Second Year B. Tech

Semester-III

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
UITL301	Data Structures and Algorithms	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-		75
UITP301	Data Structures and Algorithms Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
UITL302	Object Oriented Programming using C++	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
UITP302	Object Oriented Programming using C++ Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
UITL303	Discrete Mathematics	Program Core Course (PCC)	2	1	-	3	3	10	15	50	-	-	75
UITLXXX	Minor-I	Multidisciplinary Minor-I	2	-	-	2	2	10	15	25	-	-	50
UXXXXXX	Open Elective-I	Open Elective(OE) other than a particular program	3	-	-	3	3	10	15	50	-	-	75
UXXXXXX	Open Elective-I Laboratory	Open Elective(OE) other than a particular program	-	-	2	2	1	-	-	-	25	-	25
4UESP304	Entrepreneurship Awareness-I	Entrepreneurship / Economics/ Management Course	-	-	4	4	2	-	-	-	25	-	25
4UVEL305	Understanding India	Value Education (VEC-I)	2	-	-	2	2	-	-	-	25	-	25
24UITP306	Project Based Learning	Comm. Engg. Project (CEP)/ Field Project (FP)	-	-	4	4	2	-	-	-	25	-	25
	Total		13	1	16	30	22	50	75	225	100	50	500

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Second Year B. Tech

Semester-IV

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UITL401	Database Management System	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITP401	Database Management System Lab	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UITL402	Operating System	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITP402	Operating System Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UITL403	Software Engineering	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITLXXX	Minor –II	Multidisciplinary Minor-II	2	-	-	2	2	10	15	25	-	-	50
24UITXXXX	Open Elective -II	Open Elective(OE) other than a particular program	2	-	-	2	2	10	15	25	-	-	50
24UITP404	Web Technology	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		**11**	**-**	**22**	**33**	**22**	**60**	**90**	**200**	**100**	**50**	**500**

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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

Third Year B. Tech (Information Technology)

(With effect from Academic Year 2026-27)

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Third Year B. Tech

Semester-V

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UITL501	Design and Analysis of Algorithm	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITP501	Design and Analysis of Algorithm Lab	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UITL502	Computer Networks	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITP502	Computer Networks Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UITL503	Theory of Computation	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITL504X	PEC-I	Program Elective Course (PEC)	2	-	-	2	2	10	15	25	-	-	50
24UITP504X	PEC-I Laboratory	Program Elective Course (PEC)	-	-	4	4	2	-	-	-	25	-	25
24UITLXXX	Minor-III	Multidisciplinary Minor	2	-	-	2	2	10	15	25	-	-	50
24UITPXXX	Minor-III Laboratory	Multidisciplinary Minor	-	-	4	4	2	-	-	-	25	-	25
24UXXXXXX	Open Elective-III	Open Elective(OE) other than a particular program	2	-	-	2	2	10	15	50	-	-	75
	Total		**15**	**-**	**14**	**29**	**22**	**60**	**90**	**250**	**50**	**50**	**500**

Program Elective Course (PEC) -I
24UITL504A/ 24UITP504A: Augment Reality and Virtual Reality
24UITL504B/ 24UITP504B: Artificial Intelligence
24UITL504C/ 24UITP504C: Big Data Analytics

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Third Year B. Tech

Semester-VI

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UITL601	Web Technology	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITP601	Web Technology Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	50	50
24UITL602	Information Security	Program Core Course (PCC)	3	-	-	3	3	10	15	50	-	-	75
24UITP602	Information Security Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	50	50
24UITL603X	PEC-II	Program Elective Course (PEC)	2	-	-	2	2	10	15	25	-	-	50
24UITP603X	PEC-II Laboratory	Program Elective Course (PEC)	-	-	4	4	2	-	-	-	-	25	25
24UITL604X	PEC-III	Program Elective Course (PEC)	2	-	-	2	2	10	15	25	-	-	50
24UITP604X	PEC-III Laboratory	Program Elective Course (PEC)	-	-	4	4	2	-	-	-	25	-	25
24UITLXXX	Minor –IV	Multidisciplinary Minor	2	-	-	2	2	10	15	25	-	-	50
24UVEP605X	Vocational & Skill Enhancement Course	Vocational & Skill Enhancement Course (VSEC)	-	-	4	4	2	-	-	-	50	-	50
	Total		12	-	20	32	22	50	75	175	75	125	500

Program Elective Course (PEC)-II	Program Elective Course (PEC)-III
24UITL603A/24UITP603A: AI for Cybersecurity	24UITL604A/24UITP604A: Software Testing & Quality Assurance
24UITL603B/24UITP603B:Software Design Patterns	24UITL604B/24UITP604B: Data warehousing
24UITL603C/24UITP603C:DesignThinking and Innovation	24UITL604C/24UITP604C: Compiler Design

Vocational & Skill Enhancement Course (VSEC)
24UVEP605A:Full-Stack Web Development (MERN Stack)
24UVEP605B:Kubernetes & Docker for DevOps

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Fourth Year B. Tech

Semester-VII

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UITL701	Machine Learning	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITP701	Machine Learning Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	25	-	25
24UITL702	Cloud Computing	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITP702	Cloud Computing Laboratory	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UITL703X	PEC-IV	Program Elective Course (PEC)	2	-	-	2	2	10	15	25	-	-	50
24UITLXXX	Minor-V	Multidisciplinary Minor	2	-	-	2	2	10	15	25	-	-	50
24UITP704	Project Stage - I	Internship / OJT	-	-	8	8	4	-	-	-	50	50	100
24UITP705	Internship / OJT	Internship / OJT	-	-	16	16	8	-	-	-	100	-	100
	Total		**08**	**-**	**28**	**36**	**22**	**40**	**60**	**150**	**175**	**75**	**500**

Program Elective Course (PEC) – IV (SWAYAM Courses Recommended)
24UITL703A:Distributed Computing
24UITL703B:Cyber Security and Forensic
24UITL703C:Software Architecture

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Fourth Year B. Tech

Semester-VIII

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical / Oral		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UITL801	Business Intelligence	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITL802	Deep Learning	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UITP802	Deep Learning Laboratory	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UITL803X	PEC-V	Program Elective Course (PEC)	4	-	-	4	4	10	15	50	-	-	75
24UITP803X	PEC-V Laboratory	Program Elective Course (PEC)	-	-	4	4	2	-	-	-	25	-	25
24UITLXXX	Minor –VI	Multidisciplinary Minor	2	-	-	2	2	10	15	25	-	-	50
24UITXXXX	Project Stage -II	Project	-	-	8	8	4	-	-	-	50	50	100
24UITP404	Research Paper/ IPR	Experiential Learning Courses	-	-	4	4	2	-	-	-	50	-	50
24UBSP405	Technical Seminar	Experiential Learning Courses	-	-	4	4	2	-	-	-	25	-	25
	Total		10	-	24	34	22	40	60	175	150	75	500

Program Elective Course (PEC) –V (SWAYAM Courses Recommended)
24UITL803A/24UITP803ADevOps and Automation
24UITL803B/24UITP803B:Amazon Web Services
24UITL803C/24UITP803C:Quantum Computing

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Basket: Open Elective (OE)

Department of AI & DS					
OE-1		OE-2		OE-3	
Course code	Subject Name	Course code	Subject Name	Course code	Subject Name
24UAIL304 / 24UAIP304 A	DMS Administration	24UAIL405 A	Data Security & Privacy	24UAIL506 A	AI & ML
24UAIL304 / 24UAIP304 B	Analytics using Data Science	24UAIL405 B	Design Thinking	24UAIL506 B	AR & VR applications in Industry
24UAIL304 / 24UAIP304 C	Gen AI	24UAIL405 C	Social Network Analysis	24UAIL506 C	Deep Neural Network
24UAIL301/ 24UAIP301	Data Engineering				

Department of Information Technology					
OE-1		OE-2		OE-3	
Course code	Subject Name	Course code	Subject Name	Course code	Subject Name
24UIT304A	Software Engineering and Development	24UIT405A	Design and Analysis of Algorithms	24UIT505A	Big data analytics and R Programming
24UIT304B	Data Structures	24UIT405B	Deep Leaming	24UIT505B	Internet of Things
24UIT304C	Statistics for Engineers	24UIT405C	Android and IOS app development	24UIT505C	Cryptocurrency and block chain

Department of Mechanical Engineering					
OE-1		OE-2		OE-3	
Course code	Subject Name	Course code	Subject Name	Course code	Subject Name
24UMEL304A/ 24UMEP304A	DataAnalysis Tools	24UMEL404A	Non-Conventional Energy Sources	24UMEL506A	Technology and Financial Management
24UMEL304B/ 24UMEP304B	Data Visualization and Presentation	24UMEL404B	Additive Manufacturing	24UMEL506B	Product Design and Development
24UMEL304C/ 24UMEP304C	Mathematical Simulation	24UMEL404C	Nano Technology	24UMEL506C	Process Planning and Management

Department of E&TC

OE-1		OE-2		OE-3	
Course code	Subject Name	Course code	Subject Name	Course code	Subject Name
24UET304-A	Electromagnetics wave propagation and Antenna theory	24UET403-A	Network Analysis	24UET502- A	Wireless Sensor Networks
24UET304-B	Digital Image Processing	24UET403-B	ES and RTOS	24UET502- B	Speech and video signal processing
24UET304-C	Electronics and Electrical Engineering	24UET403-C	Mechatronics	24UET502-C	Renewable energy sources and Applications

Department of Computer Engineering					
OE-1		OE-2		OE-3	
Course code	Subject Name	Course code	Subject Name	Course code	Subject Name
24UCEL302/ 24UCEP302	Object Oriented Programming	24UCEL401 / 24UCEP401	Advance Data Structure	24UCEL501 / 24UCEP501	Database Management System
24UCEL303	Software Engineering	24UCEL402 / 24UCEP402	Operating System	24UCEL502 / 24UCEP502	Computer Networks
24UCEL1M2	Internet of Things	24UCEL2M4	Cyber Security	24UCEL3M1	Data Analysis and Visualization
24UCEL1M3	Virtual Reality	24UCEL2M5	Cognitive Psychology and User Behaviour	24UCEL3M5	User Interface (UI) and User Experience (UX) Design

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SEMESTER III

[24UITL301]: Data Structures and Algorithms

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	Understand the fundamental concepts and operations of linear and nonlinear data structures
2	Analyze the complexity of algorithms using time and space complexity.
3	Implement common data structures (arrays, linked lists, stacks, queues, trees, and graphs) in a programming language.
4	Apply appropriate data structures to solve real-world computational problems efficiently
Course Outcomes On successful completion of the course the learner will be able to:	
CO1	Explain and differentiate various data structures and their applications.
CO2	Analyze the time and space complexity of algorithms using Big-O notation
CO3	Implement and apply linear data structures like arrays, linked lists, stacks, and queues.
CO4	Implement and apply nonlinear data structures like trees and graphs.
CO5	Choose suitable data structures and algorithms for problem-solving.

Contents	**No. of Session**
Unit 1: Introduction and Complexity Analysis	
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. **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.	6
Unit 2: Arrays and Linked List	
Array as an Abstract Data Type, Operations on Array, Storage Representation and their Address Calculation: Row major and Column Major Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Polynomial as array of structure, Polynomial addition, Polynomial evaluation. 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,	6

linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List-Create, Traverse, Insert, Delete, Concatenate. Generalized Linked List (GLL) concept.	
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: Trees and Graphs	
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 **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- Prims and Kruskal Algorithms **Shortest Path Algorithms:** Dikjtra's Single source shortest path	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.
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

[24UITP301]: Data Structures and Algorithms 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 program on arrays and any 1 program on linked list from Set-B
   c. compulsory program on searching and sorting from of Set-C.
   d. Any 1 program on stack and any 1 program on queue from Set-D
   e. Any 1 program on tree and any 1 program on graph 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: 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: a) Addition of two matrices b) Subtraction of two matrices c) Multiplication of two matrices d) Transpose of a matrix
3	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.
4	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
	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 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-V (Set-E)
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	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.
3	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.
4	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.

[24UTTL302]: Object Oriented Programming using C++

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 introduce the fundamental concepts of Object-Oriented Programming (OOP) such as encapsulation, abstraction, inheritance, and polymorphism using C++.
2	To develop skills in designing and implementing classes, objects, constructors, destructors, and various types of functions in C++.
3	To explore the use of inheritance and polymorphism for code reusability and dynamic behavior.
4	To apply generic programming concepts using templates and utilize components of the Standard Template Library (STL).
6	To enable students to handle runtime errors using exception handling and perform file operations in C++.
Course Outcomes On successful completion of the course the learner will be able to:	
CO1	To apply Object-Oriented Programming principles to design and develop modular and maintainable software in C++.
CO2	To implement and use classes, objects, constructors, destructors, and different types of member functions.
CO3	To utilize inheritance and polymorphism to promote code reuse and dynamic method resolution.
CO4	To develop generic solutions using templates and use STL containers, iterators, and algorithms effectively.
CO6	To perform robust error handling and manage file input/output operations using appropriate C++ techniques.

Contents	No. of Session
Unit 1: Introduction to Object-Oriented Programming	
Programming Paradigms: Procedure-Oriented Programming (POP), Object-Oriented Programming (OOP). Principles of OOP: Encapsulation, Abstraction, Inheritance, Polymorphism. Benefits and Applications of OOP. Structure of a C++ Program. Access Specifiers (public, private, protected). Namespaces Functions in Classes: Member Functions, Inline Functions, Static Member Functions, Friend Functions Special Member Functions: Constructors (Default, Parameterized, Copy), Destructor	6
Unit 2: Inheritance – Extending Classes	
Introduction to Inheritance, Defining Derived Classes, Types of Inheritance: Single, Multilevel, Multiple, Hierarchical, Hybrid. Virtual Base Classes, Abstract Classes Access Control in Inheritance: Public, Protected, Private. Constructor and Destructor Execution Order	6
Unit 3: Polymorphism and Pointers	
Compile-Time Polymorphism: Function Overloading, Operator Overloading (Unary and Binary using Member and Friend Functions) Pointers in C++: Introduction, new and delete, Pointers to Objects, Pointers to Derived Classes, this Pointer Run-Time Polymorphism: Virtual Functions, Pure Virtual Functions, Virtual Destructors	6
Unit 4: Namespace and Templates	
Namespace: Need for Namespaces, Namespace Syntax, Using `using` Directive and `using` Declaration, Nested Namespaces (C++11 and beyond) Templates: Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading Template Functions, Member Function Templates, Non-type Template Arguments STL: Introduction, Components of STL (Containers, Algorithms, Iterators), Application of Container Classes (vector, list, map)	6
Unit 5: Exception Handling and File Handling	

Exception Handling: Basics, Try-Catch-Throw Mechanism, Rethrowing Exceptions, Specifying Exceptions File Handling: File Stream Classes, Opening and Closing Files, File Modes, End-of-File Detection, File Pointers and Manipulation, Command Line Arguments, Text vs. Binary File Handling	6

Learning Resources	
Text Book	
1	Object Oriented Programming with C++, E Balagurusamy, 8th edition.
2	Object Oriented Programming in C++, Sourav Sahay
Reference Books	
1	Let us C++, Yashvant Kanetkar, 3rd edition
2	Object Oriented Programming in C++, Robert Lafore, 4th 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

[24UITP302]: 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 Student Grade Record. Include the following members:
   Data members:
   - A) Student name
   - B) Roll number
   - C) Marks in 3 subjects

   Member functions:
   - A) To enter student details
   - B) To calculate total and average
   - C) To determine grade
   - D) To display student report

2.	Define a Triangle class with base and height attributes. A) Implement a default constructor (sets base and height to 1). B) Implement a parameterized constructor to accept custom values. C) Include a function to calculate area.
3.	Create a Book class with `title`, `yearPublished`. 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.	Define a namespace named Constants that contains declarations of some constants. Write a program that uses the constants defined in the namespace Constants
7.	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.
8.	Implement a template function sortArray() to sort an array of any data type (integers, floats, or characters).
9.	Write a program to store Student Records (Roll Number & Marks) in map container. Implement map<int, int> where key = roll number and value = marks.
10.	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.
11.	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.

[24UITL403]: Discrete Maths

Teaching Scheme:	Credit	Examination Scheme:	Marks
TH: - 2 Hours/Week	03	Teachers Assessment Examination (TAE):	10
Tut: -01		Class Assessment Examination (CAE):	15
		End Semester Examination (ESE):	50
		Total	**75**
Course Prerequisites:			

Course Objectives	
1	To introduce the fundamentals of propositional logic, logical equivalences, and mathematical induction.
2	To explore relations, functions, and their properties through set-theoretic and diagrammatic approaches.
3	To understand graph structures and apply algorithms for traversal, coloring, and shortest paths.
4	To study tree structures and their applications in searching, coding, and spanning tree algorithms.
5	To provide a foundational understanding of algebraic structures such as semigroups, monoids, and groups.
Course Outcomes On successful completion of the course the learner will be able to:	
CO1	To apply propositional logic and induction in solving logical and mathematical problems.
CO2	To analyze and construct relations, functions, and lattices with the help of diagrams.
CO3	To solve real-world problems using concepts and algorithms from graph theory.
CO4	To implement tree structures and algorithms in problem-solving and data compression.
CO5	To apply basic group theory concepts in mathematical and computational contexts.

Contents	No. of Session
Unit 1: Propositional Logic	
Logic and propositions, Propositional equivalences, Mathematical induction	4
Unit 2: Relation and function	
Relations: Properties of relations, Equivalence relations, Partial orderings, Partitions, Hasse diagrams, Lattices, Chains and anti-chains, Transitive closure, Warshall's algorithm **Functions:** Surjective, Injective, Bijective functions, Identity function, Partial function	8

Unit 3: Graph Theory	
Graph terminology, Special types of graphs, Graph representations, Graph isomorphism, Connectivity, Euler paths, Hamiltonian paths, Handshaking lemma, Dijkstra's algorithm (single source shortest path), Planar graphs, Graph colouring	7
Unit4: Tree	
Introduction to trees, Properties of trees, Binary search tree, Tree traversals, Decision trees, Prefix codes, Huffman coding, Cut sets, Spanning trees, Minimum spanning tree, Kruskal's algorithm, Prim's algorithm	7
Unit 5: -Group Theory	
Algebraic systems, Semigroups, Monoids, Groups, Group properties, Subgroups, Cyclic groups, Basic applications of 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 It's 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	**Tremblay and Manohar**, "*Discrete Mathematical Structures with Applications to Computer Science*", Tata McGraw-Hill.
2	**Schaum's Outline Series**, "*Discrete Mathematics*", McGraw-Hill.
3	**Norman L. Biggs**, "*Discrete Mathematics*", Oxford University Press.
E- Contents:	
1	NPTEL: Discrete Mathematics (Prof. Kamala Krithivasan, IIT Madras)
2	https://www.khanacademy.org/computing/computer-science/cryptography
3	NPTEL: Mathematics in Computer Science

[24UXXXXXXX]: Multidisciplinary Minor (MDM)

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 Multidisciplinary Minor(MDM) from the Basket of MDM*			

[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*			

[24UXXXXXXX]: Open Elective-1 Laboratory

Teaching Scheme	Credit	Examination Scheme	Marks
Lab: 2 Hours/Week	01	Internal Practical Exam (OR)	25
		Total	**25**
Note: *Please select the Open Elective lab from the Basket of Open Electives*			

[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	*"Start with Why"* by Simon Sinek – Explores the importance of defining the purpose behind a business.
2	*"The Lean Startup"* by Eric Ries – A guide on how startups can efficiently build products and scale through iterative testing and feedback.
3	*"Business Model Generation"* by Alexander Osterwalder and Yves Pigneur – A comprehensive guide to creating and analyzing business models.
4	*"The Innovator's Dilemma"* by Clayton Christensen – A look at how companies can innovate and grow in changing markets.
Journal Articles	
1	*"Entrepreneurship as a Career Choice: Implications for Education and Research"* by K. R. Venkataraman and S. S. Sarasvathy, *Academy of Management Learning & Education.*
2	*"The Role of Entrepreneurship Education in Shaping Entrepreneurial Intentions", Journal of Business Venturing.*
E- Contents	
1	*Harvard Business Review (HBR) – Articles on entrepreneurship, leadership, and business strategy.*
2	*Entrepreneur.com – A website offering advice on various aspects of entrepreneurship.*
Case Studies	
1	*Harvard Business School Case Studies* – Real-world business problems for entrepreneurs.
2	*Case Study: Airbnb's Startup Journey* – From the ground up to global success.

3	*The Uber Growth Story* – Scaling and disrupting the transportation industry.

[24UVEL305]: Understanding India

Teaching Scheme	Credit	Examination Scheme	Marks
TH: 2 Hours/Week	02	Internal Practical Exam (OR)	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	8

foreign travellers-Huan Tsang, Itsing, Ibn Batuta, Al Baruni. Case study of Vijaynagar Empire, Chola Empire & Maratha Empire . Literary masterpieces of India-Kalidas	
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 3Montreal, 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

[24UITP306]: Project Based Learning

Teaching Scheme:	Credit	Examination Scheme:	Marks
Lab: 4 Hours/Week	02	Internal Practical Exam	25
		External Practical Exam	25
		Total	**50**

Course Prerequisites: Basic understanding of **OOP concepts,** Fundamentals of **data structures**

Course Objectives	
1	To strengthen programming fundamentals and object-oriented design using C++.
2	To promote self-learning, collaboration, and project-based application of C++.
3	To develop problem-solving skills by building modular and scalable C++ applications.
4	To simulate real-world software development practices like version control, testing, and documentation.
Course Outcomes On successful completion of the course the learner will be able to:	
CO1	Design structured and object-oriented solutions using C++..
CO2	Implement modular programs using classes, inheritance, and file handling.
CO3	Demonstrate the use of STL and templates to build efficient code..
CO4	Apply debugging, testing, and documentation practices in software development..
CO5	Collaborate in teams to plan, develop, and present C++-based projects.

Contents	**No. of Session**
Unit 1: Orientation & Team Formation	
Course briefing and expectations, Introduction to project-based learning methodology, Formation of 2–3 member teams, Idea brainstorming and topic finalization Activity: Finalize project topic **Deliverable**: Project idea proposal (one-page)	4
Unit 2: Tools Setup & Version Control	
C++ compiler, IDE setup (Code:Blocks/VS Code), Introduction to Git & GitHub, Project directory structure & README Activity: Git/GitHub setup **Deliverable**: GitHub repo created with initial project README	4