

## Certificate in Data Structures with Java (CDSJ)

**Duration:** 2 Months (Approx. 40 Sessions, 5 sessions per week)

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### Course Overview

The Certificate Course in Data Structures using Java is designed to provide learners with a strong foundation in implementing and understanding data structures through Java programming. The course covers fundamental concepts such as arrays, stacks, queues, linked lists, trees, graphs, and searching/sorting algorithms, enabling learners to write efficient programs and solve computational problems.

This course is ideal for students, beginners in programming, and aspiring software developers who want to strengthen their problem-solving and programming skills using Java.

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### Course Objectives

- To introduce students to the concepts of **data structures and algorithms**.
  - To train learners to implement **various data structures using Java**.
  - To understand **time and space complexity** of algorithms.
  - To enhance **problem-solving and logical thinking skills** through practical coding.
  - To prepare students for **interviews, competitive programming, and real-world projects**.
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### Course Outcomes

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

1. Understand the role and importance of data structures in problem solving.
  2. Implement linear and non-linear data structures in Java.
  3. Apply searching, sorting, and traversal algorithms effectively.
  4. Compare different data structures and choose optimal solutions.
  5. Write efficient, reusable, and modular Java code for real-world applications.
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### Course Syllabus

## **Module 1: Introduction to Java & Data Structures**

- Overview of Java basics (OOP concepts, classes, objects, methods)
- Importance of Data Structures in programming
- Time & Space Complexity (Big-O Notation)

## **Module 2: Arrays & Strings**

- One-dimensional & multi-dimensional arrays
- String handling in Java
- Searching (Linear & Binary Search)
- Sorting (Bubble, Selection, Insertion, Merge, Quick Sort)

## **Module 3: Stack & Queue**

- Concept of Stack (LIFO) – Implementation using arrays & linked lists
- Applications of Stack (Expression evaluation, parentheses matching)
- Queue (FIFO) – Implementation using arrays & linked lists
- Circular Queue, Priority Queue, Double Ended Queue (Deque)

## **Module 4: Linked Lists**

- Singly Linked List – Insertion, Deletion, Traversal
- Doubly Linked List – Operations & Applications
- Circular Linked List
- Comparison with Arrays

## **Module 5: Trees**

- Introduction to Trees & Terminologies
- Binary Tree – Creation & Traversals (Inorder, Preorder, Postorder)
- Binary Search Tree (BST) – Insertion, Deletion, Searching
- Applications of Trees

## **Module 6: Graphs & Hashing**

- Introduction to Graphs (Directed, Undirected, Weighted)
- Representation: Adjacency Matrix & Adjacency List
- Graph Traversal – BFS & DFS

- Introduction to Hashing & Hash Tables

### **Module 7: Applications & Mini Project**

- Real-world applications of Data Structures
  - Mini Project: Implementing a small system (e.g., Student Database, Library System, Path Finder using Graphs)
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#### ☒ **Final Deliverable:**

- Students will complete assignments on each data structure.
- A **Mini Project in Java** showcasing the use of multiple data structures.