| Name of the Program: | BTECH CSE - AIML | Semester: 3 | Level: UG |
|---|---|---|---|
| Course Name: | Data Structures and Algorithms | Course Code/ Course Type | UBTML201/PCC |
| Course Pattern: | 2025 | Version | 1.0 |

| Assessment Scheme | | | | | Teaching Scheme | | |
|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Total Credits | Hours | CIA (Continuous Internal Assessment) | ESA (End Semester Assessment ) | Practical/ Oral |
| 3 | - | - | 3 | 3 | 40 | 60 | - |

Pre-Requisite:

1. Knowledge of C Programming

| | |
|---|---|
| **Course Objectives (CO):** | **The objectives of Data Structures and Algorithms are:**<br>1. To introduce fundamental problem-solving approaches and concepts of data structures and algorithm analysis.<br>2. To provide in-depth knowledge of linked list structures and their operations for dynamic memory management.<br>3. To develop understanding of stack and queue abstract data types along with their applications in expression handling and scheduling.<br>4. To enable learners to analyze and apply basic searching and sorting techniques along with their performance comparisons.<br>5. To impart knowledge about hierarchical and network data structures like trees and graphs, and explore their real-world applications. |
| **Course Learning Outcomes (CLO):** | **Students would be able to:**<br>1. Explain data structure types and analyze the efficiency of algorithms using time and space complexity metrics.<br>2. Demonstrate operations such as insertion, deletion, and traversal on different types of linked lists.<br>3. Apply stack and queue operations to solve computational problems like expression evaluation and process scheduling.<br>4. Compare various searching and sorting algorithms and analyze their performance in different scenarios.<br>5. Construct tree and graph-based solutions using traversal techniques and shortest path algorithms. |

## Course Contents/Syllabus:

| Descriptors/Topics | CLO | Hours |
|---|---|---|
| **UNIT I** | | |
| **Introduction to Data Structures:** General Problem-Solving Concepts, Types of Problems, Problem Solving Concepts for the Computer. Concept of data, Types of data structures: Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures. Algorithm: Characteristics of algorithm, Pseudo code, Flowchart. Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity and Space complexity of an algorithm Big 'O', ' $\Omega' and' \theta' notations$. | **CLO 1** | **6** |
| **UNIT II** | | |

| | | |
|---|---|---|
| **Stack and Queue:** Stack: Concept of stack, Operations on stack (push, pop and display) Applications of stack: recursion, converting expressions from infix to postfix, infix to prefix form, evaluating postfix or prefix form. Queue: Concept of queues as ADT, Implementation of queue using array. Concept of circular queue, double ended queue, Applications of queue: priority queue. | **CLO 2** | **9** |
| **UNIT III** | | |
| **Linked List:** Understanding the basics of Linked List, Comparison between array and linked list. Types and basic operations of Linked Lists: 1. Single Linked List. 2. Double Linked List. 3. Circular Linked List. 4. Circular Double Linked List. Basic operations: Creation. Insertion. Deletion. Traversing. | **CLO 3** | **6** |
| **UNIT IV** | | |
| **Searching and Sorting:** Searching and sorting: Need of searching and sorting, Concept of internal and external sorting, sort stability, Searching methods: Linear and binary search algorithms Sorting methods: Bubble, Insertion, Quick, Merge. Comparison of all sorting methods. Analyze Bubble Sort, Insertion sort, Quick Sort, Binary for Best, Worst and Average case. | **CLO 4** | **6** |
| **UNIT V** | | |
| **Tree and Graph:** Tree: Trees and binary trees-concept and terminology, Expression tree, Binary tree as an ADT, Binary search tree, Binary search tree as ADT (Insert Search Delete, level wise Display) Threaded binary tree: Concept of threaded binary tree (inorder, preorder and postorder), Applications of trees. Graph: Concept and terminologies, Breadth First Search traversal, Depth First Search traversal, Prim's and Kruskal's algorithms for minimum spanning tree, shortest path using Dijkstra's algorithm. | **CLO 5** | **6** |
| **Total Hours** | | **30** |

## Learning Resources:

**Text Books:**


1. JHerbert Schildt, "C++: The Complete Reference", McGraw Hill Education, 2003.
2. John R. Hubbard, "Data Structures with C++", Schaum's Outlines, Tata McGraw Hill Education, 2000.


**Reference Books:**


1. Michael T. Goodrich, Roberto Tamassia, and David Mount, 'Data Structures and Algorithms in C++', Wiley India Pvt. Ltd., 2004.
2. Seymour Lipschutz, "Data Structures", Schaum's Outlines, Tata McGraw Hill Education, 2006


**Online Resources/E-learning Resources:**

1. https://nptel.ac.in/courses/106102064 Data Structures and Algorithms, IIT Delhi Prof. Naveen Garg Date of Reference 18-4-2024
2. https://nptel.ac.in/courses/106103069 Date of Reference 18-4-2024