



COMSATS University Islamabad

Department of Computer Science

Course Description Form (CDF)

Course Information

Course Code: CSC211

Course Title: **Data Structures**

Credit Hours: 4(3,1)

Lecture Hours/Week: 3

Lab Hours/Week: 3

Pre-Requisites: **CSC103-Programming Fundamentals**

Course Objectives

- To provide students with a strong foundation in fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs.
- To develop problem-solving skills by applying appropriate data structures to real-world computing problems.
- To equip students with the ability to implement, manipulate, and optimize data structures using a programming language.
- To prepare students for advanced topics in computing by understanding the role of data structures in algorithm design and software development.

Course Contents:

This course provides fundamental knowledge of data organization. The topics include Overview of Data Structures; Static & Dynamic List; Stack; Queue; Tree & its Algorithms; Graph & its Algorithms; Sorting; Searching; Hashing.

Unit wise Major Topics:

Unit	Topics	No. of Teaching Hours
1.	Overview of Data Structures: Concept, Classification, Operations, Abstract Data Types, Trade-offs in Data Structure Design, Impact of Evolving Application Requirements on Data Structure Design, and Criteria for Selecting Appropriate Data Structures.	3
2.	List: Static List; Dynamic List: Single Linked Lists, Circular Linked List, Doubly Linked List, and Applications.	7.5
3.	Stack: Definition, Representations: Static & Dynamic, Implementation of Stack, Applications of Stack: Checking Validity of an Expression containing nested Parenthesis, Polish Notation Representation & Conversion, Evaluation of post fix expression Tower of Honoi problem, Implementation of recursion using stack.	4.5
4.	Queue: Concept, Types: Circular Queue, Priority Queue, Double Ended Queue, and Applications of Queue.	4.5
5.	Tree & its Algorithms: Rooted Tree & its Terminology, Types: Binary Tree, Strictly Binary Tree, Complete Binary Tree, Extended Binary Tree, Algebraic Expression representation in Tree, Traversal Algorithms; Creation of Binary Tree from Post order & In order Traversal, Creation of Binary Tree from Preorder & in In order Traversal, Binary Search Trees & its Various Operations; AVL Tree & Various Rotation Operations and Min & Max Heaps.	9
6.	Graph & its Algorithms: Basic Concepts & Terminology; Representation, Types; Graph Traversal Techniques: Breadth First Search, Depth First Search; Directed Acyclic Graphs, Topological Sort Connected Components, Minimum Spanning Trees: Kruskal Algorithm, Prims Algorithm; and Shortest Path Problem: Dijkstra's Algorithm.	7.5
7.	Sorting Algorithms: Bubble Sort, Selection Sort, Insertion Sort, Radix Sort, Binary Tree Sort & Heap Sort, Experimental Analysis of Sorting.	4.5

8.	Searching: Linear & Binary Search; Experimental Analysis of Searching; Hashing: Hash Functions, Hash Tables, Strategies for Avoiding & Resolving Collisions; Storage Management: Garbage Collection, Dynamic Memory Management, Method to Select free block	4.5
----	---	-----

Total Contact Hours

45

Mapping of CLOs and GAs

Sr.#	Unit #	Course Learning Outcomes	Blooms Taxonomy Learning Level	GA
CLOs for Theory				
CLO-1	1-4	Employ linear data structures to solve computing problems.	<i>Applying</i>	2-4
CLO-2	5-6	Use non-linear data structures to solve computing problems.	<i>Applying</i>	2-4
CLO-3	7,8	Apply fundamental sorting, searching, or hashing techniques on different data structures.	<i>Applying</i>	2-4
CLOs for Lab				
CLO-4	2-7	Implement various data structures, searching, sorting, and hashing in a programming language.	<i>Applying</i>	2-4
CLO-5	1-8	Develop a project using appropriate data structures in a team environment.	<i>Creating</i>	2-6

CLO Assessment Plan

Assessment Tools	CLO-1	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Quizzes	Quiz 1	Quiz 2	Quiz 3	Quiz 4	-	-
Assignments	Assignment 1	Assignment 2	Assignment 3	Assignment 4	Lab Assignments	-
Mid Term Exam	Mid Term Exam	Mid Term Exam	-	-	Lab Mid Term Exam	-
Final Term Exam	Final Term Exam			-	Lab Project/ Final Term Lab Exam	

Text and Reference Books

Textbook:

1. A Common-Sense Guide to Data Structures and Algorithms, Jay Wengrow, Pragmatic Bookshelf, 2020.

Reference Book:

1. C++ Plus Data Structures, Nell Dale, Chip Weems, Tim Richards, Jones & Bartlett Learning, 2016
2. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Addison-Wesley, 2014.