalyst for Environmental Conservation or Degradation, Mandating Sustainable Development in the Digital Era, Innovative Approaches to Digital Waste Management Through Data Recycling, Critical Discussions and Case Studies

CIE:

- There will be one exam conducted at the end of the course. That will carry the full weightage.
- This exam is for 50 marks.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Environmental Studies by Benny Joseph, McGraw Hill Education, 3rd Edition.
2. Environmental Studies: From Crisis to Cure by R. Rajagopalan, Oxford University Press, 3rd Edition.

Reference Books

1. Environmental Science by Daniel B. Botkin and Edward A. Keller, Wiley India Pvt Ltd, 8th Edition.
2. Fundamentals of Ecology by Eugene P. Odum and Gary W. Barrett, Brooks/Cole, 5th Edition.

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/environmental-science
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Semester 2

Course Title:	Computational Mathematics – II		
Course Code:	**BMAT2001**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:1:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 15 hours Tutorial	Credits	04

Course objectives:

1. Develop Critical Thinking through Mathematical Inquiry: Learn the fundamentals of inquiry-based learning and mathematical thinking to approach problems analytically and creatively.
2. Enhance Logical Reasoning and Precision with Language: Understand the role of language in mathematical proofs and logic, including logical combinators, implication, equivalence, and quantifiers.
3. Master Problem-Solving Techniques: Explore diverse proof strategies, such as proof by contradiction and quantifiers, while applying set theory and number theory to real-world challenges.
4. Apply Mathematical Models to Decision-Making: Use probability, risk analysis, and data-driven decision-making to solve problems related to fairness, voting systems, and pattern recognition.
5. Explore Advanced Mathematical Thinking: Delve into concepts like game theory, strategic thinking, mathematical applications in art and design, estimation (Fermi problems), and the mathematics of luck and gambling.

Course outcomes:

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

1. Apply mathematical models and logical reasoning to make informed decisions in daily life, business, and technology settings.
2. Demonstrate proficiency in constructing rigorous proofs, including contradiction, implication, and quantifier-based arguments.
3. Use probability, game theory, and data-driven approaches to assess risk, make strategic choices, and evaluate fairness in complex scenarios.
4. Identify and predict number sequences and patterns, applying these insights to problem-solving in art, design, technology, and everyday challenges.
5. Apply mathematical thinking to diverse fields, from computational design and strategic decision-making to understanding randomness and estimating outcomes in uncertain situations.

Module-1: Introduction to Computational Mathematics

Inquiry-Based Learning in Mathematics, Introduction to Mathematical Thinking, Precision in Mathematical Language, Fundamentals of Set Theory, Foundational Concepts in Computational Mathematics

Module-2:Logical and Language Analysis-I

Logical Combinators in Language Analysis, Implication and Logical Equivalence, Application of Quantifiers in Mathematical Logic, Formal Language Structures and Their Properties, Foundational Theories in Language and Logic

Module-3: Logical and Language Analysis-II

Proof Techniques in Mathematics: Proof by Contradiction, Mathematical Proof by Quantifiers, Introduction to Number Theory, Principles of Real Analysis, Advanced Logical Reasoning and Mathematical Argumentation

Module-4: Mathematics of Patterns, Decisions, and Fairness

Probability and Decision-Making Under Uncertainty, Risk Analysis and Data-Driven Decision-Making, Mathematical Models of Fairness and Voting Systems, Pattern Recognition and Number Sequences, Applications of Mathematical Structures in Decision Theory

Module-5: Advanced Topics in Mathematical Thinking

Game Theory and Strategic Decision-Making, Mathematical Patterns in Art and Design, Probability and Statistical Analysis in Gambling and Luck, Estimation Techniques and Fermi Problems, Applications of Advanced Mathematical Thinking in Problem Solving

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/mathematical-thinking
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Materials Chemistry for Computing Systems		
Course Code:	**BCHE2002**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:1:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 15 hours Tutorial	Credits	04

Course objectives:

1. To understand the fundamental principles of materials chemistry and their applications in computing systems, focusing on the properties and functionalities of materials used in electronics and information storage.
2. To explore the chemical processes and reactions involved in the development and optimization of semiconductor materials and nanotechnology for computing purposes.
3. To foster analytical thinking and discussion-based learning on the impact of materials science in advancing computing technology and sustainable practices.

Course outcomes:

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

1. Identify key materials and their properties relevant to computing systems.
2. Explain the chemical principles underlying the synthesis and functionality of materials used in computing.
3. Apply basic chemistry concepts to analyze the properties and potential uses of emerging materials in technology.
4. Evaluate the role of materials chemistry in the development of advanced computing systems and propose theoretical improvements.
5. Analyze the environmental and sustainability challenges associated with the use of various materials in computing devices.
6. Utilize chemical knowledge to discuss and solve conceptual problems related to materials science in computing.

Module-1: Introduction to Materials Chemistry for Computing Systems

Overview of materials chemistry, classification of materials used in computing, basic chemical principles, electronic structure and bonding in materials, chemical properties of metals, semiconductors, and insulators, role of materials in information storage and processing.

Module-2: Semiconductor Materials and Chemistry

Introduction to semiconductors, intrinsic and extrinsic semiconductors, doping and its impact on electronic properties, chemical processes in semiconductor manufacturing, silicon and its compounds, advanced semiconductor materials like GaAs and graphene, applications in transistors and microprocessors.

Module-3: Nanotechnology in Computing
Basics of nanotechnology, chemical synthesis and characterization of nanomaterials, nanostructures and their properties, quantum dots and carbon nanotubes, nanomaterials in memory storage devices, implications of nanotechnology for future computing systems.
Module-4: Materials for Data Storage and Memory
Chemical properties of materials used in magnetic and optical data storage, ferroelectric and phase-change materials, chemistry of solid-state drives (SSD) and hard disk drives (HDD), advancements in memory technologies, chemical stability and performance, comparison of different materials for data storage.
Module-5: Sustainable Materials and Environmental Considerations
Environmental impact of materials used in computing, sustainable materials and green chemistry, recycling and reusability of electronic materials, life cycle analysis of computing devices, role of chemistry in developing eco-friendly materials, future directions for sustainable computing.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Materials Chemistry by Bradley D. Fahlman, Springer, 4th Edition.
2. Materials for Information Technology: Devices, Interconnects and Packaging by Ehrenfried Zschech, Caroline Whelan, Thomas Mikolajick, Springer, 2nd Edition.

Reference Books

1. Principles of Electronic Materials and Devices by Safa O. Kasap, McGraw-Hill Education, 4th Edition.
2. Introduction to Materials Science for Engineers by James F. Shackelford, Pearson, 8th Edition.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/5-111sc-principles-of-chemical-science-fall-2014/
- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Object Oriented Programming		
Course Code:	**BPLC2003**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:2:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory +30 hours Practical	Credits	03

Course objectives:

1. Develop Foundational Understanding: To introduce students to core Object-Oriented Programming (OOP) principles, including encapsulation, inheritance, polymorphism, and abstraction, enabling them to design modular, reusable, and maintainable software systems.
2. Enhance Programming Proficiency: To equip students with hands-on experience in Java programming, covering syntax, data types, conditional statements, loops, arrays, and string manipulation, while effectively applying OOP concepts to real-world problem-solving.
3. Promote Practical Application and Software Design: To enable students to design, implement, and optimize OOP-based software solutions, adhering to industry best practices such as SOLID

principles, design patterns, and UML modeling, ensuring scalability and efficiency.

Course outcomes:

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

1. To write and execute Java programs using core syntax, data types, conditional statements, loops, arrays, and string manipulation.
2. To apply core OOP concepts, including classes, objects, and encapsulation, for developing structured and modular Java applications.
3. To implement advanced OOP principles like abstraction, constructors, static members, and data hiding for efficient program design.
4. To demonstrate inheritance in Java, including single, multilevel, hierarchical, and hybrid inheritance, while effectively using interfaces.
5. To apply polymorphism concepts, such as method overloading, overriding, and abstract classes, to build flexible and extensible software.
6. To design scalable, maintainable, and modular applications by applying SOLID principles and industry-standard design practices.

Module-1: Introduction to Java

Introduction to Java & Environment Walkthrough, Java Syntax, Tokens & Data Types, Conditional Statements & Control Flow, Loops in Java: For, While, Do-While, Arrays & ArrayLists: Basics and Operations, String Manipulation & String Handling in Java, Functions, Methods & Variable Scope

Module-2: Getting started with Object Oriented Programming

Introduction to OOPs & common programming paradigms, Understanding Classes and Objects in OOP, Building blocks of OOPs , Member Variables & Methods in Java OOP, Array of objects & this keyword in Java

Module-3: Core concepts in OOPs

Static members of a class, Abstraction, Encapsulation, Introduction to constructors and destructors, Types of constructors, Constructor overloading

Module-4: Inheritance

Introduction to Inheritance, Types of inheritance, Implementation of types of inheritance, interfaces in Java, Multiple Inheritance using Interfaces, UML Class diagrams

Module-5: Polymorphism

Introduction to Polymorphism, untime and compile time polymorphism, Abstract class, Virtual functions, pure virtual functions, Overloading & Overriding
Module-6: SOLID Principles
Introduction to Design principles, SOLID Principles, Single Responsibility Principle (SRP), Open-Closed Principle (OCP), Liskov Substitution Principle (LSP), Interface Segregation Principle (ISP), Dependency Inversion Principle (DIP)

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing marks.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)
Text Books

1. Programming with Java | 7th Edition; Balagurusamy E; McGraw Hill
2. Programming With Java (, K. Padmini Kuppala, Pathi. Haritha, Prof M. D. ANANDA RAJ, M. Leelavathi), Bluerose Publishers Pvt. Ltd., Edition: First, 2022
3. Java The Complete Reference; Herbert Schildt; McGraw Hill; Eleventh edition

Reference Books

1. Core Java: an Integrated Approach, Rao R. Nageswara, Dreamtech Press India Pvt. Ltd
2. Let Us Java; Kanetkar Yashavant; BPB Publications, 3rdEdition
3. Head First Java: A Brain-Friendly Guide, Third Edition(Kathy Sierra, Bert Bates, Trisha Gee), Shroff/O'Reilly, 3rd Edition

Web links and Video Lectures (e-Resources):
● https://ocw.mit.edu/courses/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-2011/pages/unit-1-software-engineering/object-oriented-programming/ ● www.kalvium.community/livebooks
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning ● Quizzes ● Assignments ● Discussions ● Code-alongs

Course Title:	Mechanical Engineering Sciences		
Course Code:	**BESC2004B**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory	Credits	03

Course objectives:

1. To understand the fundamental principles of mechanical engineering and their relevance to computing and IT systems, focusing on the design, dynamics, and material properties used in computer hardware and related devices.
2. To explore the mechanical aspects of hardware development, such as heat dissipation, structural integrity, and ergonomics in the design of computing systems.
3. To develop a conceptual understanding of mechanical engineering principles to analyze and discuss their applications in the design and optimization of computing equipment and technology infrastructure.

Course outcomes:

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

1. Identify basic mechanical concepts such as force, motion, and energy and their relevance to computing hardware.
2. Explain the principles of thermodynamics and material science as they apply to the development and optimization of computer systems.
3. Apply knowledge of mechanical engineering to analyze the thermal management and structural design of computing devices.
4. Analyze the mechanical challenges in the design and manufacturing of computing hardware, such as laptops, servers, and data centers.
5. Evaluate the role of mechanical systems in enhancing the performance and sustainability of IT infrastructure.
6. Utilize mechanical engineering concepts to propose theoretical improvements in the design of computing devices, focusing on efficiency and durability

Module-1: Introduction to Mechanical Engineering Concepts for Computing

Fundamental principles of mechanics, force and motion, energy and work, basic properties of materials, stress and strain, mechanical properties relevant to computing hardware, introduction to mechanical design and analysis, role of mechanical engineering in computing.

Module-2: Thermodynamics and Heat Transfer in Computing Systems

Basic concepts of thermodynamics, laws of thermodynamics, heat transfer mechanisms: conduction, convection, and radiation, thermal management in electronic devices, heat sinks and cooling systems, thermal conductivity of materials used in computing, design considerations for thermal efficiency in computer hardware.

Module-3: Material Science and Selection for Computing Hardware

Introduction to materials science, classification of engineering materials, mechanical and thermal properties of metals, polymers, and composites, material selection criteria for computing devices, properties and applications of common materials in computer hardware, failure analysis and durability considerations.

Module-4: Dynamics and Vibrations in Computing Equipment

Basic principles of dynamics, types of motion, vibration analysis, impact of vibrations on computing systems, design for minimizing vibrations in hard drives and servers, dynamics of moving parts in printers and scanners, ergonomic considerations in device design, impact of mechanical stress on device lifespan.

Module-5: Mechanical Design for IT Infrastructure and Hardware

Principles of mechanical design, structural analysis of computer enclosures and frames, design for manufacturability and assembly, modular design and maintenance, mechanical aspects of data center design, structural integrity and load management, case studies on mechanical design innovations in computing

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Engineering Mechanics: Dynamics by J. L. Meriam and L. G. Kraige, Wiley, 8th Edition.
2. Fundamentals of Thermodynamics by Richard E. Sonntag, Claus Borgnakke, and Gordon J. Van Wylen, Wiley, 9th Edition.

Reference Books

1. Materials Science and Engineering: An Introduction by William D. Callister Jr. and David G. Rethwisch, Wiley, 10th Edition.
2. Mechanical Design of Machine Elements and Machines by Jack A. Collins, Henry R. Busby, and George H. Staab, Wiley, 2nd Edition.

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Front-end Web Development - Advanced		
Course Code:	**BETC2005***	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory + 30 hours practical	Credits	04

Course objectives:

1. Master Advanced JS concepts : Students will explain advanced JavaScript concepts, including ES6 features, functional programming, recursion, asynchronous programming, and prototypal inheritance.
2. Master Advanced React Concepts: Students will understand and explain the core and advanced features of React, including components and hooks.
3. Develop and Optimize Complex Interfaces: Students will develop complex user interfaces using React and implement performance optimization techniques.
4. Integrate and Manage State Effectively: Students will evaluate state management solutions, integrate them into React applications, and connect React with various APIs and backend services for full-stack development.

Course outcomes:

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

1. Explain the core concepts and advanced features of React.
2. Develop complex user interfaces using React components and hooks.
3. Evaluate the performance of React applications and implement optimization techniques.
4. Assess state management solutions and their integration in React applications.
5. Design and implement large-scale React applications with robust architectures.
6. Integrate React with various APIs and backend services for full-stack development.

Module-1: Javascript Hard Parts - I

Clean coding principles, ES6 features including let and const, arrow functions, template literals, destructuring, and default parameters, functional programming concepts such as pure functions, immutability, and function composition, first-class and higher-order functions, closures and lexical scoping, recursion techniques for optimizing iterative tasks, Immediately Invoked Function Expressions (IIFE), advanced error handling using try-catch and custom error objects

Module-2: Javascript Hard Parts -II

Prototypal inheritance and object-oriented programming principles, asynchronous JavaScript including event loop and concurrency model, JavaScript Promises for handling asynchronous operations, Async/Await for cleaner asynchronous code, JavaScript APIs for handling HTTP requests, Axios for simplified data fetching, working with RESTful APIs and handling JSON responses, implementing secure API calls and authentication tokens, JavaScript unit testing frameworks such as Jest and Mocha, deployment strategies for JavaScript applications
Module-3:React First Steps
Environment setup and project structure for React applications, introduction to JSX syntax and virtual DOM, working with React components including functional and class-based components, props and state management for dynamic UI updates, event handling and synthetic events in React, controlled and uncontrolled components in forms, component lifecycle methods and their use cases, introduction to hooks including useState, useEffect, and useRef, working with lists and keys for efficient rendering, implementing React Router for navigation, conditional rendering techniques
Module-4: React Deep Dive - Part I
Advanced state management using Context API and Redux, Redux Toolkit for optimized state handling, Redux middleware including Thunk and Saga, asynchronous state updates and API calls using Redux, React forms handling using Formik and Yup for validation, fetching data using Axios and Fetch API, error handling in data fetching, implementing lazy loading and code splitting for performance optimization, React CSS styling with styled-components and CSS modules, integrating Material-UI for responsive design, best practices for handling asynchronous operations and side effects
Module-5: React Deep Dive - Part II
Integrating GraphQL with React using Apollo Client, authentication and authorization using Firebase, JWT, and OAuth, implementing secure routes and role-based access control, real-time data fetching using WebSockets and Firebase, performance optimization techniques including memoization with useMemo and useCallback, debugging and profiling React applications using React Developer Tools, server-side rendering (SSR) with Next.js, static site generation (SSG) for faster page loads, implementing Progressive Web Apps (PWA) with React, CI/CD deployment pipelines using GitHub Actions, Netlify, and Vercel

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing marks.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)
Text Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks
- https://www.freecodecamp.org/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions
- Code-alongs
- Building a project

Course Title:	UI and UX Design for Developers		
Course Code:	**BAEC2006B**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:2:0	Exam Hours	2
Total Hours of Pedagogy	15 hours theory + 30 hours practical	Credits	02

Course objectives:

1. Understand User-Centered Design: Students will learn the basic principles of user-centered design and how they apply to software development.
2. Evaluate and Improve Software Design: Students will evaluate existing software applications to identify and suggest improvements for user experience and usability.
3. Apply Visual Design Principles: Students will apply visual design principles, including typography, color theory, and layout, to create effective and appealing user interfaces.

Course outcomes:

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

1. To explain the basic principles of user-centered design, and how they apply to software development.
2. To evaluate and critique the design of existing software applications, and identify areas for improvement in terms of user experience and usability.
3. To apply visual design principles and techniques, such as typography, color theory, and layout, to create effective user interfaces.
4. To conduct usability testing and other evaluation methods to measure the effectiveness and usability of software applications.
5. To synthesize different design concepts and techniques to create well-designed and user-friendly software interfaces.
6. To evaluate the accessibility of software applications and understand the importance of designing for users with diverse needs.

Module-1: How to approach design as a developer

Importance of design in software development, fundamentals of design thinking and problem-solving, key differences between developer and designer mindsets, introduction to Figma and industry-standard design tools, hands-on Figma workshops for wireframing and prototyping, understanding design constraints in development, collaboration between designers and developers, best practices for implementing design systems in development workflows

Module-2: UX Design for Developers - I

Understanding the principles of user experience (UX) design, introduction to design sprints and agile UX methodologies, conducting user research and user interviews, personas and empathy mapping for better user understanding, information architecture and content structuring, navigation design and usability heuristics, accessibility principles and inclusive design practices, tools and frameworks for accessibility testing

Module-3: UX Design for Developers -II

Building intuitive and user-friendly digital products, cognitive psychology principles in UX design, impact of human perception and behavior on design decisions, user journey mapping and flow analysis, wireframing techniques for rapid prototyping, low-fidelity vs high-fidelity prototyping, usability testing and heuristic evaluation, implementing feedback loops for iterative design improvements

Module-4: UI Design for Developers -I

Core principles of visual design and aesthetics, understanding visual hierarchy and composition, typography and text styling for readability and accessibility, designing layouts for consistency and responsiveness, spacing and grid systems in UI design, best practices for UI scalability and modular design, introduction to atomic design methodology, working with design tokens and component libraries

Module-5: UI Design for Developers -II

Advanced color theory and its psychological impact in UI design, contrast and color accessibility for visually impaired users, working with images, illustrations, and media assets, creating depth and dimension using shadows and layering, motion design and micro-interactions for enhanced user

engagement, designing reusable UI components for scalable applications, hands-on implementation of UI design in front-end development frameworks, evaluating UI performance and optimizing for different devices and screen sizes

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks
- https://www.interaction-design.org/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions
- Code-alongs
- Building a project

Course Title:	Constitution of India		
Course Code:	**BMNC2007B**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	--
		Total Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	1
Total Hours of Pedagogy	15 hours theory	Credits	-

Course objectives:

1. To understand the historical context and evolution of the Indian Constitution by outlining its development and the foundational principles that guide the nation.
2. To illustrate the key constitutional provisions related to fundamental rights, duties, directive principles, and the functioning of the executive, legislature, and judiciary.
3. To analyse the federal structure and the amendment process by examining the distribution of powers between the Union and the States and the significance of constitutional amendments

Course outcomes:

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

1. Outline the historical background and development of the Indian Constitution.
2. Illustrate fundamental rights, duties, and directive principles enshrined in the Constitution.
3. Explain the structure and functions of the executive, legislature, and judiciary in India.
4. Analyse the federal structure and the distribution of powers between the Union and the States.
5. List the process and significance of constitutional amendments.

Module-1: Introduction to the Constitution of India

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

Module-2: Fundamental Rights and Duties

Fundamental rights, Fundamental duties, Directive principles of state policy, Case studies on landmark judgments
Module-3: 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: Federal Structure and Distribution of Powers
Federalism in India, Division of powers: Union, State, and Concurrent lists, Inter-state relations, Emergency provisions
Module-5: 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

Continuous Internal Exam (CIE):

- There will be 1 internal assessment.
- The assessment's score will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40%.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks
- https://onlinecourses.nptel.ac.in/noc20_lw03/preview

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Course Title:	Professional Writing Skills in English		
Course Code:	**BAEC2008B**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	2
Total Hours of Pedagogy	28 hours theory	Credits	1

Course objectives:

1. To develop effective professional writing skills for diverse business and academic contexts.
2. To enhance the ability to structure and present ideas coherently and persuasively in written communication.
3. To apply critical thinking and linguistic accuracy in crafting various professional documents.

Course outcomes:

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

1. Identify different types of professional writing styles and their appropriate contexts.
2. Summarize key elements of effective written communication in business and academic settings.
3. Apply grammatical rules and stylistic conventions in professional documents.
4. Analyze the structure and content of different professional documents such as reports, proposals, and emails.
5. Evaluate the effectiveness and clarity of written communication in professional scenarios.Create professional documents such as business letters, emails, and reports, demonstrating proficiency in writing.

Module-1: Fundamentals of Professional Writing

Overview of professional writing, differences between professional and academic writing, audience analysis and purpose identification, formal and informal language use, understanding tone and style, common grammatical and punctuation errors.

Module-2: Business Correspondence and Communication

Writing professional emails and letters, types of business correspondence, email etiquette and structure, persuasive and informative writing, writing business proposals and memos, communicating effectively with clients and colleagues.

Module-3: Reports and Technical Writing

Types of reports and their structures, writing research and technical reports, presenting data and information visually and textually, using headings, tables, and figures, writing executive summaries and abstracts, revising and editing technical content.

Module-4: Writing for Digital and Social Media

Crafting content for websites and blogs, writing for social media platforms, creating engaging content for diverse audiences, understanding SEO principles, digital communication ethics, writing and editing online articles and newsletters.

Module-5: Creative and Critical Writing

Exploring creative writing techniques in professional contexts, incorporating storytelling in business writing, writing persuasive arguments and critiques, developing clear and compelling narratives, reflective writing and professional portfolios, peer review and feedback.

Continuous Internal Exam (CIE):

- There will be 5 internal assessments.
- The aggregate score of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40%.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Gerson, Sharon, and Gerson, Steven. Technical Communication: Process and Product. Pearson Education, 8th edition.
2. Murphy, Herta A., and Hildebrandt, Herbert W. Effective Business Communications. McGraw-Hill, 7th edition.

Reference Books

1. Garner, Bryan A. Garner's Modern English Usage. Oxford University Press, 4th edition.
2. Lannon, John M., and Gurak, Laura J. Technical Communication. Pearson Education, 14th edition.
3. Bovee, Courtland L., and Thill, John V. Business Communication Today. Pearson Education, 14th edition.

Web links and Video Lectures (e-Resources):
• www.kalvium.community/livebooks • https://www.coursera.org/specializations/academic-english
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Quizzes • Assignments • Discussions

Semester 3

Backend Web Development

Course Title:	Backend Web Development		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:4:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 60 hours Practical	Credits	04

Course objectives:

1. Understand Server-Side Programming: Students will learn the fundamental concepts of server-side programming and the role of the backend in web development.
2. Develop Applications with Node.js and Express: Students will develop server-side applications using Node.js and Express.
3. Integrate Back-end with Front-end: Students will integrate back-end services with front-end applications, creating a cohesive full-stack environment.

Course outcomes:

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

1. Explain the fundamental concepts of server-side programming and the role of backend in web development.
2. Develop server-side applications using Node.js and Express.
3. Compare different database management systems and their use in back-end development.
4. Assess and optimize the performance of server-side applications.
5. Design and implement secure and scalable back-end solutions.
6. Integrate back-end services with front-end applications in a full-stack environment.

Module-1: 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: Working with Express.js
Introduction to Express.js, Routing in Express, Middleware in Express, Building RESTful APIs, Handling requests and responses
Module-3: Database Management
Introduction to databases, SQL vs NoSQL databases, Working with MongoDB, Mongoose ORM, CRUD operations in MongoDB
Module-4: 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: Performance and Scalability
Performance optimization techniques, Caching strategies, Load balancing and clustering, Handling concurrent requests, Scaling applications

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

1. 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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

NoSQL Databases for Web Development

Course Title:	NoSQL Databases for Web Development		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:4:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 60 hours Practical	Credits	04

Course objectives:

1. Describe the fundamental concepts and architecture of NoSQL databases, including MongoDB and Redis.
2. Develop and implement CRUD operations and advanced features using MongoDB and other NoSQL technologies.
3. Analyze and assess the suitability, performance, and scalability of NoSQL databases for various application scenarios.

Course outcomes:

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

1. Describe the fundamental concepts of NoSQL databases and their differences from traditional relational databases.
2. Explain the architecture and data models used in MongoDB and other NoSQL databases.
3. Develop basic CRUD operations and queries using MongoDB.
4. Analyze use cases to determine the suitability of NoSQL databases over relational databases for specific scenarios.
5. Assess the performance and scalability of MongoDB in various application contexts.
6. Design and implement a complete application using MongoDB, incorporating advanced features such as indexing, aggregation, and replication.

Module-1: 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: MongoDB Basics

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

Module-3: CRUD Operations in MongoDB

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

Module-4: Indexing and Aggregation

Understanding indexing in MongoDB, Creating and managing indexes, Aggregation framework: pipelines, stages, and operators, Examples of aggregation queries
Module-5: 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

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Full Stack Web Development

Course Title:	Full Stack Web Development		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:4:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 60 hours Practical	Credits	04

Course objectives:

1. Understand Full Stack Development: Students will explain the full stack development process and the roles of front-end and back-end technologies.
2. Develop Applications with MERN Stack: Students will develop full stack applications using MongoDB, Express.js, React, and Node.js.
3. Create and Integrate Complete Web Applications: Students will design and implement complete web applications from scratch and integrate third-party services and APIs into their projects.

Course outcomes:

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

1. To describe the architecture and components of a full stack web application, including front-end and back-end technologies and their interactions.
2. To design and develop a database schema using MongoDB, including defining data models, creating indexes, and writing queries.
3. To create RESTful APIs using Node.js and Express, including handling HTTP requests and responses, and interacting with the database.
4. To implement front-end user interfaces using React, including using React components, managing state, and handling user input.
5. To integrate front-end and back-end components to create a fully functional full stack web application, including using asynchronous communication and handling errors and exceptions.
6. To design and implement a unique full stack application as a capstone project, including identifying user requirements, developing a software design, and implementing and testing the application.

Module-1: 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: 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: 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: 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: 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

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Operating Systems

Course Title:	Operating Systems		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

1. Understand Operating System Concepts: Students will explain the fundamental concepts and structures of operating systems.
2. Manage Processes and Resources: Students will use system calls and other OS services to create and manage processes, and evaluate different CPU scheduling algorithms and their implementations.
3. Solve OS-related Problems: Students will assess synchronization techniques and deadlock handling methods, and design and implement memory management strategies to solve complex problems related to process management, memory management, and file systems.

Course outcomes:

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

1. To understand the fundamental concepts of operating systems such as processes, threads, synchronization, and memory management.
2. To analyze the performance of various scheduling and memory allocation algorithms.
3. To compare and contrast different types of operating systems, such as batch, multi-programmed, and real-time systems.
4. To develop an understanding of device management, file systems, and virtualization.
5. To gain practical experience in implementing basic operating system functionalities.
6. To understand the security and privacy issues in modern operating systems.

Module-1: Computer Arithmetic & 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, micro program sequencing, pre-fetching microinstructions. Introduction to graphical processing unit (GPU).

Module-2: Memory Organization

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

Module-3: 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: 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: Fist 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: 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.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Essence of Indian Knowledge Tradition

Course Title:	Essence of Indian Knowledge Tradition		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	1
Total Hours of Pedagogy	15 hours Theory	Credits	0

Course objectives:

1. To introduce students to the core ideas of Indian knowledge systems, including philosophy, science, and culture.
2. To encourage a deeper appreciation of traditional Indian wisdom and its relevance to contemporary issues.
3. To explore how Indian traditions can enrich modern-day life and education.

Course outcomes:

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

1. To understand the key principles of Indian philosophy, including Vedanta, and their impact on modern thought.
2. To explore the concept of Yoga and its applications for personal well-being and mental discipline.
3. To appreciate the contributions of ancient Indian science and its influence on contemporary scientific thought.
4. To recognize the importance of Indian cultural practices and their role in promoting harmony and balance in society.
5. To critically evaluate the relevance of traditional Indian knowledge systems in solving modern-day challenges.
6. To integrate core ideas from Indian philosophy and science into global discourses on sustainability, ethics, and education.

Module-1: Essence of Indian Knowledge and Tradition

Concepts: Overview of Indian Philosophy, Vedanta and the Concept of Unity, Yoga and Mental Discipline, Ancient Indian Scientific Contributions, Indian Culture and Art, Relevance of Traditional Knowledge in Modern Times

Continuous Internal Exam (CIE):

- There will be 1 CIE that will be counted towards 100% of the weightage.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. The Bhagavad Gita by Eknath Easwaran (Nilgiri Press, 2007)
2. The Upanishads by Eknath Easwaran (Nilgiri Press, 2007)

Reference Books

1. Science and Civilization in India by C. K. Raju (Pearson, 2015)
2. Indian Philosophy: A Very Short Introduction by Sue Hamilton (Oxford University Press, 2001)

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Critical Thinking

Course Title:	Critical Thinking		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:0:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory	Credits	02

Course objectives:

1. Understand Cognitive Biases and Heuristics: Students will learn about cognitive biases and heuristics, and how they can lead to thinking errors.
2. Identify and Analyze Thinking Errors: Students will recognize common thinking errors and fallacies in everyday situations and analyze arguments and evidence critically.
3. Develop and Communicate Well-Supported Arguments: Students will synthesize ideas from different sources to create reasoned arguments and communicate their critical thinking solutions effectively, both orally and in writing.

Course outcomes:

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

1. To describe the cognitive biases and heuristics that can affect human reasoning, and explain how they can lead to thinking errors.
2. To recognize and identify common thinking errors and fallacies in everyday situations.
3. To apply critical thinking skills to analyze and evaluate arguments and evidence.
4. To synthesize ideas and perspectives from different sources to develop reasoned and well-supported arguments.
5. To evaluate the reliability and validity of different sources of information and evidence.
6. To communicate critical thinking ideas and solutions clearly and effectively, both orally and in writing.

Module-1: Two Systems of Thinking

Why think critically, the two systems of thinking, the lazy system and cognitive ease, problem solving and the scientific method, media literacy and misinformation, the brain as a prediction machine.

Module-2: Heuristics and Biases – Part 1

Cognition and cognitive dissonance, norms and the marvels of priming, biases heuristics and judgments, the anchoring effect, the availability heuristic, sunk cost fallacy, commitment bias, the representativeness bias, the conjunction fallacy.

Module-3: Heuristics and Biases – Part 2

Survivorship bias, fundamental attribution error, confirmation bias, Barnum effect, loss aversion, gambler's fallacy, framing, better-than-average bias, bias blind spot.

Module-4: Overconfidence and Choices

The problem with hindsight bias, the illusion of validity, intuition vs formulas, when to trust expert intuition, prospect theory, endowment effect, bad events, the fourfold pattern.

Module-5: Critical Thinking in Action

Application of bias recognition in real-life scenarios, analysis of misinformation and media influence, evaluating arguments and perspectives through structured reasoning, developing critical reviews and comparative analysis, practicing perspective-taking and empathy through analytical writing, reflection on personal decision-making and bias awareness.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Computer Organization and Architecture

Course Title:	Computer Organization and Architecture		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	4:0:0:0	Exam Hours	2
Total Hours of Pedagogy	60 hours Theory	Credits	04

Course objectives:

1. Understand Computer Components: Students will explain the basic components of computer systems and their functions, including the CPU, memory, and I/O systems.
2. Analyze System Performance: Students will analyze the performance of computer systems using metrics such as clock rate and CPI.
3. Write and Debug Assembly Programs: Students will write and debug assembly language programs that interact with system hardware.

Course outcomes:

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

1. To explain the basic components of computer systems and their functions at a low level, including CPU, memory, and I/O systems.
2. To analyze the performance of computer systems based on metrics such as clock rate and CPI.
3. To design and implement simple CPU and memory systems using hardware description languages such as Verilog.
4. To write and debug assembly language programs that interact with system hardware.
5. To 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.
6. To apply knowledge of computer organization and architecture to optimize code for performance and minimize energy consumption.

Module-1

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

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

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

Memory system design: semiconductor memory technologies, memory organization.

Module-4

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

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

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

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Semester 4

Data Structures and Algorithms - 1

Course Title:	Data Structures and Algorithms - 1		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

1. To introduce foundational concepts in data structures, complexity analysis, and mathematical tools for algorithm design.
2. To develop problem-solving skills using programming patterns, recursion, and basic sorting/searching techniques.
3. To build the ability to implement and manipulate linear data structures such as arrays and linked lists.

Course outcomes:

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

1. To explain the principles and concepts underlying data structures and algorithms, such as complexity analysis and recursion.
2. To design and implement foundational data structures such as arrays, linked lists, stacks, and queues.
3. To analyze the performance and correctness of algorithms using complexity analysis.
4. To apply programming patterns and recursion to solve algorithmic problems.
5. To evaluate sorting and searching techniques for different computational problems.
6. To create and present well-documented code implementing foundational data structures and algorithms.

Module-1: Introduction to DSA and Programming Patterns

Introduction to DSA, Foundational Mathematics for DSA, Time and Space Complexity, Deep Dive into Complexity Analysis, Sieve of Eratosthenes, Introduction to Arrays, Common Programming Patterns

Module-2: Arrays and Problem Solving Patterns

Sieve of Eratosthenes, Introduction to Arrays, Common Programming Patterns, Intersection of Two Arrays, Top K Frequency Elements

Module-3: Sorting and Searching Techniques

Overview of Sorting Techniques, 3-Sum Closest, Binary Search Introduction, Lower Bound and Upper Bound, Maximum Consecutive Ones

Module-4: Recursion and Divide & Conquer

Introduction to Recursion, Deep Dive into Recursion, Quick Sort, Merge Sort, Subsequence Patterns

Module-5: Linked Lists and Pointer-Based Structures

Introduction to Singly Linked List, Design a Linked List, Doubly Linked List, Implementation of Doubly Linked List, Slow and Fast Pointer Technique, Circular Linked List, Josephus Problem

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017

Reference Books

1. Robert Lafore, Data Structures and Algorithms in Java, Pearson, 2002
2. Michael T. Goodrich, Roberto Tamassia, Data Structures and Algorithms in Java, Wiley, 2014

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Professional Skills for the Workplace

Course Title:	Professional Skills for the Workplace		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	4:0:0:0	Exam Hours	2
Total Hours of Pedagogy	60 hours theory	Credits	04

Course objectives:

1. Understand Human Skills Matrix: Students will learn about the four quadrants of the Human Skills Matrix and their importance in workplace success.
2. Develop Critical Thinking and Decision-Making: Students will enhance their critical thinking skills to solve complex problems and make effective decisions.
3. Improve Communication and Collaboration: Students will learn to communicate clearly and persuasively and to lead and collaborate effectively in various professional contexts.

Course outcomes:

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

1. To explain the four quadrants of the Human Skills Matrix and how they relate to success in the workplace.
2. To apply critical thinking skills to solve complex problems and make effective decisions.
3. To lead and collaborate effectively with others, including managing teams and facilitating group discussions.
4. To communicate clearly and persuasively in various professional contexts, including written, verbal, and nonverbal communication.
5. To manage time and prioritize tasks effectively, including setting goals and developing strategies for self-motivation and self-improvement.
6. To synthesize different human skills and apply them to real-world workplace challenges, such as conflict resolution, innovation, and project management.

Module-1 - Managing Ourselves

Self-awareness through reflective practices and feedback, Adaptability to changing environments and goals, Managing emotions with emotional intelligence and stress regulation, Accountability in actions and outcomes, Professionalism including time discipline and workplace etiquette, Taking initiative by spotting opportunities and acting without waiting, Persistence in the face of setbacks and long-term effort, Planning and organizing using tools like calendars and task managers, Integrity through ethical decision-making and value alignment

Module-2 - Interacting
Writing effective emails and structured reports, Using communication tools like Slack and Zoom effectively, Collaborating through project management tools like Trello or Notion, Curating professional relationships through LinkedIn and other platforms, Building negotiation skills for win-win outcomes, Delivering persuasive presentations, Practicing verbal and non-verbal communication in meetings and group settings, Active listening and giving constructive feedback
Module-3 - Thinking
Navigating ethical dilemmas with structured thinking, Practicing intrapreneurship by innovating within organizations, Developing a growth mindset to embrace challenges and feedback, Applying systems thinking to analyze interconnected problems, Practicing first principles thinking, Enhancing decision-making under uncertainty
Module-4 - Leading
Empowering others through delegation and trust, Creating and communicating a strategic vision, Managing projects with clear goals, timelines, and accountability, Managing performance with goal-setting, feedback, and coaching, Practicing inclusive leadership and empathy, Handling conflict within teams constructively, Leading by example with consistency and integrity
Module-5 - Using Generative AI as a professional assistant
Writing emails, blogs, and summaries using AI tools, Creating advanced content like contracts and project proposals, Summarising long documents to extract key insights, Analyzing and synthesizing content for faster decision-making, Switching between different writing styles and tones, Using chain-of-thought prompts to improve reasoning and creativity, Integrating AI into daily workflows for productivity and learning

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Database Management Systems

Course Title:	Database Management Systems		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory + 30 hours practical	Credits	04

Course objectives:

1. Understand Fundamental DBMS Concepts: Students will learn the fundamental concepts of database management systems, including data models, data normalization, and database design.
2. Design and Implement Relational Databases: Students will design and implement relational databases using SQL and manage them using popular DBMS tools like MySQL.
3. Query and Manipulate Data with SQL: Students will use SQL to query and manipulate data stored in databases.

Course outcomes:

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

1. To understand the fundamental concepts of database management systems including data models, data normalization, and database design.
2. To be able to design and implement a relational database using SQL.
3. To be able to use a popular DBMS tool such as MySQL to create and manage databases.
4. To be able to use SQL to query and manipulate data stored in a database.
5. To be able to apply database management concepts to real-world scenarios and problem-solving.
6. To be able to design and implement a functional database-driven web application.

Module-1 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 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 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 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 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.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Introduction to Artificial Intelligence

Course Title:	Introduction to Artificial Intelligence		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory + 30 hours practical	Credits	04

Course objectives:

1. Understand the core concepts, history, and evolution of artificial intelligence, including foundational theories and major milestones.
2. Learn and apply essential AI techniques such as search algorithms, knowledge representation, inference, and planning.
3. Explore real-world applications of AI while critically evaluating its ethical, societal, and technological implications.

Course outcomes:

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

1. Identify key concepts and historical developments in artificial intelligence (AI), such as major milestones and foundational theories.
2. Illustrate foundational AI techniques, including search algorithms (like BFS, DFS, and A*), knowledge representation (such as propositional and predicate logic), and heuristic functions.
3. Explain the basics of reasoning and problem-solving in AI, including inference methods and planning strategies.
4. Apply AI techniques to solve simple problems and scenarios, demonstrating practical understanding of algorithms and methods.
5. Analyse the ethical implications of AI technologies, exploring issues related to privacy, bias, and societal impact.
6. Assess the potential applications and limitations of AI, including its use in robotics, natural language processing, and expert systems.

Module-1 Introduction to AI

History of AI, definitions of AI, weak AI and strong AI, key concepts in AI, goals of AI, types of AI, intelligent agents, Turing test, branches of AI, AI applications across domains, ethical considerations in AI, AI safety, explainability and transparency

Module-2 Search Algorithms

Problem formulation, state space, search trees, uninformed search techniques – breadth first search, depth first search, depth-limited search, iterative deepening, informed search – greedy best-first search, A* search, heuristic functions, optimization problems, constraint satisfaction problems, hill climbing, simulated annealing

Module-3 Knowledge Representation

Logical representation, propositional logic, predicate logic, forward and backward chaining, knowledge bases, semantic networks, ontologies, conceptual graphs, frames, rules and production systems, knowledge acquisition and engineering

Module-4 Reasoning and Problem Solving

Inference in propositional and predicate logic, resolution, unification, non-monotonic reasoning, reasoning under uncertainty, Bayesian networks, fuzzy logic, problem-solving strategies, means-end analysis, goal formulation, planning in AI, STRIPS, planning graphs

Module-5 AI Applications and Future Trends

Applications in robotics – path planning, robot perception, intelligent control, applications in natural language processing – text classification, sentiment analysis, speech recognition, expert systems – architecture, use cases, shell and knowledge base, AI in healthcare and education, emerging trends – generative AI, AGI, ethics and governance of AI, case studies from industry

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

Introduction to Artificial Intelligence by Wolfgang Ertel, Springer International Publishing AG; 2nd ed. 2017 edition

Reference Books

Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6e, Pearson Education, (1 June 2021)

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Artificial Intelligence Methods, Tools and Techniques

Course Title:	Artificial Intelligence Methods, Tools and Techniques		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory + 30 hours practical	Credits	04

Course objectives:

1. Understand various AI methods and optimization techniques used in intelligent system design, including heuristic search, rule-based systems, and expert systems.
2. Gain proficiency in logic programming and AI toolkits such as Prolog, CLIPS, and expert system shells to implement AI solutions.
3. Explore the integration of advanced AI techniques and tools for real-world applications, critically evaluating their performance and societal impact.

Course outcomes:

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

1. Explain the workings of different AI methods and techniques, including heuristic search, knowledge-based systems, and expert systems.
2. Illustrate the principles and applications of heuristic search algorithms, optimization techniques, rule-based systems, and inference engines.
3. Explain the use of AI tools and frameworks, such as Prolog, CLIPS, and expert system shells, for implementing AI solutions.
4. Apply AI techniques to develop intelligent systems, utilising appropriate methods and tools to address specific problems.
5. Examine the performance and effectiveness of AI solutions, evaluating their efficiency and accuracy in real-world scenarios.
6. Develop a simple project using AI – utilising modern tools and techniques, demonstrating practical skills in creating and managing AI systems.

Module-1 Heuristic Search and Optimization

Problem formulation, heuristic search algorithms – greedy search, A* search, local search, hill climbing, simulated annealing, optimization techniques, genetic algorithms – representation, crossover, mutation, fitness evaluation, evolutionary strategies, swarm intelligence, ant colony optimization

Module-2 Knowledge based systems

Knowledge representation – semantic networks, frames, rules, production systems, rule-based systems – architecture and applications, expert systems – components, types, shell-based development, inference engines – forward chaining, backward chaining, certainty factors, conflict resolution, knowledge acquisition and validation

Module-3 Logic Programming and Automated Reasoning

Introduction to logic programming, syntax and semantics of Prolog, recursive programming in Prolog, unification and resolution, theorem proving, Horn clauses, constraint logic programming, knowledge-based reasoning, case studies on logic-based applications
Module-4 AI Tools and Frameworks
Overview of AI development tools – Prolog, CLIPS, expert system shells, architecture and usage, knowledge engineering in tools, building rule-based and logic-based applications, debugging and evaluation techniques, case studies on AI implementation using these tools, integration with other systems
Module-5 Advanced AI Techniques
Natural language processing – parsing, tokenization, sentiment analysis, robotics and AI integration – perception, control, motion planning, intelligent agents – reactive and deliberative agents, multi-agent systems, AI and ethics – bias, transparency, accountability, societal impacts, real-world AI applications and case studies

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

Artificial Intelligence: A Modern Approach by Russell/Norvig, Pearson Education, 4th edition

Reference Books

1. "Prolog Programming for Artificial Intelligence" by Ivan Bratko, Addison-Wesley, 4th Edition, 2011.
2. "Handbook of Knowledge Representation" by Frank van Harmelen, Vladimir Lifschitz, and Bruce Porter, Elsevier, 2008.

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Linux Administration

Course Title:	Linux Administration		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours theory + 30 hours practical	Credits	04

Course objectives:

1. Equip learners with foundational and advanced skills for administering Linux-based systems, including file systems, user management, and network configuration.
2. Provide practical experience in using command-line tools, managing packages, configuring services, and securing Linux environments.
3. Enable students to troubleshoot performance issues, formulate backup strategies, and apply best practices in Linux server administration.

Course outcomes:

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

1. Infer Linux commands and utilities to perform basic system administration tasks, including user management and file system operations.
2. Determine network settings and services to ensure proper communication and security in a Linux environment.
3. Identify software packages and updates using various package management tools to maintain system integrity and functionality.
4. Analyse system performance and troubleshoot issues using monitoring tools and logs to optimise Linux server operations.
5. Formulate backup strategies to ensure data protection and system recovery in case of failures.
6. Evaluate system security by configuring firewalls, managing permissions, and applying best practices for secure administration.

Module-1 Introduction to Linux

Linux operating system overview, major Linux distributions, Linux architecture and kernel, installation of Linux systems, basic Linux commands, command-line navigation, file and directory operations, working with editors, Linux help systems

Module-2 User and group management

Creating and managing user accounts, user profiles and home directories, managing groups, user switching and permissions, file ownership, chmod, chown, chgrp, configuring sudoers, root access and privilege management

Module-3 File Systems and Process Management

Linux file system hierarchy, partitions and file systems (ext4, xfs), mounting and unmounting file systems, disk partitioning and formatting tools, working with fstab, process management – ps, top, kill, nice, cron jobs and scheduling, system monitoring tools

Module-4 Network Configuration

Linux network stack, IP addressing and hostname configuration, managing interfaces using nmcli and ifconfig, configuring DNS, DHCP, and SSH, working with network services (httpd, ftp, etc.), network troubleshooting using ping, netstat, traceroute, remote access configuration using SSH

Module-5 Security and Troubleshooting

Linux security fundamentals, configuring firewalls with iptables and firewalld, introduction to SELinux and AppArmor, data backup tools (rsync, tar, cron-based backups), restoring systems, reading and interpreting system logs, diagnosing common issues in Linux environments, best practices in hardening Linux systems

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Semester 5

Data Structures and Algorithms - 2

Course Title:	Data Structures and Algorithms - 2		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

- To strengthen problem-solving skills using advanced data structures and algorithms
- To introduce algorithmic paradigms such as greedy algorithms, divide-and-conquer, and dynamic programming
- To analyze and evaluate the performance and correctness of advanced algorithms

Course outcomes:

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

1. Remember advanced data structures like heaps, hash tables, and graphs
2. Understand algorithmic paradigms including greedy, divide-and-conquer, and dynamic programming
3. Apply graph algorithms and hashing techniques to practical problems
4. Analyze the efficiency and correctness of algorithmic solutions
5. Evaluate trade-offs in choosing algorithm strategies for different problems
6. Create optimized solutions to computational problems using advanced techniques

Module-1: Hashing and Heaps

Hash functions and collision resolution, Open addressing and chaining, Applications of hash tables, Min-heaps and max-heaps, Heap operations, Priority queues and heap sort

Module-2: Advanced Trees

AVL trees and rotations, B-trees and B+ trees, Tries and prefix trees, Segment trees and Fenwick trees, Applications in indexing and range queries
Module-3: Graphs and Graph Algorithms
Graph representations and traversals, BFS and DFS, Topological sorting, Shortest path algorithms including Dijkstra and Bellman-Ford, Minimum spanning tree algorithms like Kruskal and Prim, Applications in networks and routing
Module-4:Divide-and-Conquer and Greedy Algorithms
Principle of divide-and-conquer, Merge sort and quick sort revisited, Binary search variations, Greedy strategy and algorithm design, Activity selection, Huffman coding, Job sequencing with deadlines
Module-5: Dynamic Programming and Backtracking
Dynamic programming concepts and overlapping subproblems, Matrix chain multiplication, 0/1 knapsack, Longest common subsequence, Introduction to backtracking, N-Queens, Subset sum, Sudoku solver

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Algorithm Design* by Jon Kleinberg and Éva Tardos, Pearson Education, 1st Edition, 2005
2. *Data Structures and Algorithms Made Easy* by Narasimha Karumanchi, CareerMonk Publications, 2nd Edition, 2016

Reference Books

1. *The Algorithm Design Manual* by Steven S. Skiena, Springer, 2nd Edition, 2008
2. *Algorithms* by Robert Sedgewick and Kevin Wayne, Addison-Wesley, 4th Edition, 2011

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Formal Language and Automata Theory

Course Title:	Data Structures and Algorithms - 2		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	04

Course objectives:

1. Identify Recognizable Languages: Students will identify the regular and context-free languages that a given automaton can recognize.
2. Design Grammars and Automata: Students will design regular expressions, context-free grammars, and construct finite automata, pushdown automata, and Turing machines to recognize given languages.
3. Apply Formal Language Principles: Students will apply the principles of formal languages and automata to real-world problems, such as pattern matching and parsing.

Course outcomes:

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

1. To identify the regular and context-free languages that a given automaton can recognize.
2. To design regular expressions and context-free grammars for given languages.
3. To construct finite automata, pushdown automata, and Turing machines to recognize given languages.
4. To analyze the time and space complexity of algorithms that operate on formal languages.
5. To apply the principles of formal languages and automata to real-world problems, such as pattern matching and parsing.
6. To evaluate and critique different models of computation and their relative strengths and weaknesses.

Module-1: 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: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: Context free Grammar and Languages

Context free grammar, Parse trees, Applications, Ambiguity

Module-4: Pushdown Automata

The languages of a PDA, Equivalance of PDA and CFG, Deterministic PDA

Module-5: Intro to Turing machines

Problems that computers cannot solve, The Turing machine, Programming techniques for Turing machine, Extensions to the basic Turing machine

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Automata Theory Language & Computation; Hopcraft; Pearson 3rd edition

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Machine Learning

Course Title:	Machine Learning		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:2:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 30 hours Practical	Credits	03

Course objectives:

- To provide students with an understanding of core machine learning algorithms and techniques
- To equip students with practical skills to implement machine learning models and evaluate their performance
- To explore the applications of machine learning in real-world scenarios

Course outcomes:

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

1. Understand the different types of machine learning algorithms (supervised, unsupervised, reinforcement learning)
2. Implement machine learning algorithms such as linear regression, decision trees, and clustering techniques
3. Evaluate the performance of machine learning models using appropriate metrics
4. Apply preprocessing techniques for data preparation and feature selection
5. Build and train machine learning models using popular libraries (e.g., Scikit-learn, TensorFlow)
6. Apply machine learning techniques to solve real-world problems in various domains

Module-1: Introduction to Machine Learning

Overview of machine learning, Types of machine learning (supervised, unsupervised, reinforcement), Key concepts in machine learning, The machine learning pipeline, Data preprocessing and cleaning, Introduction to training and testing sets

Module-2: Supervised Learning

Linear regression, Logistic regression, Classification algorithms (K-Nearest Neighbors, Naive Bayes, Support Vector Machines), Decision trees, Random forests, Overfitting and underfitting, Model evaluation metrics (accuracy, precision, recall, F1 score)
Module-3: Unsupervised Learning
Clustering techniques (K-means, Hierarchical clustering), Dimensionality reduction (PCA, LDA), Anomaly detection, Association rule learning, Applications of unsupervised learning, Evaluating clustering algorithms
Module-4: Neural Networks and Deep Learning
Introduction to neural networks, Perceptron and multi-layer perceptrons, Backpropagation, Deep learning fundamentals, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Introduction to frameworks (TensorFlow, Keras)
Module-5: Model Evaluation and Advanced Topics
Cross-validation, Hyperparameter tuning, Model selection, Ensemble methods (Bagging, Boosting), Reinforcement learning basics, Ethical considerations in machine learning, Future trends in machine learning

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Pattern Recognition and Machine Learning* by Christopher M. Bishop, Springer, 1st Edition, 2006

2. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* by Aurélien Géron, O'Reilly Media, 2nd Edition, 2019

Reference Books

1. *Machine Learning: A Probabilistic Perspective* by Kevin P. Murphy, MIT Press, 1st Edition, 2012

2. *Deep Learning* by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 1st Edition, 2016

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Tools and Techniques for Creative Thinking

Course Title:	Tools and Techniques for Creative Thinking		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. Generate New Ideas: Students will use a variety of creative thinking tools and techniques to generate new ideas.
2. Evaluate Creative Solutions: Students will apply critical thinking skills to analyze and evaluate creative ideas and solutions.
3. Collaborate and Communicate: Students will develop effective communication skills for presenting and selling creative ideas, and work collaboratively with others to generate and implement creative solutions.

Course outcomes:

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

1. To use a variety of creative thinking tools and techniques to generate new ideas
2. To apply critical thinking skills to analyze and evaluate creative ideas and solutions
3. To identify and overcome barriers to creative thinking and problem-solving
4. To apply creative thinking skills in practical situations, such as in business, design, and technology
5. To develop effective communication skills for presenting and selling creative ideas
6. To work collaboratively with others to generate and implement creative solutions

Module-1: Introduction to Principles of Creativity

Mother and father of innovation, Levels of creativity, Creative environments

Module-2: Creativity tools

Creativity tools, Brainstorming techniques, Principles of brainstorming, Flip chart, Post-it, Alphabet brainstorming, Brainwriting, Grid brainstorming

Module-3:Thinking styles

The value of diversity, Principles of various thinking styles, Design thinking, Different thinking styles in practice

Module-4: Morphological analysis

Principles of morphological analysis, Group application of plotline MA

Module-5: TRIZ theory

Principles and discussion, Contradiction matrix, TRIZ Parameters and Principles

Module-6: SCAMPER

SCAMPER for architecture, team innovation using SCAMPER, Use of different thinking styles

Module-7: Using the tools in combination

Creative problem solving, Double diamond model, Circle brainstorming steps, E-tivity: B-link

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Lateral Thinking: A Textbook of Creativity; Penguin; 2016 edition

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

LLM Systems Foundation

Course Title:	LLM Systems Foundation		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:2:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 30 hours Practical	Credits	3

Course objectives:

- To introduce the architecture and working principles of large language models
- To understand the training techniques used for LLMs, including data handling and optimization strategies
- To explore practical applications and challenges of LLM systems

Course outcomes:

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

1. Understand the structure and architecture of large language models
2. Apply machine learning techniques for training LLMs, including pretraining and fine-tuning
3. Handle large-scale text data for model training and evaluation
4. Understand the limitations and challenges of LLM systems in real-world applications
5. Build and deploy simple LLM-based applications
6. Evaluate the ethical considerations and biases in LLM

Module-1: Introduction to LLMs

Overview of large language models, Evolution of LLMs, Types of LLMs (e.g., GPT, BERT), Transformer architecture, Self-attention mechanism, Embedding layers, Positional encoding

Module-2: Training Large Language Models

Pretraining vs. fine-tuning, Text data collection and preprocessing, Model architectures (GPT, BERT, T5), Transfer learning in LLMs, Optimizers and loss functions for training

Module-3: Model Evaluation and Fine-Tuning
Evaluation metrics for LLMs, Fine-tuning on specific tasks (text generation, classification, summarization), Hyperparameter tuning, Transfer learning for domain-specific models
Module-4: Applications of LLMs
Text generation and completion, Sentiment analysis, Question answering systems, Language translation, Summarization, Text-based applications in industries (healthcare, finance)
Module-5: Challenges and Ethical Considerations
Bias and fairness in LLMs, Model explainability and interpretability, Handling adversarial attacks, Privacy concerns, Ethical issues in deploying LLMs, Future trends and research directions

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Transformers for Natural Language Processing* by Denis Rothman, Packt Publishing, 1st Edition, 2021

2. *Deep Learning with Python* by François Chollet, Manning Publications, 2nd Edition, 2021

Reference Books

1. *Speech and Language Processing* by Daniel Jurafsky and James H. Martin, Pearson, 3rd Edition, 2020

2. *Natural Language Processing with Transformers* by Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 1st Edition, 2022

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Semester 6

Design and Analysis of Algorithms

Course Title:	Design & Analysis of Algorithms		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 15 hours Theory	Credits	04

Course objectives:

1. Apply Algorithm Design Techniques: Students will apply various algorithm design methods to solve computational problems efficiently.
2. Analyze Algorithm Efficiency: Students will analyze the time and space complexity of algorithms and compare the efficiency of different algorithms for the same problem.
3. Implement Classical Techniques: Students will demonstrate proficiency in dynamic programming, greedy algorithms, and other classical algorithmic techniques.

Course outcomes:

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

1. To apply algorithmic problem-solving techniques using a variety of algorithm design methods.
2. To analyze the time and space complexity of algorithms and compare the efficiency of different algorithms for the same problem.
3. To select appropriate data structures to optimize algorithms for specific problems.
4. To demonstrate proficiency in dynamic programming, greedy algorithms, and other classical algorithmic techniques.
5. To apply algorithmic solutions to real-world problems and evaluate the quality of the solution.
6. To analyze the limitations and challenges of algorithms in various contexts and assess the ethical implications of algorithm design.

Module-1: 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: 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: Sorting and searching algorithms

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

Module-4:Divide and conquer algorithms

General characteristics, Problem solving using Greedy methods, Activity selection problem, MST, The Knapskack problem

Module-5: String matching

The naive string matching algorithm, The Rabin-Karp algorithm, String Matching with infinite automata

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Computer Networks

Course Title:	Computer Networks		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	4

Course objectives:

1. Understand Networking Principles: Students will explain the fundamental concepts and principles of computer networks.
2. Implement Networking Protocols: Students will implement basic networking protocols and configure network devices.
3. Troubleshoot Network Issues: Students will integrate networking concepts to troubleshoot and optimize network performance.

Course outcomes:

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

1. To identify the different components and layers of computer networks.
2. To explain the functions of different protocols used in computer networks.
3. To analyze the performance and limitations of different network architectures.
4. To design and implement basic network configurations using routers and switches.
5. To troubleshoot common network issues using various network analysis tools.
6. To evaluate the security concerns and design solutions to ensure network security.

Module-1: Internetworking and Routing

Definition and importance of self-awareness; Techniques for introspection and self-reflection; Identifying personal values, beliefs, and biases; Understanding emotions and their impact on behavior; Developing self-compassion and self-acceptance

Module-2: Resource Management

End-to-End Congestion Control, Router-Assisted Congestion Control, Active Queue Management, and Scheduling, Modeling and Measurement, Adaptive Applications and Internet QoS

Module-3:Network Services

Wireless/Mobile Networking, Naming: DNS, Peer-to-Peer Networking, Distributed Hash Tables, Overlay Routing, Multicast, Network Protection, Reliable Transport and Congestion Control, Unicast Routing, Adaptive and Network-Aware Applications, Traffic Engineering, Flow Modeling, Wireless Protocols, Naming, Web Caching

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Compiler Design

Course Title:	Compiler Design		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:4:0	Exam Hours	2
Total Hours of Pedagogy	15 hours Theory + 60 hours Practical	Credits	03

Course objectives:

1. Understand Compiler Principles: Students will apply the principles of formal language and automata theory in building compilers for programming languages.
2. Develop Lexical Analyzers and Parsers: Students will design and implement the lexical analyzer and parser for a programming language.
3. Generate and Optimize Code: Students will generate intermediate code from source code and apply various optimization techniques.

Course outcomes:

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

1. To apply the principles of formal language and automata theory in building compilers for programming languages.
2. To design and implement the lexical analyzer and parser for a programming language.
3. To generate intermediate code from source code using different techniques.
4. To optimize code generation using various optimization techniques.
5. To implement error handling and debugging mechanisms in a compiler.
6. To evaluate and compare different compiler design and optimization techniques.

Module-1: Introduction and Directed Translator

Basic economic principles, Supply and demand, Market structures, Economic systems (capitalism, socialism, mixed economy), Role of government in the economy

Module-2: Lexical analysis

Foundations of political science, Types of government (democracy, authoritarianism, monarchy), Political ideologies (liberalism, conservatism, socialism), Electoral systems and processes, Policy-making and implementation

Module-3: Syntax analysis

Sociological perspectives, Social institutions (family, education, religion), Social stratification and inequality, Cultural diversity and social change, Role of technology in society

Module-4: Syntax directed translation
Economic policies and their social impact, Political decisions and economic outcomes, Social policies and their economic implications, Case studies on the interplay between these areas, Globalization and its effects on economics, politics, and society
Module-5: Intermediate Code Generation
Analysis of current economic issues (e.g., recession, unemployment), Examination of political challenges (e.g., governance, corruption), Societal problems and engineering solutions (e.g., urbanization, climate change), Role of engineers in public policy, Case studies on recent events and their implications
Module-5: 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

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Advanced Machine Learning

Course Title:	Advanced Machine Learning		
Course Code:		CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:0:2:0	Exam Hours	2
Total Hours of Pedagogy	30 hours Theory + 30 hours Practical	Credits	03

Course objectives:

- To provide a deep understanding of advanced machine learning algorithms
- To explore the application of deep learning, ensemble methods, and reinforcement learning
- To enable students to develop complex machine learning models and evaluate their performance

Course outcomes:

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

1. Understand the theory behind advanced machine learning algorithms
2. Implement deep learning models using frameworks like TensorFlow and PyTorch
3. Apply ensemble methods such as Random Forests and Gradient Boosting
4. Develop and deploy reinforcement learning algorithms
5. Evaluate the performance of advanced models using cross-validation and other techniques
6. Address overfitting and underfitting challenges in complex models

Module-1: Deep Learning

Introduction to deep learning, Neural networks and activation functions, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Autoencoders, Transfer learning, Deep learning frameworks (TensorFlow, PyTorch)

Module-2: Ensemble Methods

Bagging and boosting, Random Forests, Gradient Boosting Machines (GBM), XGBoost, AdaBoost, Stacking, Model selection and tuning using ensemble methods

Module-3: Reinforcement Learning

Introduction to reinforcement learning, Markov Decision Processes (MDP), Q-learning and SARSA, Policy gradient methods, Deep Q-Networks (DQN), Applications of reinforcement learning (games, robotics)

Module-4: Syntax directed translation

Economic policies and their social impact, Political decisions and economic outcomes, Social policies and their economic implications, Case studies on the interplay between these areas, Globalization and its effects on economics, politics, and society
Module-5:Unsupervised Learning and Clustering
Clustering techniques (K-means, DBSCAN), Dimensionality reduction (PCA, t-SNE), Self-organizing maps (SOM), Generative models (GANs), Anomaly detection
Module-5: Advanced Topics and Applications
Transfer learning, Federated learning, Meta-learning, Multi-task learning, Applications in NLP, computer vision, and autonomous systems, Challenges and ethical considerations in advanced machine learning

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Deep Learning* by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 1st Edition, 2016

2. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* by Aurélien Géron, O'Reilly Media, 2nd Edition, 2019

Reference Books

1. *Pattern Recognition and Machine Learning* by Christopher Bishop, Springer, 1st Edition, 2006

2. *Reinforcement Learning: An Introduction* by Richard S. Sutton and Andrew G. Barto, MIT Press, 2nd Edition, 2018

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

System Design

Course Title:	System Design		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 Hours Practical	Credits	4

Course objectives:

.Understand the basic principles and terminology of cryptography.

1. Apply symmetric and asymmetric encryption techniques to secure data.
2. Analyze the security and efficiency of various cryptographic protocols

Course outcomes:

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

1. Identify the basic principles and terminology of cryptography. (L1 - Remember)
2. Describe classical and modern cryptographic algorithms and their applications. (L2 - Understand)
3. Apply symmetric and asymmetric encryption techniques to secure data. (L3 - Apply)
4. Analyze the security and efficiency of various cryptographic protocols. (L4 - Analyze)
5. Evaluate the strengths and weaknesses of different cryptographic methods. (L5 - Evaluate)
6. Discuss the role of cryptography in contemporary security systems. (L2 - Understand)

Module-1: Introduction to Cryptography

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

Module-2: Classical Cryptography

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

Module-3: Modern Cryptography

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

Module-4: Cryptographic Protocols

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

Module-5: Advanced Topics in Cryptography

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

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Programming with Prompt Engineering

Course Title:	Programming with Prompt Engineering		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	1

Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. **Understand the Fundamentals of Prompt Engineering**
   Equip students with a strong foundation in prompt engineering concepts, including prompt types, structure, and strategies to effectively influence AI model behavior.

2. **Develop Proficiency in Designing and Evaluating Prompts**
   Enable students to craft, test, and refine prompts across various use cases and domains to optimize the performance of language models for specific tasks.

3. **Apply Prompt Engineering Techniques Using Programming Tools**
   Train students to integrate prompt engineering within programming environments and tools, applying their skills to solve real-world problems and build AI-driven applications.

Course outcomes:

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

1. Identify fundamental principles of prompt engineering and its applications.
2. Describe techniques for creating effective and efficient prompts avoiding AI hallucinations.
3. Explain the impact of prompt design on AI performance and outputs.
4. Apply prompt engineering techniques to optimise AI systems and integrate with AI Platforms.
5. Analyse case studies and real-world examples to understand the practical applications of prompt engineering.
6. Develop innovative solutions using prompt engineering in various AI projects.

Module-1: 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: 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: 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: 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: 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

Continuous Internal Exam (CIE): ● There will be 1 CIE that will be counted towards 100% of the weightage.

Suggested Learning Resources: **Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)** **Text Books** ● 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 Books** ● 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
Web links and Video Lectures (e-Resources):
● www.kalvium.community/livebooks
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning ● Quizzes ● Assignments ● Discussions

Semester 7

Fundamentals of Business Management

Course Title:	Fundamentals of Business Management		
Course Code:		CIE Marks	50
		SEE Marks	50

Course Type (Theory/Practical/Integrated)	Theory	Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	2
Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. Understand Business Management Principles: Students will explain the fundamental concepts and principles of modern business management, including organizational structures, functions, and processes.
2. Develop Core Business Skills: Students will develop a strong foundation in core business disciplines, such as accounting, finance, marketing, and operations management.
3. Formulate and Execute Strategies: Students will develop the ability to formulate and execute effective business strategies, understanding the importance of strategic thinking and planning in business management.

Course outcomes:

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

1. To understand the fundamental concepts and principles of modern business management, including organizational structures, functions, and processes.
2. To develop a strong foundation in core business disciplines, such as accounting, finance, marketing, and operations management.
3. To acquire the necessary knowledge and skills to manage people effectively, including leadership, motivation, and communication.
4. To understand the importance of strategic thinking and planning in business management, and to develop the ability to formulate and execute effective business strategies.
5. To learn to manage resources efficiently and effectively, including financial, technological, and human resources.
6. To develop critical thinking and problem-solving skills, and to apply them in real-world business scenarios.

Module-1: Introduction to business management and Marketing

How business operate, Branding, customer centricity, Go-to market strategies, different modes of marketing

Module-2: Financial Accounting

Balance sheet, Accrual accounting, Income sheet, Cash flows, Ratio analysis

Module-3: Background to Entrepreneurship

Motivation and reward, Tasks, jobs and system of work, Making good & timely decisions, Designing and changing the organization's architecture

Module-4: Managing social and human capital

Theories of entrepreneurship, Activity scope and role in modern society, The effects of entrepreneurial activity on economic systems, contributions and benefits of entrepreneurial activity, Entrepreneurship in Oman. Problems faced by small firms, types of entrepreneurs and innovators.
Module-5: The Entrepreneur
The individual in terms of psychology, personality and trait theories; The individual in terms of motivation and achievement theories; The individual in terms of behaviour and characteristics theories; Differentiated entrepreneur typologies.
Module-6: Conceiving a Business Idea and Creating a Business Plan
Business Idea - Models for new ventures, idea generation, screening ideas, business analysis, and feasibility studies. Business Plan - Purpose and benefits, design of a business plan, layout and content, focused recipient, approaching potential investors.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. "Principles of Management" by Peter F. Drucker (HarperCollins, 2017)
2. "Fundamentals of Management" by Stephen P. Robbins and David A. DeCenzo (Pearson, 2017)

Reference Books

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

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Natural Language Processing

Course Title:	System Design		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 Hours Practical	Credits	4

Course objectives:

- To provide an understanding of the core techniques in Natural Language Processing
- To teach students how to preprocess and transform text data for machine learning applications

- To explore various NLP tasks such as text classification, named entity recognition, and machine translation

Course outcomes:

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

1. Preprocess text data for various NLP tasks, including tokenization and stemming
2. Implement machine learning models for text classification and sentiment analysis
3. Build NLP pipelines for named entity recognition and part-of-speech tagging
4. Apply sequence-to-sequence models for machine translation and text summarization
5. Understand and implement word embeddings (Word2Vec, GloVe)
6. Explore the impact of deep learning techniques in NLP tasks

Module-1: Introduction to Natural Language Processing

Overview of NLP, Challenges in NLP, Text preprocessing (tokenization, stopwords removal, stemming), Part-of-speech tagging, Named entity recognition (NER), Word tokenization and sentence segmentation

Module-2:Language Modeling and Text Representation

N-grams and Markov models, Introduction to word embeddings (Word2Vec, GloVe), Bag of words, TF-IDF, Latent Semantic Analysis (LSA), Vector space models, Word embeddings vs. one-hot encoding

Module-3: Supervised and Unsupervised Learning for NLP

Supervised learning for NLP (classification, regression), Unsupervised learning for NLP (clustering, topic modeling), Support Vector Machines for text classification, Naive Bayes for text classification, K-means clustering for text data

Module-4: Advanced NLP Techniques

Sequence models (Recurrent Neural Networks, LSTMs, GRUs), Attention mechanism, Transformer models (BERT, GPT), Fine-tuning pre-trained models for specific tasks, Machine translation using seq2seq models

Module-5: Applications of NLP
Text summarization, Sentiment analysis, Question answering systems, Text generation, Named entity recognition, Machine translation, NLP applications in industry (e.g., chatbots, virtual assistants)

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Speech and Language Processing* by Daniel Jurafsky and James H. Martin, Pearson, 3rd Edition, 2020

2. *Natural Language Processing with Python* by Steven Bird, Ewan Klein, and Edward Loper, O'Reilly Media, 1st Edition, 2009

Reference Books

1. *Neural Network Methods in Natural Language Processing* by Yoav Goldberg, Morgan & Claypool, 1st Edition, 2017

2. *Deep Learning for Natural Language Processing* by Palash Goyal, Sumit Pandey, and Karan Jain, Springer, 1st Edition, 2018

Web links and Video Lectures (e-Resources):
• www.kalvium.community/livebooks
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Quizzes • Assignments • Discussions

Building on the Blockchain

Course Title:	Building on the Blockchain		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1

Total Hours of Pedagogy	45 hours Theory + 30 Hours Practical	Credits	4

Course objectives:

1. To introduce the foundational principles of blockchain technology and distributed ledgers.
2. To enable students to build decentralized applications (DApps) using modern blockchain frameworks.
3. To explore real-world use cases of blockchain beyond cryptocurrency, including NFTs, supply chains, and digital identity.

Course outcomes:

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

1. Explain the core concepts of blockchain, smart contracts, and consensus mechanisms.
2. Evaluate the trade-offs between various blockchain platforms like Ethereum, Solana, and Polygon.
3. Design and develop basic decentralized applications (DApps).
4. Integrate smart contracts with frontend interfaces using Web3 libraries.
5. Identify security challenges in blockchain systems and propose mitigation strategies.
6. Analyze the societal and legal implications of blockchain-based systems.
7. Work collaboratively to develop, test, and deploy a real-world blockchain solution.

Module-1: Foundations of Blockchain Technology

Introduction to Blockchain, Distributed Ledgers, Cryptographic Hash Functions, Proof of Work vs Proof of Stake, Blockchain Forks, Consensus Mechanisms

Module-2:Smart Contracts and Ethereum Ecosystem

Smart Contracts and Ethereum, Solidity Programming Basics, Gas and Transactions, Remix IDE, Events and Modifiers

Module-3: Decentralized Application Development
DApps Architecture, Web3.js and Ethers.js, Frontend Integration with Smart Contracts, MetaMask and Wallet Connections, State Management in DApps
Module-4: Advanced Blockchain Concepts
Advanced Blockchain Platforms, Layer 2 Solutions, Interoperability, NFTs and Token Standards (ERC-20, ERC-721), Blockchain Scaling Techniques
Module-5: Blockchain Security and Real-World Use Cases
Security in Blockchain, Common Vulnerabilities in Smart Contracts, Blockchain in Supply Chain, Digital Identity and DAO, Legal and Ethical Concerns in Decentralization

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.

- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Mastering Blockchain* by Imran Bashir, Packt Publishing, 3rd Edition, 2020
2. *Ethereum Smart Contract Development* by Mayukh Mukhopadhyay, Apress, 2018

Reference Books

1. *Blockchain Applications: A Hands-On Approach* by Arshdeep Bahga and Vijay Madisetti, VPT, 1st Edition, 2017
2. *Building Ethereum DApps* by Roberto Infante, Manning Publications, 1st Edition, 2018

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Edge Computing

Course Title:	Edge Computing		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 Hours Practical	Credits	4

Course objectives:

- Understand the fundamentals and evolution of edge computing and how it complements cloud computing.
- Explore edge architectures, platforms, and deployment models relevant to real-world applications.
- Apply edge computing principles to develop, deploy, and optimize distributed computing systems at the network edge.

Course outcomes:

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

1. Explain the core concepts and motivations behind edge computing.
2. Analyze edge computing architecture, devices, and networking paradigms.
3. Develop edge-native applications using appropriate hardware and software stacks.
4. Evaluate performance, latency, and energy trade-offs in edge versus cloud deployments.
5. Demonstrate integration of edge systems with IoT and cloud platforms.
6. Assess security, privacy, and reliability concerns in edge deployments.
7. Apply knowledge of edge computing to real-world case studies and industrial use cases.

Module-1: Introduction to Edge Computing

Introduction to Edge Computing, Evolution from Cloud to Edge, Edge vs. Fog Computing, Edge Ecosystem and Stakeholders, Use Cases and Benefits

Module-2:Edge Architecture and Infrastructure

Edge Architecture and Components, Edge Devices and Sensors, Edge Gateways and Micro Data Centers, Edge-Cloud Continuum, Networking at the Edge

Module-3: Edge Application Development

Edge Application Development, Edge AI and ML Workloads, Frameworks and Tools (EdgeX Foundry, AWS Greengrass), Containerization and Orchestration

Module-4: IoT and Edge Integration

IoT and Edge Integration, Protocols (MQTT, CoAP), Real-Time Data Processing, Edge Data Storage, Edge Analytics, Case Studies in Smart Cities and Healthcare

Module-5: Security and Future Trends in Edge Computing

Security and Privacy at the Edge, Threat Models and Risk Mitigation, Resource Constraints, Reliability and Redundancy, Emerging Trends and Future Directions

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)
Text Books

1. *Edge Computing: A Primer* by Jie Cao, Weisong Shi, Springer, 2020

2. *Architecting the Internet of Things: State of the Art* by Dieter Uckelmann et al., Springer, 2011

Reference Books

1. *Fog and Edge Computing: Principles and Paradigms* by Rajkumar Buyya and Satish Narayana Srirama, Wiley, 2019

2. *Designing Distributed Systems* by Brendan Burns, O'Reilly Media, 2018

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Human Mind and Behaviour

Course Title:	Human Mind and Behaviour		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. Understand key psychological concepts and theories related to human mind and behavior.
2. Apply psychological theories to analyze cognitive processes and emotional responses.
3. Evaluate the influence of social and cultural factors on behavior and development.

Course outcomes:

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

1. Identify key psychological concepts and theories related to human mind and behavior. (L1 - Remember)
2. Describe the cognitive processes underlying perception, memory, and learning. (L2 - Understand)
3. Explain the emotional and motivational factors that influence behavior. (L2 - Understand)
4. Analyze the impact of social and cultural factors on individual behavior and group dynamics. (L4 - Analyze)
5. Evaluate different psychological approaches to understanding mental health and illness. (L5 - Evaluate)
6. Discuss the developmental stages of human growth and their psychological implications. (L2 - Understand)

Module-1: Introduction to Psychology

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

Module-2: Cognitive Processes

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

Module-3: Emotion and Motivation

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

Module-4: Social and Cultural Influences

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

Module-5: Developmental Psychology
Stages of human development, Cognitive and emotional development, Social and moral development, Psychological disorders across the lifespan

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

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

Reference Books

1. "The Developing Person Through the Life Span" by Kathleen Stassen Berger, Worth Pub, 11th edition
2. "The Social Animal" by Elliot Aronson, Worth Publishers Inc.,U.S., 2018 edition

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Organization behaviour

Course Title:	Organization behaviour		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. Understand key concepts and theories of organizational behavior.
2. Apply motivational and leadership theories to analyze team dynamics and organizational culture.
3. Evaluate strategies for improving communication and conflict resolution within organizations.

Course outcomes:

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

By the end of this course, students will be able to:

1. Identify fundamental concepts and theories of organizational behavior. (L1 - Remember)
2. Describe the factors that influence individual behavior in organizations. (L2 - Understand)
3. Explain the dynamics of group behavior and teamwork in organizational settings. (L2 - Understand)
4. Analyze the impact of leadership styles and practices on organizational performance. (L4 - Analyze)
5. Evaluate the role of organizational culture in shaping behavior and outcomes. (L5 - Evaluate)
6. Discuss strategies for effective communication and conflict resolution in organizations. (L2 - Understand)

Module-1: Introduction to Organizational Behavior

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

Module-2: Individual Behavior in Organizations

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

Module-3: Group Behavior and Team Dynamics
Group formation and development, Teamwork and collaboration, Group decision-making, Conflict and negotiation
Module-4: Leadership in Organizations
Leadership theories and styles, Power and politics in organizations, Leadership and organizational change, Emotional intelligence and leadership effectiveness
Module-5: Organizational Culture and Communication
Components of organizational culture, Creating and sustaining culture, Communication processes and barriers, Strategies for effective organizational communication

Continuous Internal Exam (CIE):

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Organizational Behavior: Improving Performance and Commitment in the Workplace" by Jason A. Colquitt, Jeffery A. LePine, and Michael J. Wesson, McGraw-Hill Education, 4th edition
2. "Organizational Behavior" by Stephen P. Robbins and Timothy A. Judge, Pearson Education, 18th edition

Reference Books

1. "Organizational Culture and Leadership" by Edgar H. Schein, John Wiley & Sons, 4th edition
2. "The Fifth Discipline: The Art & Practice of The Learning Organization" by Peter M. Senge, Doubleday, 2006 edition

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Design thinking 101

Course Title:	Design thinking 101		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory	Credits	3

Course objectives:

1. Understand the principles and stages of the design thinking process.
2. Apply design thinking techniques to generate and develop innovative solutions.
3. Evaluate the effectiveness of design prototypes through iterative testing and user feedback.

Course outcomes:

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

1. Identify the key principles and stages of the design thinking process.
2. Describe the importance of empathy and user-centered design in solving problems. Apply design thinking techniques to generate innovative solutions.
3. Analyze user needs and define clear problem statements.
4. Evaluate the effectiveness of prototypes through iterative testing.
5. Collaborate effectively in teams to develop and refine design solutions.

Module-1: Introduction to Design Thinking
Overview of design thinking, Key principles and mindsets, The design thinking process (Empathize, Define, Ideate, Prototype, Test), Case studies of design thinking in action
Module-2: Empathize
Understanding the user, Conducting interviews and observations, Building empathy maps, Synthesizing user insights
Module-3: Define
Defining the problem, Creating problem statements, Identifying user needs and challenges, Framing design challenges
Module-4: Ideate
Brainstorming techniques, Encouraging creativity and divergent thinking, Generating a wide range of ideas, Selecting and prioritizing ideas
Module-5: Prototype and Test
Prototyping methods (low-fidelity and high-fidelity), Building and iterating on prototypes, Conducting user testing, Gathering and analyzing feedback, Refining solutions based on user input

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.

- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" by Tim Brown, HarperBusiness (29 September 2009)
2. "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems" by Michael Lewrick, Patrick Link, and Larry Leifer, Wiley; 1st edition (May 22, 2018)

Reference Books

1. "Design Thinking: Understanding How Designers Think and Work" by Nigel Cross, Bloomsbury Publishing India Private Limited (1 January 2011)
2. "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days" by Jake Knapp, John Zeratsky, and Braden Kowitz, Simon & Schuster; Illustrated edition (8 March 2016)

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Robotics and Automation

Course Title:	Robotics and Automation		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 Hours Practical	Credits	4

Course objectives:

1. Understand Robotics and Automation Fundamentals: To provide students with a comprehensive understanding of the basic principles and concepts of robotics and automation.
2. Develop Theoretical Knowledge of Robot Design and Control: To equip students with the knowledge to understand robot design, control systems, and programming.
3. Explore Applications and Impacts of Robotics and Automation: To enable students to analyze the applications, benefits, and challenges of robotics and automation in various fields.

Course outcomes:

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

1. Identify key components and types of robotic systems.
2. Describe the principles of robot kinematics, dynamics, and control.
3. Explain the basics of robot programming and automation systems.
4. Analyse the applications of robotics in industrial and service sectors.
5. Evaluate the ethical and societal implications of robotics and automation.
6. Demonstrate strong conceptual understanding of robotic system design and operations.

Module-1: Introduction to Robotics and Automation
History and evolution of robotics, Basic concepts and definitions, Types of robots (industrial, mobile, service), Overview of automation systems
Module-2: Components and Mechanisms
Robot anatomy (joints, links, actuators), Sensors and perception, Power sources and transmission, End effectors and grippers
Module-3: Kinematics and Dynamics
Forward and inverse kinematics, Robot dynamics, Motion planning and trajectory generation, Control systems (PID, adaptive control)
Module-4: Robot Programming and Control
Introduction to robot programming languages, Robot Operating System (ROS), Programming paradigms (event-driven, reactive), Automation in manufacturing (PLC, SCADA)
Module-5: Applications and Future Trends
Industrial automation and robotics, Service robots (healthcare, logistics, domestic), Autonomous vehicles and drones, Ethical and societal implications, Future trends in robotics and automation

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):
The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson Education, 4th Edition, 2018.
2. "Robotics: Control, Sensing, Vision, and Intelligence" by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee, McGraw Hill Education, 1st Edition, 2008

Reference Books

1. "Robotic Process Automation" by Alok Mani Tripathi, Packt Publishing, 1st Edition, 2018.
2. "Springer Handbook of Robotics" by Bruno Siciliano and Oussama Khatib, Springer, 2nd Edition, 2016.

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Speech Processing

Course Title:	Speech Processing		
Course Code:		CIE Marks	100

Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	4

Course objectives:

1. Understand Speech Processing Fundamentals: To provide students with a comprehensive understanding of the principles and techniques of speech processing.
2. Develop Practical Speech Processing Skills: To equip students with the ability to implement speech processing techniques using modern tools and frameworks.
3. Enhance Problem-Solving Abilities through Real-World Applications: To enable students to apply speech processing methods to solve real-world problems, fostering innovation and practical problem-solving skills.

Course outcomes:

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

1. Identify key concepts and techniques in speech processing.
2. Describe methods for speech signal processing, feature extraction, and modeling.
3. Explain advanced speech processing topics such as speech recognition and synthesis.
4. Apply speech processing tools and techniques to analyze speech data.
5. Analyse speech processing models on their performance.
6. Create a simple speech processing application for a real-world project.

Module-1: Fundamentals of Speech Production and Acoustics

Speech organs and production mechanisms, acoustic phonetics, phonemes, prosody, speech waveform characteristics.

Module-2: Signal Processing Techniques for Speech

Fourier analysis, digital filtering, short-time Fourier transform (STFT), Mel-frequency cepstral coefficients (MFCCs), linear predictive coding (LPC).

Module-3: Speech Analysis and Feature Extraction

Feature extraction methods, pitch detection, formant analysis, speech segmentation, spectral analysis.

Module-4: Speech Coding and Compression

Quantization, coding techniques, vocoders, speech synthesis, speech enhancement, noise reduction techniques

Module-5: Speech Recognition and Applications

Automatic speech recognition (ASR) systems, speaker recognition, language identification, emotion recognition, machine learning approaches in speech processing.

Continuous Internal Exam (CIE):

- There will be a total of 2 internal assessments conducted during the semester.
- The sum total scores of the assessments will be scaled to 50 marks and considered for CIE.
- The minimum passing score on CIE must be 40% in order to be eligible for SEE.

Semester End Examination(SEE):

The SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 2-3 hours)**

- The medium of the question paper shall be English. The duration of SEE is 2-3 hours.
- The SEE will be conducted digitally on a proctored online platform, in a university-designated classroom.
- The SEE will be scored for 50.
- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition; Daniel Jurafsky, James H. Martin, Pearson Education India, 2nd Edition, 1 January 2013.
2. Digital Processing of Speech Signals; Lawrence R. Rabiner, Ronald W. Schafer; Pearson, 1st Edition, 1 October 1978.

Reference Books

1. Fundamentals of Speech Recognition; Lawrence Rabiner, Biing-Hwang Juang; Pearson India, 1st Edition, 1 January 2008.
2. Discrete-Time Speech Signal Processing: Principles and Practice;Thomas F. Quatieri; Pearson Prentice Hall; 29 October 2001.

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions

Cloud Computing for Data Analytics

Course Title:	Cloud Computing for Data Analytics		
Course Code:		CIE Marks	100
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	0
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	1
Total Hours of Pedagogy	45 hours Theory + 30 hours Practical	Credits	4

Course objectives:

- Understand the fundamentals of cloud computing and its role in modern data analytics pipelines.
- Explore scalable tools, platforms, and services available for big data processing on the cloud.
- Apply cloud-native data analytics techniques to real-world use cases using platforms like AWS, GCP, and Azure.

Course outcomes:

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

1. Explain key concepts of cloud computing and its benefits for data analytics.
2. Use cloud platforms to store, process, and analyze large-scale datasets.
3. Compare services like Amazon Redshift, Google BigQuery, and Azure Synapse Analytics.
4. Implement end-to-end data pipelines using cloud-native tools and serverless computing.
5. Apply big data frameworks (Hadoop, Spark) in cloud environments.
6. Evaluate cost, performance, and scalability trade-offs in cloud analytics workflows.
7. Work with real-world datasets using cloud tools for ETL, visualization, and machine learning.

Module-1: Foundations of Cloud and Data Analytics

Cloud Computing Basics, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models, Benefits and Challenges for Data Analytics, Overview of Data Analytics Lifecycle

Module-2: Data Storage and Warehousing on the Cloud
Cloud Storage Options (Object, Block, File), Cloud Data Lakes and Warehouses, Amazon S3, Google Cloud Storage, BigQuery, Snowflake, Data Partitioning and Compression
Module-3: Cloud-Based Data Processing Frameworks
Hadoop on Cloud, Apache Spark on Cloud, Serverless Data Processing (AWS Lambda, GCP Cloud Functions), Batch vs. Stream Processing, Auto-Scaling and Job Scheduling
Module-4: Building Data Pipelines in the Cloud
ETL vs. ELT, Data Ingestion Tools (AWS Glue, Google Dataflow), Workflow Orchestration (Apache Airflow, Azure Data Factory), Case Study on Real-Time Analytics Pipelines
Module-5: Advanced Analytics and Visualization
Cloud ML Services (AWS SageMaker, Azure ML, Google Vertex AI), Interactive Dashboards (Looker, Power BI, Tableau Cloud), Cost Optimization Strategies, Security & Compliance

Continuous Internal Exam (CIE):

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- Out of this, 40% will be considered passing mark.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. *Cloud Computing: Concepts, Technology & Architecture* by Thomas Erl, Pearson, 2013

2. *Designing Data-Intensive Applications* by Martin Kleppmann, O'Reilly Media, 2017

Reference Books

1. *Data Analytics with Google Cloud Platform* by Murari Ramuka, Packt Publishing, 2021

2. *Cloud Analytics with Google Cloud Platform* by Sanket Thodge, Packt Publishing, 2021

Web links and Video Lectures (e-Resources):

- www.kalvium.community/livebooks

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Discussions