



Course Title : Data Structure and Algorithms

Course Code: BTCS 301-18

Semester: 3rd



PTU SYLLABUS

- Module 1: Introduction Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis. [6 hrs] (CO1)
- Module 2: Stacks and Queues ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis. [10 hrs] (CO2, CO4, CO5)
- Module 3: Linked Lists Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: All operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis. [10 hrs] (CO2, CO4, CO5)
- Module 4: Sorting and Hashing Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. [10 hrs] (CO3)
- Module 5: Graph Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis. [6 hrs] (CO2, CO4)



Module 1: Introduction

- Basic Terminologies:
- DATA : raw facts / set of values
- Eg : 25
- INFORMATION: useful or processed form of data.
- Eg: age=25

Basic Terminologies: contd..

- Data Item: single unit of value

Types: 1.Group Data Item

2. Elementary Data Item

- Entity
- Entity Set
- Field
- Record



Data Structure

- The logical or mathematical model of a particular organization of data is called data structure.
- It is a particular way of storing and organizing data in a computer so that it can be used efficiently.
- Types of Data Structures:
 - Linear
 - Arrays
 - Linked Lists
 - Stack
 - Queue
 - Non-Linear
 - Tree
 - Graphs



Data Structure Operations

- Traversing : Accessing each element exactly once.
- Searching : Finding the location of a particular Record.
- Insertion : Adding a new record to the structure.
- Deletion : Removing a record from the structure.
- Sorting : Arranging the records in some logical order.



Data Types

- Character
- Integer
- Floating
- Logical



Algorithm

- Well defined list of steps for solving a particular problem.
- Performance Metrics:
 - Time and space
- Complexity of an algorithm is the function which gives the running time and space in terms of the input size.



Characteristics Of a Data Structure

- **Time Complexity** – Running time or execution time of operation of data structure must be as small as possible.
- **Space Complexity** – Memory usage of a data structure operation should be as little as possible.

Types of complexity: Worst case

Average case

Best case



Asymptotic Notations

- O Notation : Formal way to express upper bound of an algorithm's running time.
- Ω Notation : Formal way to express lower bound of an algorithm's running time.
- Θ Notation : Formal way to express both upper and lower bound of an algorithm's running time.