Certificate Course in Data Structures using C (CCDSC)

Duration: 2 Months

Course Overview

The **Certificate Course in Data Structures using C** is designed to provide students with a solid foundation in data organization, manipulation, and problem-solving techniques using the C programming language. The course covers fundamental and advanced data structures such as arrays, linked lists, stacks, queues, trees, and graphs. Emphasis is placed on writing efficient programs, understanding algorithmic complexity, and applying data structures to solve real-world computational problems.

Course Objectives

1. To strengthen the understanding of **C programming fundamentals**.
2. To introduce the concepts of **data structures and algorithms**.
3. To teach the implementation of different data structures in **C**.
4. To develop problem-solving and analytical thinking using **data structures**.
5. To provide knowledge about **algorithm efficiency** and **Big-O notation**.
6. To prepare students for advanced topics in **competitive programming, system design, and software development**.

Course Outcomes

By the end of this course, learners will be able to:

- Understand and implement **linear and non-linear data structures**.
- Apply **arrays, stacks, queues, linked lists, trees, and graphs** in problem-solving.
- Write efficient C programs using **dynamic memory allocation and pointers**.
- Analyze algorithm performance using **time and space complexity**.
- Develop mini-projects demonstrating the practical use of data structures.
- Be prepared for further study in **algorithms, competitive programming, or interviews**.

Course Syllabus

Module 1: Introduction & Basics

- Introduction to Data Structures
- Importance & Applications of Data Structures
- Review of C Programming (Variables, Operators, Control Structures, Functions)
- Pointers & Dynamic Memory Allocation
- Structures in C

Module 2: Linear Data Structures

- **Arrays**: Representation, Operations, Applications (Searching & Sorting)
- **Strings**: Operations & Manipulation in C
- **Stack**: Concept, Array & Linked List Implementation, Applications (Expression Evaluation, Conversion)
- **Queue**: Simple Queue, Circular Queue, Priority Queue, Deque

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Module 3: Linked Lists

- Singly Linked List – Creation, Traversal, Insertion, Deletion
- Doubly Linked List – Operations & Applications
- Circular Linked List – Operations & Applications

Module 4: Non-Linear Data Structures

- **Trees**: Binary Trees, Traversals (Inorder, Preorder, Postorder)
- Binary Search Tree (BST) – Operations
- Introduction to Balanced Trees (AVL basics)
- **Graphs**: Representation (Adjacency Matrix/List), Traversal (DFS, BFS)

Module 5: Searching, Sorting & Algorithm Analysis

- Searching Algorithms: Linear Search, Binary Search

- Sorting Algorithms: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort
- Time & Space Complexity Analysis (Big-O, Ω, Θ Notations)

Module 6: Applications & Mini Project

- Hashing – Introduction & Applications
- Real-world applications of Data Structures (Scheduling, Routing, Compiler Design, etc.)
- **Mini Project Examples**:
    - Student Database Management (Linked List)
    - Expression Evaluator (Stacks)
    - Shortest Path Finder (Graphs)
    - Library Management System

☑ This 2-month certificate course ensures learners gain both **theoretical knowledge and practical coding skills** in Data Structures using C, which is essential for **interviews, competitive coding, and higher studies in CS**.