

Code: BCA- CC-IV 2002T (For Theory) BCA- 2002P (For Practical)	Data Structures	3L+T: 4P	5 Credits (45 hour theory and 60 hour practical)
Max Marks; Theory: 100 (Int: 25; Ext: 75); Practical: 100			
Course Outcomes: Upon completion of the course, students will be able to			
CO1: Understand the fundamental concepts of data structures and their classifications, including arrays and their operations.			
CO2: Develop the ability to implement and manipulate linked lists and apply hashing techniques for efficient data storage and retrieval.			
CO3: Apply stack, queue, and recursion concepts to solve complex computational problems in c programming.			
CO4: Implement tree and graph data structures to solve real-world problems and optimize data organization.			
Unit	Topics	Purposed lectures	
I	Definition, Classification and Operations of Data Structures: Definition of data structures, Types of Data Structures: Linear and Non-Linear Data Structure, Algorithms: Complexity, Time-Space Tradeoff. Difference between algorithm and programs. Arrays: Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear Arrays: Traversing, Inserting, Deleting, Searching, Sorting and Merging. Searching: Linear Search and Binary Search, Comparison of Methods. Sorting: Bubble Sort, Selection Sort, and Insertion Sort. Multi-Dimensional Arrays: Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.	11	
II	Linked Lists and Hashing Linked Lists: Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials. Hashing and Collision: Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.	11	
III	Stacks, Queues, and Recursion Stacks: Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List. Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression. Recursion: Definition, Recursive Notation, Runtime Stack. Applications of Recursion: Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi. Queues: Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List. Applications of Queues: Various use cases in problem-solving.	11	
IV	Graphs and Trees Graphs: Definition, Terminology, Representation, Traversal. Trees: Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation. Binary Search Tree: Inserting, Deleting and Searching in Binary Search Tree. Height Balanced Trees: AVL Trees, Insertion and Deletion in AVL Tree.	12	

- 1. Array Operations:**
 - o Write a program for insertion and deletion operations in an array.
- 2. Searching in an Array:**
 - o Write a program to search for an element in an array using Linear Search and Binary Search.
- 3. Sorting an Array:**
 - o Write a program to sort an array using Bubble Sort, Selection Sort, and Insertion Sort.
- 4. Merging Arrays:**
 - o Write a program to merge two arrays.
- 5. Matrix Operations:**
 - o Write a program to add and subtract two matrices.
 - o Write a program to multiply two matrices.
- 6. Singly Linked List Operations:**
 - o Write a program to insert an element into a Singly Linked List:
 - At the beginning
 - At the end
 - At a specified position
 - o Write a program to delete an element from a Singly Linked List:
 - At the beginning
 - At the end
 - A specified element
- 7. Doubly Linked List Operations:**
 - o Write a program to perform the following operations in a Doubly Linked List:
 - Create
 - Search for an element
- 8. Circular Linked List Operations:**
 - o Write a program to perform the following operations in a Circular Linked List:
 - Create
 - Delete an element from the end
- 9. Stack Operations:**
 - o Write a program to implement stack operations using an array.
 - o Write a program to implement stack operations using a linked list.
- 10. Polynomial Addition:**
 - Write a program to add two polynomials using linked lists.
- 11. Postfix Evaluation:**
 - Write a program to evaluate a postfix expression using a stack.
- 12. Recursion Operations:**
 - Write a program to perform the following using recursion:
 - o Find the factorial of a number
 - o Find the GCD of two numbers
 - o Solve the Towers of Hanoi problem
- 13. Queue Operations:**
 - Write a program to implement simple queue operations using an array.
 - Write a program to implement circular queue operations using an array.
 - Write a program to implement circular queue operations using a linked list.
- 14. Binary Search Tree (BST) Operations:**
 - Write a program to perform the following operations on a binary search tree:
 - o Preorder Traversal
 - o Inorder Traversal
 - o Postorder Traversal
 - Write a program to perform insertion operation in a binary search tree.

Text Books:

1. Seymour Lipschutz, Data Structures with C, Schaum's Outlines, Tata McGraw-Hill, 2011.
2. Yashavant Kanetkar, Data Structures Through C, 4th Edition, BPB Publications, 2022.
3. Cormen T. H., Leiserson C. E., Rivest R. L., and Stein C., Introduction to Algorithms, PHI.(2011)
4. R. S. Salaria, "Data Structures & Algorithms ", Khanna Book
5. 5.Data Structures Through C in depth, S. K. Shrivastava, BPB Publications

Reference Books:

6. Reema Thareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.
7. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2007.
8. Expert Data Structures -RB Patel, Khanna Book Publishing