



सावित्रीबाई फुले पुणे विद्यापीठ

Indira College of Engineering and Management
An Autonomous Institute of
Savitribai Phule Pune University, Pune
Maharashtra, India

National Education Policy (NEP)-2020 Compliant Curriculum

Second Year B.Tech (Computer Engineering)
(With effect from Academic Year 2025-26)

**Indira Chanakya Campus (ICC), S.No. 64,65, Gat No. 276 At Post : Parandwadi,
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Second Year BTech

Semester-III

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total		Theory			Practical / Oral		Total Marks
								TAE	CAE	ESE	INT	EXT	
24UCEL301	Data Structures	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-		75
24UCEP301	Data Structures Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UCEL302	Object Oriented Programming	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UCEP302	Object Oriented Programming Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UCEL303	Software Engineering	Program Core Course (PCC)	3	-	-	3	3	-	-	50	-	-	50
24UCELXXX	Minor-I	Multidisciplinary Minor-I	2	-	-	2	2	10	15	25	-	-	50
24UXXXXXXXX	Open Elective-I	Open Elective(OE) other that a particular program	3	-	-	3	3	10	15	50	-	-	75
24UXXXXXXXX	Open Elective-I Laboratory	Open Elective(OE) other that a particular program	-	-	2	2	1	-	-	-	25	-	25
24UESP304	Entrepreneurship Awareness-I	Entrepreneurship / Economics/ Management Course	-	-	4	4	2	-	-	-	25	-	25
24UVEL305	Understanding India	Value Education (VEC-I)	2	-	-	2	2	-	-	-	25	-	25
24UCEP306	Minor Project	Comm. Engg. Project (CEP)/ Field Project (FP)	-	-	4	4	2	-	-	-	25	25	50
	Total		14	-	16	30	22	40	60	225	100	75	500


Dr. Soumitra Das
HoD Computer


Dr. Saurabh Gupta
Dean Academics


Dr. Nilesh Uke
Director





Second Year BTech

Semester-IV

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total		Theory			Practical / Oral		Total Marks
								TAE	CAE	ESE	INT	EXT	
24UCEL401	Advanced Data Structure	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UCEP401	Advanced Data Structure Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UCEL402	Operating System	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UCEP402	Operating System Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UCEP403	Discrete Maths & Graph Theory	Program Core Course (PCC)	2	1	-	3	3	10	15	50	-	-	75
24UCELXXX	Minor –II	Multidisciplinary Minor-II	2	-	-	2	2	10	15	25	-	-	50
24UCEXXXX	Open Elective - II	Open Elective(OE) other that a particular program	2	-	-	2	2	10	15	25	-	-	50
24UCEP404	Web Development	Vocational & Skill Enhancement Course (VSC)	-	-	4	4	2	-	-	-	25	-	25
24UBSP405	Communication Skills	Ability Enhancement Course (AEC-I)	-	-	4	4	2	-	-	-	25	-	25
24UESP406	Entrepreneurship Awareness- II	Entrepreneurship / Economics/ Management Course	-	-	4	4	2	-	-	-	25	-	25
24UVEP407	Environment Studies	Value Education Course (VEC)	-	-	4	4	2	10	15	-	25	-	50
	Total		10	1	22	33	22	60	90	200	100	50	500


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[24UCEL301]: Data Structures

Teaching Scheme	Credit	Examination Scheme	Marks
TH: - 2 Hours/Week	02	Teachers Assessment Examination (TAE)	10
		Class Assessment Examination (CAE)	15
		End Semester Examination (ESE)	50
		Total	75
Course Prerequisites: Basic Programming Concepts			

Course Objectives	
1	To understand various data structures and know the concept of analysis of algorithms.
2	To understand array as a linear data structure.
3	To understand various data searching and sorting methods.
4	To understand stack and queue concepts with applications.
5	To understand stack and queue concepts with applications.
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	To understand data structures, algorithms and the analysis of algorithms
CO2	To demonstrate use of sequential data structures like Array with its applications.
CO3	To understand computational efficiency (time complexity) of the algorithms for searching and sorting and choose the most efficient one for the application.
CO4	To Understand, implement and apply principles of data structure like stack and queue to solve computational problems.
CO5	To Understand, implement and apply principles of data structure like linked list.

Contents	No. of Session
Unit 1: Fundamentals of Data Structure and Algorithms	
<p>Introduction to Data Structures (Data, Data Types, Data Objects, Data Structure, ADT), Types of Data Structure (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures), Introduction to Algorithms, Characteristics of algorithm, Pseudocode, example of an algorithm.</p> <p>Analysis of algorithms: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming Constructs-Linear, Quadratic, Cubic, Logarithmic.</p>	6
Unit 2: Linear Data Structure using Array	
<p>Sequential Organization, linear data structure using sequential organization: arrays, Array as an Abstract Data Type, Operations on Array, Storage Representation and their Address Calculation: Row major and Column Major</p> <p>Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays.</p> <p>Polynomial as array of structure, Polynomial addition, Polynomial evaluation.</p> <p>Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix-Simple and Fast Transpose, Time and Space trade-off.</p>	6

Unit 3: Searching and Sorting	
Searching: Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search-Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search Sorting: Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.	6
Unit4: Stack & Queue	
Stack: Basic concept, stack Abstract Data Type, Representation of Stacks Using Sequential Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Recursion. Queue: Queue as Abstract Data Type, Representation of Queue using Sequential organization, Queue Operations, Circular Queue and its advantages, Deque-Basic concept, types (Input restricted and Output restricted), Priority Queue- Basic concept, types (Ascending and Descending)	6
Unit 5: Linked List	
Introduction to Static and Dynamic Memory Allocation Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management, operations, Linked List as ADT, Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List-Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Generalized Linked List (GLL) concept.	6

Learning Resources	
Text Book	
1	Varsha H Patil – Data Structure using C++, Oxford University press, ISBN-13: 978-0-19-806623-1, ISBN-10: 0-19-806623-6
Reference Books	
1	Horowitz, Sahani, Dinesh Mehata, —Fundamentals of Data Structures in C++, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2	Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley Publication, ISBN: 978-1-118-29027-9.
3	Brassard & Bratley —Fundamentals of Algorithmic Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
4	Allen Downey, Jeffery Elkner, Chris Meyers-How to think like a Computer Scientist: Learning with Python, Dreamtech Press, ISBN:9789351198147.
5	R. Gillberg, B. Forouzn —Data Structures: A Pseudo code approach with C, Cenage Learning, ISBN: 9788131503140.
6	M. Weiss—Data Structures and Algorithm Analysis in C++, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.
E- Contents	
1	https://onlinecourses.swayam2.ac.in/cec19_cs04/preview
2	https://onlinecourses.swayam2.ac.in/cec19_cs04/preview
3	http://www.cse.unt.edu/~rada/CSCE3110/
4	http://www.math.tau.ac.il/~matias/ds03.html

[24UCEP301]: Data Structures Laboratory

Teaching Scheme	Credit	Examination Scheme	Marks
Lab: 4 Hours/Week	02	External Practical Exam:	25
		Total	25
Course Prerequisites: Basic Programming Concepts, Data Structures			

List of Laboratory Assignments

1. Use C++ open-source compilers for the implementation and execution of the programs
2. Perform
 - a. any 1 from Set-A
 - b. any 1 from Set-B
 - c. compulsory program on searching and sorting from of Set-C.
 - d. 1 program on stack and any 1 program on queue from Set-D
 - e. any 1 program from Set-E

Unit-I (Set-A)

1	Write a C++ program to read a given 'N' digit number and print the reverse of the number. Analyse the space and time complexity of the program.
2	Write a C++ program to read numeric values from the user till the users explicitly stops the input. Perform addition on all these input numbers and print the result. (Do not use an array or any other data structure for storing these numbers. The numbers are read from user on fly). Analyse the space and time complexity of the program.

Unit-II (Set-B)

1	Write a C++ program to compute following operations on String: <ol style="list-style-type: none"> a) To display word with the longest length b) To determines the frequency of occurrence of particular character in the string c) To check whether given string is palindrome or not d) To display index of first appearance of the substring e) To count the occurrences of each word in a given string
2	Write a C++ program to compute following computation on matrix: <ol style="list-style-type: none"> a) Addition of two matrices b) Subtraction of two matrices c) Multiplication of two matrices d) Transpose of a matrix

Unit-III (Set-C)

1	Write a C++ program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and binary search. Compare these two algorithms with respect to the number of comparisons required to find the given students. (Mandatory)
2	Write a C++ program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using <ol style="list-style-type: none"> a) Selection Sort b) Bubble sort and display top five scores.
3	Write a C++ program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores.

Unit-IV (Set-D)

1	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions- a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not
2	In any language program mostly syntax error occurs due to unbalancing delimiter such as {}, [], (). Write C++ program using stack to check whether given expression is well parenthesized or not.
3	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
4	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.

Unit-IV (Set-E)

1	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of second, third and final year of department can be granted membership on request. Similarly, one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member 'information using singly linked list. Store student PRN and Name. Write functions to: a) Add and delete the members as well as president or even secretary. b) Compute total number of members of club c) Display members d) Two linked lists exist for two divisions. Concatenate two lists.
2	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display- a) Set of students who like both vanilla and butterscotch b) Set of students who like either vanilla or butterscotch or not both c) Number of students who like neither vanilla nor butterscotch

[24UCEL302]: Object Oriented Programming

Teaching Scheme	Credit	Examination Scheme	Marks
TH: - 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	75

Course Prerequisites: Fundamental Programming-1(24UCEL107) and Fundamental Programming-2 (24UCEL208)

Course Objectives

This course aims to introduce **object-oriented programming (OOP) concepts** using C++ and help students develop skills in designing and implementing **modular, reusable, and maintainable software**.

1	To learn the Basics of Object-Oriented Programming, focusing on encapsulation and Data Hiding.
2	To learn Classes and Objects, constructors, destructors, and function overloading in C++.
3	To learn Inheritance and its type and Code Reusability
4	To learn Compile time polymorphism (Operator Overloading and Function Overloading) and Runtime Polymorphism and Virtual functions.
5	To learn generic programming with templates.
6	To learn exception handling and file Handling in C++
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Apply Object-Oriented Concepts in C++ for problem solving
CO2	Implementing Data Abstraction and Encapsulation
CO3	Utilizing Inheritance for Code Reusability
CO4	Applying Function Overloading and Operator Overloading
CO5	Demonstrating Runtime Polymorphism Using Virtual Functions
CO6	Implementing Exception handling and File Handling in C++

Contents	No. of Session
Unit 1: Introduction to Object Oriented Programing	
Principles of Object Oriented Programming: Procedure Oriented Programming Paradigm, Object Oriented Programming Paradigm, Basic Concept of OOP, and Benefits of OOP and Applications of OOP. Beginning with C++: Structure of C++ Program, access specifiers, Functions: Member functions, Special Member function: Constructors: Default, Parameterized, Copy, Destructor, Inline functions, static member function, Friend functions.	6
Unit 2: Inheritance: Extending Classes	
Inheritance: Introduction, Defining Derived classes, Types of Inheritance: Single inheritance, Multilevel Inheritance, Multiple inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base classes, Abstract classes.	6
Unit 3: Polymorphism	
Compile time Polymorphism: Function Overloading, Operator Overloading: Rules for overloading operators, Defining operator overloading, Overloading unary operator and binary operator using member function and friend function. Pointers: Introduction to pointers, Memory management operator: new and delete keyword, Pointers to Object, Pointers to derived class, this pointer. Run Time Polymorphism: Virtual function, Pure virtual function, Virtual Constructor and destructor.	6
Unit4: Templates	
Introduction to templates, Class templates, class templates with multiple parameters, Function templates, function templates with multiple parameters, overloading of template functions, member function templates, non-type template arguments. STL: Introduction, Components of STL, Application of Container classes.	6
Unit 5: Exception Handling and File Handling	

Basics of Exception Handling, Exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exceptions. File Handling: Introduction, Classes for file stream operations, Opening and closing a file, Detecting end-of-file, file modes, file pointers and their manipulations, command line arguments	6
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Learning Resources	
Text Book	
1	Object Oriented Programming with C++, E Balagurusamy, 8 th edition.
2	Object Oriented Programming in C++, Sourav Sahay
Reference Books	
1	Let us C++, Yashvant Kanetkar, 3 rd edition
2	Object Oriented Programming in C++, Robert Lafore, 4 th edition, Sams Publishing
E- Contents	
1	https://nptel.ac.in/courses/106105151
2	https://onlinecourses.nptel.ac.in/noc20_cs07/preview
3	https://link.springer.com/book/10.1007/978-1-4471-0289-2

[24UCEP302]: Object Oriented Programming Laboratory

Teaching Scheme	Credit	Examination Scheme:	Marks
Lab: 2 Hours/Week	01	External Practical Exam:	25
		Total	25
Course Prerequisites: Fundamental Programming-1 (24UCEP107) and Fundamental Programming-2 (24UCEP208)			

List of Laboratory Assignments (Any 5)	
1.	Define a class to represent a bank account. Include the following members: Data members: a) Name of the depositor b) Account number c) Type of account d) Balance amount in the account Member functions: a) To assign initial values b) To deposit an amount c) To withdraw an amount after checking the balance d) To display name and balance
2.	Define a Rectangle class with length and width attributes.

	a) Implement a default constructor (sets length & width to 1). b) Implement a parameterized constructor to accept custom values. c) Include a function to calculate area.
3.	Create a Student class with name and marks. Overload sort() to sort: a. By name (alphabetical order) b. By marks (descending order)
4.	Design a Student Database using multiple inheritance with the following classes: a) Person (Base Class) – Stores name and age. b) Academic (Base Class) – Stores roll number and marks in 3 subjects. c) Student (Derived Class) – Inherits from both Person and Academic, Calculates total marks and percentage.
5.	Write a Program to overload Increment Operator, which increments the value of data member by 100 using Member function and friend function
6.	Develop a Time class to represent hours and minutes, and overload the << and >> operators. a) Overload >> to input hours and minutes. b) Overload << to display time in hh:mm format.
7.	Implement a template function sortArray() to sort an array of any data type (integers, floats, or characters).
8.	Write a program to store Student Records (Roll Number & Marks) in map container. Implement map<int, int> where key = roll number and value = marks.
9.	Write a C++ program that accepts an array of integers from the user and allows the user to access an element at a specified index. If the user enters an invalid index (i.e., out of bounds), the program should throw an exception indicating an "Index Out of Bounds" error.
10.	Write a program to create two separate files. 1. for storing name of country(file1.txt) 2. Other for storing its capital(file2.txt) Read the data from both the file simultaneously and display content on the output screen.

[24UCEL303]: Software Engineering

Teaching Scheme	Credit	Examination Scheme	Marks
Theory: 3 Hours/Week	03	Teachers Assessment Examination (TAE):	-
		Class Assessment Examination (CAE):	-
		End Semester Examination (ESE):	50
		Total	50
Course Prerequisites: Fundamentals of Programming Languages			

Course Objectives	
1	To help students to understand the basic concept of software engineering.
2	To learn process models and agile software development methods.
3	To understand the principles of design model.
4	To learn and understand different software testing strategies and its application in software development
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Understand software engineering preliminaries and software development process models.
CO2	Apply requirements engineering to software systems.
CO3	Understand and Apply design and code concepts.
CO4	Apply different testing strategies and generate a simple test report.
CO5	Evaluate the cost of software

Contents	No. of Session
Unit 1: Software Engineering and Process	
Software Engineering: Definition; Phases in software engineering, key challenges, Software Process, Project, Product, Process Assessment, Software engineering life cycle models (water fall, incremental, spiral, WINWIN spiral, evolutionary, prototyping, object oriented), selection criteria of software process models. Case Study 1: Selection Criteria for Software Process Models in the Development of a Banking Application.	9
Unit 2: Requirement Engineering	
What is software Requirement, feasibility studies, requirements elicitation, Requirement analysis, analysis patterns, Requirements specification, Requirement validation and management, Requirement engineering tools. Case Study2: Student Admission and Examination System.	9
Unit 3: Software Design & Coding	
Design: Basic of software design, data design, architectural design, component level design, user interface design, pattern based software design. Software design documentation. Coding: Features of software code, coding guidelines, coding methodology, Programming practices, code verification technique, coding tools, code documentation Case Study 3: Data Processing system	9
Unit 4: Software Testing	
Software testing basic, test plan, test case design, software testing strategies, V model of software testing, level of software testing, testing techniques, object oriented testing, software testing tools, Debugging, software test report. Case Study 4: Implementing a Comprehensive Software Testing Strategy for an Online Food Delivery Application. OR Case Study 5: Problem Statement and Solution	9
Unit 5: Software Cost Estimation	

Basic of cost estimation, software cost estimation process, decomposition technique, software estimation model, criteria for evaluating estimation model, estimation for object oriented projects Case Study 6: ATM Software Systems	9
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Learning Resources	
Text Book	
1	Rohit Khurana “Software Engineering, Principles and Practices”, Vikas Publishing House Pvt. Ltd, ITL ESL, ISBN: 81-259-1909-0
Reference Books	
1	Roger S.Pressman, Software engineering- A practitioner’s Approach, McGraw-Hill International Edition, 7th edition.
2	Ian Sommerville, Software engineering, Pearson education Asia
3	Michael Blaha, James Rumbaugh “Object-Oriented Modeling and Design with UML”-2 nd edition, Pearson Education
4	Rajib Mall “Fundamentals of Software Engineering”- 4 th edition, PHI Learning Private Limited, ISBN- 978-81-203-4898-1
5	Pankaj Jalote” An Integrated Approach to Software Engineering”-3 rd edition, Springer
E- Contents	
1	https://www.javatpoint.com/software-engineering
2	https://nptel.ac.in/courses/106105182
3	https://www.geeksforgeeks.org/software-engineering/?ref=gcse_ind

[24UCELXXX]: Multidisciplinary Minor-I

Teaching Scheme	Credit	Examination Scheme	Marks
Theory: 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	25
		Total	50
Note: Please select the Minor from the Basket of Minors as per Annexure-I			

[24UXXXXXXX]: Open Elective-I

Teaching Scheme	Credit	Examination Scheme	Marks
Theory: 3 Hours/Week	03	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	75
Note: Please select the Open Elective from the Basket of Open Electives as per Annexure-II			

[24UXXXXXXX]: Open Elective-1 Laboratory

Teaching Scheme	Credit	Examination Scheme	Marks
Lab: 2 Hours/Week	01	Internal Practical Exam (OR)	25
		Total	25
Note: <i>Please select the Open Elective lab from the Basket of Open Electives as per Annexure-II</i>			

[24UESP304]: Entrepreneurship Awareness - I

Teaching Scheme	Credit	Examination Scheme	Marks
Lab: 4 Hours/Week	02	Internal Practical Exam	25
		Total	25
Course Prerequisites: [24UBSL113] : Professional Communication			

Course Objectives

1	To introduce the entrepreneurship skills and the entrepreneurial mind-set.
2	To familiarize students with tools for identifying business opportunities and managing risks.
3	To enhance leadership, creativity, and problem-solving capabilities.
4	To teach students how to develop a comprehensive business plan.

Course Outcomes

On successful completion of the course the learner will be able to:

CO1	Understand the skills required by a good Entrepreneur.
CO2	Demonstrate Leadership and Teamwork Skills: Cultivate leadership qualities and work effectively in teams for business success.
CO3	Identify Business Opportunities: Analyze market trends, recognize gaps, and generate innovative business ideas.
CO4	Develop a Business Plan: Create a feasible business plan covering vision, mission, market analysis, financial projections, and strategic planning.

List of Laboratory Assignments

1	Students should execute the self SWOC analysis and Analyze it.
2	Importance of Leadership, Teamwork, and Management Skills and execute an activity. (Leadership Styles and Entrepreneurship, Building and Managing Teams in Startups, Conflict Resolution and Negotiation Skills, Effective Communication for Entrepreneurs, Motivating and Managing Employees)
3	Introduction to Entrepreneurship - Definition of Entrepreneurship, Characteristics and Traits of Successful Entrepreneurs, The Role of Entrepreneurs in Economic Development, Types of Entrepreneurship (small business, scalable startups, large companies, social enterprises), The Entrepreneurial Mindset: Risk-taking, Innovation, Resilience

4	Opportunity Identification and Idea Generation -Techniques for Identifying Business Opportunities, Creativity and Innovation in Entrepreneurship, Evaluating Feasibility and Potential of Business Ideas, Tools for Idea Generation: Brainstorming, Design Thinking
5	Business Planning and Strategy Development: Importance of a Business Plan, Components of a Business Plan: Executive Summary, Market Research, Marketing Strategy, Operational Plan, Developing Financial Projections (Revenue, Cost, Profit), Strategic Planning and Goal Setting, Business Model Design (e.g., B2B, B2C, SaaS).
6	Marketing for Entrepreneurs: Market Research and Competitive Analysis, Developing a Marketing Plan and Strategy, Brand Positioning and Building a Brand Identity, Customer Acquisition and Retention Strategies
7	Financial Management for Entrepreneurs: Basics of Accounting and Financial Statements (Income Statement, Balance Sheet, Cash Flow), Budgeting and Financial Forecasting, Understanding Capital Requirements and Funding Needs, Financial Ratios and Decision-Making.
8	Risk Management and Problem-Solving: Identifying and Analyzing Business Risks, Risk Management Strategies: Risk Avoidance, Mitigation, and Transfer, Crisis Management and Business Continuity Planning, Decision-Making Models for Entrepreneurs.
9	Case Studies of an Entrepreneur.

Learning Resources

Text Book

1	<i>“Start with Why”</i> by Simon Sinek – Explores the importance of defining the purpose behind a business.
2	<i>“The Lean Startup”</i> by Eric Ries – A guide on how startups can efficiently build products and scale through iterative testing and feedback.
3	<i>“Business Model Generation”</i> by Alexander Osterwalder and Yves Pigneur – A comprehensive guide to creating and analyzing business models.
4	<i>“The Innovator's Dilemma”</i> by Clayton Christensen – A look at how companies can innovate and grow in changing markets.

Journal Articles

1	<i>“Entrepreneurship as a Career Choice: Implications for Education and Research”</i> by K. R. Venkataraman and S. S. Sarasvathy, <i>Academy of Management Learning & Education</i> .
2	<i>“The Role of Entrepreneurship Education in Shaping Entrepreneurial Intentions”</i> , <i>Journal of Business Venturing</i> .

E- Contents

1	<i>Harvard Business Review (HBR)</i> – Articles on entrepreneurship, leadership, and business strategy.
2	<i>Entrepreneur.com</i> – A website offering advice on various aspects of entrepreneurship.

Case Studies

1	<i>Harvard Business School Case Studies</i> – Real-world business problems for entrepreneurs.
2	<i>Case Study: Airbnb’s Startup Journey</i> – From the ground up to global success.
3	<i>The Uber Growth Story</i> – Scaling and disrupting the transportation industry.

[24UVEL305]: Understanding India

Teaching Scheme	Credit	Examination Scheme	Marks
TH: 2 Hours/Week	02	Internal Teamwork	25
		Total	25
Course Prerequisites: Basic knowledge about Indian history, geography, culture, society, and polity			

Course Objectives	
1	To expose the students to our social, economic and cultural heritage
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Contemporary India with its historical perspective
CO2	Constitutional obligations: fundamental rights and duties.
CO3	Indian knowledge systems (IKS)
CO4	India's struggle for freedom

Contents	No. of Session
Unit 1: Geography of India	
India on the map of world and its neighbouring countries • Physical features of India including mountain, plateau, plain, coast, island, vegetation, rivers, soils, and climate • Racial diversities, Population, its growth, distribution, Migration • People and Culture of India: Major Festivals, Culinary traditions and Costumes	4
Unit 2: History of India	
Harappan civilisation and Vedic age • Religious Tradition of India: Vedic Age, Buddhism, Jainism, Bhakti, Sufi, Social Reform Movement and Revivalism. • Hinduism and its etymological roots • Indian Universities-Taxila, Nalanda, IITs, NITs, IIMs • Accounts of foreign travellers-Huan Tsang, Itsing, Ibn Batuta, Al Baruni • Case study of Vijaynagar Empire, Chola Empire & Maratha Empire • Literary masterpieces of India-Kalidas	8
Unit 3: Understanding Indian Economy & polity	
Kautilya's Arthashastra & Mauryan administration • Vidurneeti • Kacchitsarg • Forms of govt in India-16 Mahajanpadas	6
Unit4: Indian Constitution	
Preamble, Salient features, Fundamental rights, Fundamental duties • Important Bills	4
Unit 5: Nationalists in Indian National Movements	
1857 revolt • Non-violence, Satyagraha and Social Justice • Leaders of India's freedom struggle: Lokmanya Tilak, V D Savarkar, Mahatma Gandhi, Subhashchandra Bose, Bhagatsingh.	8

Learning Resources	
Text Book	
1	Bipan Chandra (1987). India's Struggle for Independence. Penguin. Delhi
2	Dhar. P. K. (2000): Growing Dimensions of Indian Economy. Kalyani Publishers. New Delhi.
3	Dhingra. I. C. (2020): Indian Economy. Sultan Chand & Sons. New Delhi.
4	Dutt, R. and Sundharam (2018): Indian Economy. S. Chand & Co. Ltd. New Delhi
5	Gautam A (2009): Advanced Geography of India. Sharda Pustak Bhawan. Allahabad.
6	Godschalk. D.R. (et.al.) (1999): Natural Hazard Mitigation Recasting Disaster Policy and Planning. Island Press. Washington. D.C.
7	Gore. M. S. (2002) Unity in Diversity: The Indian Experience in Nation-Building. Rauat Publication. Jaipur.
8	Government of India, Economic Survey (Annual). Economic Division. Ministry of Finance, New Delhi.
9	K. Roy, C. Saunders and J. Kincaid (2006) (eds.) 'A Global Dialogue on Federalism'. Volume 3 Montreal, Queen's University Press.
10	Kabir. Humayun (1946). Our Heritage. National Information and Publications Ltd., Mumbai.
11	L. Rudolph and S. Rudolph. (2008) 'Explaining Indian Institutions: A Fifty-Year Perspective, 1956-2006'. Volume 2. Neu Delhi. Oxford University Press.
12	M. Singh, and R. Saxena (2011) (eds.), 'Indian Politics: Constitutional Foundations and Institutional Functioning'. Delhi: PHI Learning Private Ltd.
13	Malik. S. C. (1975). Understanding Indian Civilization: A Framework of Enquiry. Indian Institute of Advanced Study
E- Contents:	
1	https://onlinecourses.swayam2.ac.in/ntr25_ed18/preview

[24UCEP306]: Minor Project

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	Internal Practical Exam	25
		External Practical Exam	25
		Total	50
Course Prerequisites: Software Engineering, Any programming Language, Any software designing tools			

Course Objectives	
Enable students to develop problem-solving skills, build innovative solutions, and improve teamwork through hackathon participation	
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Formulate clear and impactful problem statements by applying brainstorming techniques and analytical thinking.
CO2	Design and implement technical solutions using programming languages, frameworks, and APIs aligned with industry standards.
CO3	Collaborate efficiently within teams by assigning roles, managing tasks, and ensuring smooth communication throughout project development.

CO4	Develop engaging presentations that effectively communicate the problem statement, solution, and project impact to judges and stakeholders.
CO5	Utilize hackathon experience to build portfolios, contribute to open-source projects, and pursue entrepreneurial or research opportunities.

Contents	No. of Session
Unit 1: Introduction to Hackathons	
<ul style="list-style-type: none"> What is a Hackathon? Types of Hackathons (Themed, Open Innovation, etc.) Understanding Hackathon Rules and Formats Key Roles in a Hackathon (Team Lead, Developer, Designer, Presenter) Benefits of Participating in Hackathons 	6
Unit 2: Ideation and Problem Definition	
<ul style="list-style-type: none"> Identifying Real-World Problems Brainstorming Techniques (Mind Mapping, SCAMPER, etc.) How to Develop Problem Statements? Evaluating Feasibility and Innovation Creating Effective Proposals <p>Practical Activity: Forming teams and identifying potential ideas</p>	6
Unit 3: Technology Stack and Tools	
<ul style="list-style-type: none"> Choosing the Right Tech Stack (Web, Mobile, AI/ML, etc.) Introduction to APIs, Cloud Services, and Databases Version Control Systems (e.g., GitHub, GitLab) Collaborative Tools (e.g., Slack, Discord, Trello) Rapid Prototyping Tools (e.g., Figma, Canva) <p>Practical Activity: Setting up a development environment and initiating a sample project</p>	6
Unit 4: Project Development and Implementation	
<ul style="list-style-type: none"> Effective Coding Practices for Hackathons Integrating APIs, Libraries, and Open-Source Resources Building MVPs (Minimum Viable Products) Testing and Debugging Strategies Ensuring Code Efficiency and Scalability <p>Practical Activity: Developing a basic working model for a chosen idea</p>	6
Unit 5: Presentation and Pitching	
<ul style="list-style-type: none"> Creating Engaging Presentations Storytelling for Project Impact Demo Techniques (Live Demo vs Recorded) 	6

<ul style="list-style-type: none"> • Answering Judges' Questions Effectively <p>Practical Activity: Teams prepare and present their projects</p>	
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Learning Resources:	
Text Book:	
1	"Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", By Idris Mootee, JOHN WILEY (ORIGINAL) ISBN: 9781118620120 MOOTEE cbs publishers and distributors pvt ltd PH - 01149344934
2	Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming, By Eric Matthes, ISBN-10:1593279280,ISBN-13:978-1593279288
Reference Books:	
1	Prototyping for Designers: Developing the Best Digital and Physical Products, By Kathryn McElroy,O'Reilly Media Publication, ISBN-10:1491954086,ISBN-13:978-1491954089
2	Agile Estimating and Planning, By Mike Cohn, Pearson Education India,ISBN-10:813170548X,ISBN-13:978-8131705483
E- Contents: Visit the following for online courses	
1	Coursera, edX, Udemy, YouTube Channels
2	Hackathon Platforms: Devpost, Hacker Earth, Major League Hacking

SEMESTER IV

[24UCEL401]: Advanced Data Structure

Teaching Scheme:	Credit	Examination Scheme:	Marks
TH: - 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	75
Course Prerequisites: Data Structures (24UCEL301) Basic Mathematics, Geometry, linear algebra, vectors and matrices			

Course Objectives	
1	To understand dynamic data structures Tree with the operations on it.
2	To understand dynamic data structures Graph with the operations on it.
3	To understand Indexing and Multiway Trees.
4	To understand Hashing.
5	To understand File Organization with applications.
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	To demonstrate Tree as dynamic data structures with algorithms operating on it.
CO2	To demonstrate Graph as dynamic data structures with algorithms operating on it along with its applications.
CO3	To understand the concept of Indexing and learn various representation of trees with their applications in various domains of computer science.
CO4	To Understand, implement and apply principles hashing to solve various computational problems.
CO5	To Understand, implement and apply principles of File Organization.

Contents	No. of Session
Unit 1: Tree	
Tree- Basic terminology, General tree and its representation, Tree representation using sequential and linked organization. Binary Tree- properties, converting general tree to binary tree, binary tree traversals (recursive and non-recursive)- inorder, preorder, post order, Operations on binary tree. Binary Search Tree (BST): BST operations like insertion, deletion, search, Huffman Tree (Concept and Use). Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree.	6
Unit 2: Graph	
Graph: Basic Concepts, Storage representation, Adjacency matrix, adjacency list. Traversals- depth first and breadth first. Minimum spanning Tree: Greedy algorithms for computing minimum spanning tree- Prim's and Kruskal Algorithms Shortest Path Algorithms: Dijkstra's Single source shortest path, Topological ordering.	6
Unit 3: Indexing and Multiway Trees	

Weight balanced tree - Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree. B-Tree- insertion, deletion, B+ Tree - insertion, deletion, use of B+ tree in Indexing.	6
Unit4: Hashing	
Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing Hash Functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal. Collision resolution strategies- open addressing and chaining Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining.	6
Unit 5: File Organization	
Files: concept, need, primitive operations. Sequential file organization- concept and primitive operations, Direct Access File- Concepts and Primitive operations, Indexed sequential file organization- concept, types of indices, structure of index sequential file, Linked Organization- multi list files, coral rings, inverted files.	6

Learning Resources:	
Text Book:	
1	Varsha H Patil – Data Structure using C++, Oxford University press, ISBN-13: 978-0-19-806623-1, ISBN-10: 0-19-806623-6
Reference Books:	
1	Horowitz, Sahani, Dinesh Mehata, —Fundamentals of Data Structures in C++I, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2	Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley Publication, ISBN: 978-1-118-29027-9.
3	Brassard & Bratley —Fundamentals of Algorithmic Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
4	Allen Downey, Jeffery Elkner, Chris Meyers-How to think like a Computer Scientist: Learning with Python, Dreamtech Press, ISBN:9789351198147.
5	R. Gillberg, B. Forouzn —Data Structures: A Pseudo code approach with C, Cenage Learning, ISBN: 9788131503140.
E- Contents:	
1	https://www.cs.usfca.edu/%7Egallies/visualization/Algorithms.html

[24UCEP401]: Advanced Data Structure Laboratory

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	External Practical Exam:	25
		Total	25
Course Prerequisites: Advanced Data Structure (24UCEL401)			

List of Laboratory Assignments

Use C++ open-source compilers for the implementation and execution of the programs
Perform any one program from each set.

Unit-I (Set-A)

1	A Dictionary stores keywords & its meanings. Provide facility for: i. adding new keywords ii. deleting keywords iii. updating values of any entry. iv. Provide facility to display whole data sorted in ascending/ Descending order. v. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.
2	Beginning with an empty binary search tree, construct binary search tree by inserting the name and age in the order given by age of a person . After constructing a binary tree - i. Insert new node ii. Find number of nodes in longest path from root iii. Minimum data value found in the tree iv. Change a tree so that the roles of the left and right pointers are swapped at every node v. Search a value
3	Construct an expression tree from the given prefix expression eg. $+-a*bc/def$ and traverse it using In-order and Post-order traversal (non recursive) and then delete the entire tree.

Unit-II (Set-B)

1	Use the map of the area around the college as the graph. Identify the prominent land marks as nodes. Represent a given graph using adjacency matrix/list to perform DFS and using adjacency list to perform BFS.
2	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight take to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Check whether the graph is connected or not. Justify the storage representation used.
3	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.

Unit-III (Set-C)

1	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree (AVL tree) and find the complexity for finding a keyword.
2	The students with different age values are to given a colour as red or black. The roll numbers in sequence are 33, 13, 53, 11, 41, 21 and 61. Implement red black tree to perform the basic operation of insertion and display the contents of the tree.

Unit-IV (Set-D)

1	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number.
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	Make use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers.
2	Implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key)
Unit-IV (Set-E)	
1	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to maintain the data.
2	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.

[24UCEL402]: Operating System

Teaching Scheme:	Credit	Examination Scheme:	Marks
TH: - 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	75
Course Prerequisites: Computer Organization, Basic Data Structures			

Course Objectives	
1	To provide overview of major components and different aspect of Operating system.
2	To understand the methods for Process Scheduling & inter process communication.
3	To familiarize students with the techniques of process synchronization and deadlock handling.
4	To understand and apply different types of memory management strategies.
5	To understand various, I/O Management and File and Disk management.
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Understand major components and different aspect of Operating system.
CO2	Apply and analyse process scheduling & inter process communication.
CO3	Apply and analyse process synchronization & deadlock handling.
CO4	Understand and apply memory management strategies.
CO5	Understand various I/O , Disk and File management strategies.

Contents	No. of Session
Unit 1: Introduction to Operating System	

What Operating Systems Do, Computer System Architecture(Single processor, Multiprocessor systems), Clustered systems, Operating-System Structure, Process Management, Memory Management , Storage Management, Protection and Security, Special Purpose systems, Real-Time Embedded Systems, Multimedia Systems, Handheld System etc.,Operating System Services, System calls, Operating-System Structure, Simple approach, layered approach, Virtual machine	6
Unit 2: Process Management & Scheduling	
The Process, Process State, Process Control Block, Threads, Process Scheduling, Operations on Processes, Interprocess Communication (Shared-Memory Systems, Message-Passing Systems), Multithreading Models. Process Scheduling Basic Concepts(CPU-I/O Burst Cycle, CPU scheduler, Preemptive Scheduling, Dispatcher),Scheduling Criteria, Scheduling Algorithms(FCFS, SJF ,Priority, Round-Robin),Example: Linux Scheduling	6
Unit 3: Process Synchronization & Deadlock	
Process Synchronization Background, The Critical-Section Problem, Synchronization Hardware Semaphores, Classic Problems of Synchronization, The Readers-Writers Problem, The Dinning Philosophers Problem, Monitors, Synchronization in Linux. Deadlocks, System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance(Banker's Algorithm)	6
Unit4: Memory Management	
Background(Basic Hardware, Address Binding, Logical versus Physical Address Space, Dynamic Loading, Dynamic Linking and Shared Libraries), Swapping, Contiguous Memory Allocation, First fit, Best fit, Worst Fit, Fragmentation, Paging(Basic Method, Hardware Support, structure of the page table),Segmentation, Virtual Memory Management ,Demand Paging, Page Replacement(FIFO, Optimal, LRU), Thrashing	6
Unit 5: Storage Management	
File Concept (File Attributes, File Types, File Structure), Access Methods, Directory Structure, File Sharing, Virtual File Systems. Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN), RAID structure I/O devices and controllers, Interrupt handlers	6

Learning Resources:	
Text Book:	
1	Silberschatz, Abraham, and Gagne, Greg. Operating System Principles, 7th Ed. India, Wiley India Pvt. Limited, 2011.
2	Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 9th Edition, 2016.
Reference Books:	
1	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014.
2	Maurice J. Bach, "Design of UNIX Operating System", PHI.
E- Contents:	
1	https://onlinecourses.nptel.ac.in/noc21_cs72/preview

[24UCEP402]: Operating System Laboratory

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 2 Hours/Week	01	External Practical Exam:	25
		Total	25
Course Prerequisites: Computer Organization			

List of Laboratory Assignments(Any 5)	
1.	Explore Linux Commands Explore usage of basic Linux Commands and system calls for file, directory and process management.
2.	Linux shell script a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name.
3.	.Process Management: Scheduling a. Write a program to implement the concept of non-pre-emptive or pre-emptive scheduling algorithms b. Demonstrate the concept of non-pre-emptive or pre-emptive scheduling algorithms using CPU – OS Simulator
4.	Process Management: Synchronization Write a C program to implement Peterson’s solution for critical section
5.	Process Management: Deadlock Write a program to demonstrate the concept of deadlock avoidance through Banker’s Algorithm
6.	Memory Management Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.
7.	Memory Management: Virtual Memory Write a program to demonstrate the concept of page replacement policies for handling page faults
8.	File Management & I/O Management Write a program to demonstrate concept of disk scheduling.

24UCEL403]: Discrete Maths and Graph Theory

Teaching Scheme:	Credit	Examination Scheme:	Marks
TH: - 2 Hours/Week	03	Teachers Assessment Examination (TAE):	10
Tut: - 1 Hours/Week		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	75
Course Prerequisites: Set Theory			
Course Objectives			
1	To introduce the fundamental concepts of propositional logic and mathematical reasoning		
2	To provide a thorough understanding of relations and functions, including their properties and practical applications		

3	To develop problem solving skills in graph theory, including graph representations, connectivity, and algorithms.
4	To explore the properties and applications of trees and spanning trees in computational problems.
5	To introduce the fundamentals of group theory and its role in algebraic structures.
Course Outcomes On successful completion of the course the learner will be able to:	
CO1	Apply propositional logic and mathematical induction to solve problems
CO2	Analyse and work with relations and functions, including bijective and surjective properties
CO3	Solve problems using graph theory concepts such as Eulerian and Hamiltonian paths, Graph colouring, and shortest path algorithms
CO4	Develop and implement algorithms related to trees, including binary search trees, spanning trees, and Huffman coding
CO5	Demonstrate an understanding of algebraic structure, including group, semigroup, and monoids, and apply them to mathematical problems.

Contents	No. of Session
Unit 1: Propositional Logic	
Propositional Logic, Propositional Equivalence-De Morgan's Law, Logical Equivalence and simplification, Mathematical Reasoning and Proof Techniques, Mathematical Induction	4
Unit 2: Relation and function	
Relations and their Properties, Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm. Functions- Surjective, Injective and Bijective functions, Identity function, Partial function...	8
Unit 3: Graph Theory	
Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path Dijkstra's Algorithm, Planar Graphs, Graph Colouring.	7
Unit4: Tree	
Introduction, properties of trees, Binary search tree, tree traversal, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network)	7
Unit 5: -Group Theory	
Introduction to algebraic Systems, Semigroup, Properties of Semigroup, Monoids, Groups- Abelian group, Basic Properties, subgroup, cyclic groups	4

Learning Resources:	
Text Book:	
1	Discrete Mathematical Structure by Kolman, Busby and Rose, Prentice Hall of India
2	Kenneth H. Rosen, "Discrete Mathematics and Its Applications with Combinatorics and Graph Theory. Tata McGraw Hill

3	Narsingh Deo, “ Graph Theory with Applications to Engineering and Computer Science”, Prentice Hall of India.
Reference Books:	
1	Discrete Mathematics with Applications" by Susanna S. Epp
2	Introduction to Graph Theory" by Douglas B. West
E- Contents:	
1	https://youtu.be/2-Ayb4GGwbY?si=JqYYuvyvEiFUjVyD
2	https://youtu.be/E40r8DWgG40?si=rqdgeUmco_wnWePm

[24UCELXXX]: Multidisciplinary Minor-II

Teaching Scheme	Credit	Examination Scheme	Marks
Theory: 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	25
		Total	50
Note: <i>Please select the Minor from the Basket of Minors as per Annexure-I</i>			

[24UXXXXXXXX]: Open Elective-II

Teaching Scheme	Credit	Examination Scheme	Marks
Theory: 2 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	25
		Total	50
Note: <i>Please select the Open Elective from the Basket of Open Electives as per Annexure-II</i>			

[24UCEP404]: Web Development

Teaching Scheme:		Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week		02	Internal Practical Exam:	25
			Total	25
Course Prerequisites: HTML, Database				
Course Objectives				
1	Understand the basics of web development and its importance in modern technology.			
2	Learn HTML and CSS for creating structured and visually appealing web pages.			
3	Explore JavaScript for adding interactivity and dynamic content to web pages.			
4	To develop skills in XML, Servlet and JSP.			
5	Apply best practices in web development, including accessibility, usability, and responsive design.			
Course Outcomes				
On successful completion of the course the learner will be able to:				
CO1	Understand the core concepts and technologies underlying web development, including HTML, CSS, JavaScript, PHP and MySQL			
CO2	Apply CSS styling techniques to enhance the visual presentation and layout of web pages, ensuring responsiveness across various devices.			
CO3	Implement client-side interactivity and dynamic behavior using JavaScript.			
CO4	Analyze the concept of XML, Servlet and JSP.			
CO5	Design and develop a complete web application from scratch, incorporating both front-end and back-end components.			

Contents	No. of Session
Unit 1: Introduction to HTML and CSS	
Introduction to HTML: HTML Basics, Structure, text, images, links, and lists. Introduction to Cascading Style Sheets (CSS): CSS Basics: Styling HTML elements, typography, colors, margins, padding, selectors and layouts (Flexbox and Grid). Practical Implementation: Create responsive web pages using HTML and CSS.	6
Unit 2: JavaScript Syntax and Basics	
JavaScript Syntax and Basics: Understanding JavaScript syntax: variables, functions, operators, conditionals, loops. DOM manipulation and event handling, Form Validation, Displaying Feedback, CSS for Validation. Practical Implementation: Enhancement and Validation of web page using Java script.	6
Unit 3: Introduction to XML	
Introduction to XML: Basics of XML structure and syntax. XML Document Creation, Introduction to XSL (Extensible Stylesheet Language), XSLT Basics, XSLT Elements, Using XSLT to Display XML Data, XSLT with Conditions and Loops, Linking XML with XSLT in the Browser, Querying and Filtering Data in XSL, Debugging XSLT and XML. Practical Implementation: Display Structured XML Data in a Web Browser Using XSLT for	6

Transformation.		
Unit4: Introduction to Servlets & JSP		
Introduction to Servlets & JSP: Architecture of Servlet and JSP, Setting Up Servlet and JSP Environment, Servlet Lifecycle & Handling HTTP Requests/Responses, Generating Dynamic Content with Servlets, Session Management and Cookies in Servlets, Servlet Parameters & Error Handling, Servlets and Database Interaction using JDBC. Introduction to JSP: Syntax, Directives, and Implicit Objects, Creating, Deploying, and Handling Form Data in JSP, JSP Expressions, Script lets, and Tags (Standard & Custom), Session Management in JSP, Error Handling in JSP, Connecting JSP with Databases. Practical Implementation: Creation of dynamic content in web application using servlets & JSP.		6
Unit 5: Introduction to PHP		
Introduction to PHP, setting up PHP environment (XAMPP/WAMP/LAMP), PHP Syntax and Basics: PHP syntax, variables, data types, operators, and control structures (if-else, loops) Working with Forms in PHP, connecting to MySQL Database, CRUD Operations (Create, Read, Update, Delete), Displaying Data Dynamically, Session Management in PHP, working with Cookies in PHP, PHP Error Handling, Security Measures in PHP, Deploying PHP and MySQL Web Application. Practical Implementation: Build a dynamic web application using PHP and MySQL		6
Learning Resources:		
Text Book:		
1	Powell, Thomas. HTML & XHTML: the complete reference. McGraw-Hill, Inc., 2003.	
2	Robert W. Sebesta,“ Programming the World Wide Web”, 4th Edition, Pearson education, 2008.	
3	Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.	
4	Godbole, Achyut, and Atul Kahate. "Web Technologies." McGraw Hill Education (India) Private Limited,	
Reference Books:		
1	McGrath, Mike. HTML, CSS & JavaScript in easy steps. In Easy Steps Limited, 2020.	
2	Robbins, Jennifer Niederst. Learning web design: A beginner's guide to HTML, CSS, JavaScript, and web graphics. " O'Reilly Media, Inc.", 2012.	
3	Marty Hall, Larry Brown, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.	
4	Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.	
E- Contents:		
1	W3Schools HTML/CSS/JavaScript Tutorial: https://www.w3schools.com/html/	
2	User Interface Design By Prof. Saptarshi Kolay https://onlinecourses.nptel.ac.in/noc21_ar05/preview	
3	Web Technology By Dr. Ashutosh Kumar Bhatt https://onlinecourses.swayam2.ac.in/nou24_cs09/preview	
4	HTML By Prof Kannan Moudgalya - https://onlinecourses.swayam2.ac.in/aic20_sp11/preview	
5	https://www.php.net/	

[24UBSP405]: Communication Skills

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	Internal Practical Exam:	25
		Total	25
Course Prerequisites: Basic English Grammar			

Course Objectives	
1	Developing Proficiency in English.
2	Enhancing Writing Skills.
3	Improving Public Speaking and Presentation Skills.
4	Developing Listening and Reading Comprehension.
5	Fostering Interpersonal Communication Skills.
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Demonstrate Effective Written Communication.
CO2	Engage in Clear Oral Communication.
CO3	Improve Listening and Reading Comprehension.
CO4	Showcase Interpersonal and Teamwork Skills.
CO5	Apply English Language Proficiency in Professional Contexts.

List of Laboratory Assignments	
1	Introduction to Communication: <ol style="list-style-type: none"> Overview of Communication: Definition, types, and importance of communication in the engineering field. Process of Communication: Sender, message, receiver, feedback, and noise. Barriers to Communication: Psychological, cultural, physical, and language barriers. Effective Communication Skills: Listening, speaking, reading, and writing as components of effective communication. Role of Communication in Engineering: The need for clear communication in technical and non-technical contexts
2	SWOT analysis: The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, non-verbal skills, achievements. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects. The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.
3	Writing Skills <ol style="list-style-type: none"> Paragraph and Essay Writing: Structure and organization of paragraphs; writing clear and cohesive essays. Formal and Informal Writing: Difference and usage in emails, memos, and letters/Applications. Each student will write one formal letter, and one application. The

	<p>teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.</p> <p>c) Technical Writing: Writing reports, proposals, and manuals. The teacher should teach the students how to write report. The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal</p> <ul style="list-style-type: none"> • Structure of technical reports (abstract, introduction, methodology, results, conclusion). • Guidelines for presenting data and information clearly. <p>d) Review and Editing: Proofreading techniques, identifying and correcting errors.</p> <p>e) Writing for the Web: Writing effective content for web pages, blogs, and forums.</p>
4	<p>Oral Communication Skills</p> <p>a) Public Speaking: Prepared speech (Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.)</p> <p>b) Presentation Skills: Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.</p> <p>c) Group Discussions: Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedbacks.</p> <p>d) Interview Skills: Preparing for job interviews, mock interviews, and communication in an interview setting.</p> <p>e) Speech Delivery Techniques: Voice modulation, body language, eye contact, and engaging the audience.</p>
5	<p>Interpersonal and Cross-Cultural Communication</p> <p>a) Verbal and Non-Verbal Communication: The role of body language, facial expressions, and tone of voice.</p> <p>b) Interpersonal Communication: Communicating effectively in one-on-one or small group settings, building rapport.</p> <p>c) Cross-Cultural Communication: Understanding and navigating cultural differences in communication.</p> <p>d) Conflict Resolution: Techniques for resolving misunderstandings and disagreements in communication.</p> <p>e) Teamwork and Collaboration: Effective communication in team projects and professional settings.</p>
6	<p>Reading and Listening skills</p> <p>The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages asked questions on the article by the readers. Students will get marks on various topics to students for evaluating their reading comprehension</p>
7	<p>Resume writing- Guide students and instruct them to write resume.</p>

Learning Resources:	
Text Book:	
1	Sanjay Kumar, Pushp Lata - “Communication skills “, Oxford university press, ISBN 0-19-945706-9, 9780199457069
Journal Articles:	
1	2. P.D. Chaturvedi, Mukesh Chaturvedi - “Business Communication” ,PEARSON, isbn 978-81-317-1872-8, 9-788131718728
2	3. Andrea J. Rutherford - “Basic communication skills for technology”, PEARSON Education, ISBN 978-81-7758-407-3, 9-788177-584073
3	2. P.D. Chaturvedi, Mukesh Chaturvedi - “Business Communication” ,PEARSON, isbn 978-81-317-1872-8, 9-788131718728
E- Contents:	
1	https://onlinecourses.swayam2.ac.in/ntr25_ed62/preview
2	https://www.udemy.com/course/business-english-complete/?couponCode=ST11MT170325G3
3	https://www.udemy.com/course/learn-english-grammar-online/?couponCode=ST11MT170325G3
4	https://www.coursera.org/learn/verbal-communications-and-presentation-skills

[24UESP406]: Entrepreneurship Awareness-II

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	Internal Practical Exam:	25
		Total	25
Course Prerequisites: [24UESL304] : Entrepreneurship I			

Course Objectives	
1	To provide students with core knowledge of start-up, entrepreneurship, and the ecosystem while supporting idea generation and business model creation.
2	To familiarize students with legal, ethical, and regulatory aspects of starting and managing a business.
3	To provide insights into product development, prototyping, and the use of emerging technologies in status.
4	To develop an understanding of financial planning, funding sources, and investor pitching techniques
5	To teach marketing strategies, customer acquisition, and growth hacking for start-up success.
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Understand Start-up's, entrepreneurship, and the ecosystem while identifying opportunities, applying ideation techniques, and developing viable business models.
CO2	Analyse market opportunities and apply ideation techniques to generate innovative business ideas and develop a viable business model.
CO3	Navigate legal, ethical, and regulatory requirements for setting up and managing a start-ups, including company registration, compliance, and intellectual property protection.

CO4	Apply product development and prototyping techniques, leveraging emerging technologies for start-up innovation.
CO5	Develop financial planning strategies by understanding revenue models, funding sources, and investment pitching techniques

List of Laboratory Assignments

1	Introduction to Start-up's & Entrepreneurship: What is a start-up? ,Differences between a start-up & traditional business, Start-up ecosystem & key players (incubators, accelerators, VCs),Engineering innovation & its role in Start-ups
2	Ideation & Business Model Development : Identifying problems & market opportunities, Design Thinking & Ideation Techniques, Business Model Canvas (BMC),Building an MVP (Minimum Viable Product).
3	Legal, Regulatory & Ethical Considerations: Company Registration: Private Limited, LLP, Sole Proprietorship, Patents, Copyrights & Trademarks for engineering Start-ups, Compliance, taxation & government schemes for Start-ups, Ethical issues in technology-based Start-ups
4	Product Development & Engineering Prototyping : Product Development Life Cycle (PDLC),Prototyping & Rapid Development Techniques, Using emerging technologies (AI, IoT, Blockchain) in Startups, Software & hardware considerations in tech Startups.
5	Financial Planning & Startup Funding: Basics of startup finance: revenue models, cost structures, Funding options: Bootstrapping, Angel Investors, Venture Capital, Financial planning & cash flow management, Pitching a startup idea to investors (Elevator Pitch & Pitch Deck).
6	Marketing & Growth Hacking: Basics of digital marketing (SEO, SEM, Social Media),Customer segmentation & target market selection, Growth Hacking Strategies for rapid scale-up, Branding & positioning for tech Startups.
7	Operations & Team Management :Setting up a start-up's operational workflow, Supply Chain & Inventory Management for product-based stratus, Hiring & team building strategies, Managing co-founders, leadership & conflict resolution.
8	Scaling, Sustainability & Exit Strategies : Scaling up a startup: challenges & strategies, Risk management & handling failures, Sustainable business models, Exit strategies: Mergers, Acquisitions, IPOs.
9	Project: Real-world case studies of successful & failed Startups, Engineering startup project: students create a prototype & business model, Presentation & evaluation of startup projects.

Learning Resources:

Text Book:

1	" <i>The Lean Startup</i> " by Eric Ries – A guide on how Startups can efficiently build products and scale through iterative testing and feedback.
2	" <i>Zero to One</i> " by Peter Thiel–Focuses on innovation, creating unique businesses, and avoiding competition
3	" <i>The Startup Owner's Manual</i> " by Steve Blank & Bob Dorf -A practical guide covering customer development, business models, and startup methodologies.
4	" <i>Disciplined Entrepreneurship</i> " by Bill Aulet,-Provides a step-by-step framework for launching a startup.

5	<i>"The Corporate Yodha: Unleashing the Power of Qu in You"</i> by Chetan Wakkar-Focuses on transformative journey through the multifaceted realms of human excellence. Drawing on nearly three decades of experience in education
Journal Articles:	
1	<i>"Prior Knowledge and the Discovery of Entrepreneurial Opportunities"</i> by Scott Shane, <i>Organization Science</i> , 11(4), 448-469 (2000).
2	<i>"The Relational Organization of Entrepreneurial Ecosystems"</i> by Ben Spigel, Published.
E- Contents:	
1	<i>Harvard Business Review (HBR) – Articles on entrepreneurship, leadership, and business strategy.</i>
2	<i>Entrepreneur.com – A website offering advice on various aspects of entrepreneurship.</i>
Case Studies:	
1	<i>Harvard Business School Case Studies – Case studies on successful and failed Startups.</i>
2	<i>Stanford e Corner – Startup Stories- Videos and lectures from successful startup founders and investors.</i>
3	<i>TED Talks on startup - Inspiring talks on startup culture, innovation, and business strategy.</i>

[24UVEP407]: Environment Studies

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	Teachers Assessment Examination (TAE):	10
		Class Assessment Examination (CAE):	15
		Internal Teamwork:	25
		Total	50
Course Prerequisites: Foundation in Science Subjects			

Course Objectives	
Environment Studies aim to develop awareness, impact knowledge and foster positive attitudes towards the environment.	
Course Outcomes	
On successful completion of the course the learner will be able to:	
CO1	Associate the role of environment in man-environment relationship and critically analyse the necessity of environment awareness in society.
CO2	Create awareness about the environmental issue and the role of pollution act in the conservation of resources.

Assignments /Activities
Seminar / Group Discussion, Home Assignments/Group Activities and Report writing of field work

List of Laboratory Assignments		No. of Session
Unit 1: Global Environmental Crisis		
Introduction to the Global Environmental Crisis: <i>The Story of Kalahandi</i> Major Causes: Population, Pollution, Water and Sanitation, Forests, Land, Biodiversity. Climate and Environmental Impact: Global Warming, Carbon Dioxide Emissions, Disasters, Urbanisation. Scientific and Industrial Revolutions, Ecological Measures: Ecological Footprint, Humanity's Ecological Footprint. Response to the Crisis: The world's response to the environmental crisis, Public awareness and environmental issues, Environmental studies and related terms. Practical Implementation: Case Study Discussion / Presentation: Students research Kalahandi's environmental and socio-economic issues and present findings.		6
Unit 2: Ecosystems: Basic Concepts		
<i>The Story of Himalayas</i> Where do we start in our journey through environmental issues? Ecosystem, Biosphere, Classification of ecosystems, Structure of an ecosystem, Food chains and food webs, Trophic levels, Ecological Pyramid, Habitat, Cycles in ecosystems. Practical Implementation: Investigate the structure and functioning of a local ecosystem by identifying its key components (producers, consumers, decomposers), constructing its food web and ecological pyramid, and analyzing how natural cycles (water, carbon, nitrogen) maintain ecosystem balance.		6
Unit 3: Water Resources		
<i>The story of Cherrapunji</i> Water: a unique resource Availability of water in the world, Measuring water scarcity, Water scarcity in cities, Water for irrigation, Conflicts over water, Water situation in India, Urban water supply in India, Water consumption by Indian industries. Practical Implementation: Analyze water availability and scarcity in your local area or a nearby city, identify major sources of water consumption, and explore water conservation methods.		6
Unit4: Air and Noise Pollution		
<i>The story of juvenile asthma</i> The juvenile asthma case, Air pollution, The source of outdoor air pollution, The role of automobiles in air pollution, Smog, The levels of outdoor air pollution in India, The effects of outdoor air pollution, Controlling outdoor air pollution, Cleaner cars, Regulation of automobile emissions in India, The causes and effects of indoor air pollution, Indoor air pollution in India, Noise pollution and its sources, The effects of noise pollution, Noise pollution in India. Practical Implementation: Examine the impact of outdoor and indoor air pollution on respiratory health, particularly juvenile asthma, and explore measures to reduce air and noise pollution in your local area.		6
Unit 5: Energy Resources		

<p>The story of women headloaders</p> <p>Global energy crisis, Our energy needs, The global energy consumption pattern, Our sources of energy, Fossil fuels, Oil: a worldwide concern</p> <p>Coal, Natural gas, Nuclear power, Safer renewable sources, Solar energy, Wind energy, Hydropower, The hydrogen economy, Efficient use of energy, The energy scene in India, Energy conservation.</p> <p>Practical Implementation: Explore local energy use patterns and the impact of traditional energy sources on communities, especially focusing on the role of women headloaders, and suggest ways to promote safer, renewable energy and energy conservation.</p>	6
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Learning Resources:	
Text Book:	
1	R. RAJAGOPALAN “ Environmental Studies From Crisis to Cure ” (2 nd Edition).
Reference Books:	
1	Erach Bharucha, “ Textbook of Environmental Studies for Undergraduate Courses ”, University Press (India) Pvt. Ltd., 2005, ISBN: 978-81-7371-540-2.
2	D.L. Manjunath, “ Environmental Studies ”, 3rd Edition, Pearson Education, 2006, ISBN: 978-81-317-0912-2.
3	P. Anandan and R. Kumaravelan, “ Environmental Science and Engineering ”, Scitech Publications, 2009, ISBN: 9788188429821.
4	Dr. J.P. Sharma, “ Environmental Studies ”, 3rd Edition, University Science Press, 2016, ISBN: 978-81-318-0641-8.
E- Contents:	
1	https://www.coursera.org/learn/environmental-law (Introduction to Environmental Law and Policy)
2	https://www.coursera.org/learn/environmental-science (Environmental Studies)
3	https://onlinecourses.swayam2.ac.in/cec24_ge05/preview (Environmental Studies)
4	https://onlinecourses.nptel.ac.in/noc23_hs155/preview (Environmental Science)
5	https://www.udemy.com/course/phase-i-esa/?couponCode=CP130525
Case Studies:	
1	Pollution in Urban India: Delhi’s air pollution crisis and its health impacts.
2	Cherrapunji: Water scarcity despite heavy rainfall; traditional water harvesting methods.
3	Noise Pollution: Effects of urban noise on health, studied in metro cities such as Mumbai.

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