



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 Hanoi 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 |

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|--|---|---|--------------|--------------------------------|-------------------|----------------------------------|
| 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. | | Applying | 2-4 | |
| CLO-2 | 5-6 | Use non-linear data structures to solve computing problems. | | Applying | 2-4 | |
| CLO-3 | 7,8 | Apply fundamental sorting, searching, or hashing techniques on different data structures. | | Applying | 2-4 | |
| CLOs for Lab | | | | | | |
| CLO-4 | 2-7 | Implement various data structures, searching, sorting, and hashing in a programming language. | | Applying | 2-4 | |
| CLO-5 | 1-8 | Develop a project using appropriate data structures in a team environment. | | Creating | 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-Weslev. 2014. | | | | | | |