COMSATS University Islamabad
Department of Computer Science
Lecture Wise Plan

Course Information

Teacher: **Tahreem Saeed**	Email: tahreem@cuisahiwal.edu.pk
Program: **BSCS**	Semester: **Fall-23**
Course Code: **CSC211**	Course Title: **Data Structures and Algorithms**
Credit Hours: **4(3,1)**	Lecture Hours/Week: **3**
Lab Hours/Week: **3**	Pre-Requisites: **Programming Fundamentals**

Catalogue Description

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; and Time Complexity of an Algorithm.

Text & Reference Books

Textbook:

1. A Common-Sense Guide to Data Structures and Algorithms, Jay Wengrow, Pragmatic Bookshelf, 2020.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Ed., Addison Wesley, 2012.
3. Schaum's Outlines Data Structure by Seymore Lipschutz

Reference Book:

1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Addison-Wesley, 2014.

Unit wise major Topics:

Unit	Topic	No. of teaching hours of Theory
1	Data Structure: Overview, Importance, Classification, Operations, and Abstract Data Types.	3
2	Static List: Dynamic List: Single Linked List, Doubly Linked List, and Applications	10.5
3	Stack: Concept and Applications	6
4	Queue: Concept and Applications	3
5	Tree: Concept and Applications	12
6	Graph: Concept and Applications	4.5
7	Sorting Algorithms	3
8	Complexity Analysis	3
Total Contact Hours		45

Week wise plan

Lecture #	CDF Unit	Topics Covered	Reading Material	Assessment

1.	1	Introduction to Data Structures- Need and Significance, Review of the Pre-requisite Knowledge, OO Design and Implementation, Algorithms- Implementation and Testing		
2.	1	Abstraction, Concrete and Abstract Data Types, Class invariants and pre- and post-conditions, Structures	Any Internet Source	
3.	2	Introduction to Data structures, their importance, and types of Abstract Data Types, Static vs dynamic data structures, review of pointers, arrays, structures		
4.	2	Why we need list Data Structure? Implementing sequential lists using arrays, List Operations: insertion, searching, traversal, deletion	Seymore-Chapter 1	
5.	2	Applications of Linear and Non-linear Data Structures, Mathematical Functions, Control Flow Structures, Complete Problem-Solving Procedure including Algorithms, Flowcharts, Programs, Process, Threads		
6.	8	Complexity Analysis, Algorithm time and space complexity trade offs	Seymore-Chapter 2	Quiz 1 Assignment1
7.	8	Asymptotic Notations and their practice, Arrays (basic and Object types) Array as ADT, Algorithms on arrays	Shaffer-Chapter 3	
8.	2	Operations on Arrays- Linear and Binary Search Algorithms and their Complexity		

9.	7	Bubble Sort and its variants, Complexity of Bubble Sort, Insertion and Deletion in Arrays and its complexity		
10.	2	Dynamic Arrays, Multi-dimensional Arrays, Dynamic Memory Management-Garbage Collection	Seymore-Chapter 3,4	Quiz 2 Assignment2
11.	2	Introduction of Link List, Creating different types of Link List, Linked List – Operations and Representations, Variations of Linked Lists (doubly, circularly)		
12.	2	Comparison of different operations on Link List & Arrays	Seymore-Chapter 5	
13.	3	Applications – Polynomials, Sparse Matrices, Dynamic Memory Allocation, Stacks: Basic functions Static and Dynamic Representations		
14.	3	Stack Applications – Arithmetic Expression, Infix, post-fix and pre-fix notations, in-to post transformation and post-fix evaluation, backtracking, memory management, function calls.	Seymore-Chapter 6	Quiz 3 Assignment 3
15.	3	Recursion, Complexity of Recursive Algorithms, Applications of Recursion – Fibonacci Numbers and the Moivre Formula		
16.	3	Tower of Hanoi, Permutations, Recursive Binary Search		
Mid Term Exam				
19.	7	Sorting Algorithms (Merge Sort) and complexity Analysis,	Lafore: Chapter 7	
20.	4	Quick Sort, Queues: Basic Functions		
21.	4	Static and Dynamic	Seymore-Chapter 6	

		Representations Queue Variations Deque, priority Queue, Queue Applications		
22.	5	Non-liner Data Structures, Introduction to Trees, Graphs and Hash Tables and their generic implementation		
23.	5	Basic concepts of rooted Tree, Binary tree and other types of trees, Tree traversal algorithms (pre-order, in-order, post-order).		
24.	5	Binary Tree representation, basic operations		
25.	5	Binary Search trees, representation, and operations, Deletion in BST Heaps and Associated Algorithms.		
26.	5	AVL Trees: Inserting in AVL tree, Left to Right rotation, right to left rotation, left to left rotation, and Right to right rotation, Deletion of a node in a AVL tree.		
27.	5	Heap: Build heap (max/min from a set of data items		
28.	5	Delete (max/ min) in a heap, Heap sort and Analysis of heap sort, B-Tree, Splay Trees		Quiz 4 Assignment 4
29.	5	Huffman Algorithm and its application	Dale- Chapter 8	
30.	6	Graphs: terminology, operations, and representation, Graph Implementation: Adjacency Matrix and Adjacency List		
31.	6	Graphs: Traversal Algorithms, BFS and DFS		
32.	6	Spanning Tree, Prims and Kruskal's Algorithms for Minimum Spanning Tree	Dale- Chapter 9	
Final Term Exam				

Student Outcomes (SOs)

S#	Description
1	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
2	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines
3	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
4	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
5	Function effectively as an individual and as a member or leader in diverse teams and in multi- disciplinary setting.

Course Learning Outcomes (CLOs)

CLO Sr.#	Unit#	Course Learning Outcomes	Bloom Taxonomy Learning Levels	SO
CLO's for Theory				
CLO-1	1-4	Employ linear data structures to solve computing problems.	Applying	1,2
CLO-2	5-6	Use non-linear data structures to solve computing problems.	Applying	1,2
CLO-3	7-8	Analyze the time complexity of various algorithms.	Applying	2
CLO's for Lab				
CLO-4	1-7	Implement data structures and algorithms.	Applying	2,3,4
CLO-5	1-8	Develop a project using appropriate data structures in a team environment.	Creating	2-5

CLO Assessment Mechanism

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

	Final Exam
Project	Project

Policy & Procedures

- **Attendance Policy:** Every student must attend 80% of the lectures delivered in this course and 80% of the practical/laboratory work prescribed for the respective courses. The students falling short of required percentage of attendance of lectures/seminars/practical/laboratory work, etc., shall not be allowed to appear in the terminal examination of this course and shall be treated as having failed this course.
- **Course Assessment:**

	Quizzes	**Assignments**	**Md Term Exam**	**Terminal Exam**	**Total**
Theory (T)	15	10	25	50	100
Lab (L)	-	25	25	50	100
T+L	**(T/100)*75+(L/100)*25**				

- **Grading Policy:** The minimum pass marks for each course shall be 50%. Students obtaining less than 50% marks in any course shall be deemed to have failed in that course. The correspondence between letter grades, credit points, and percentage marks at CUI shall be as follows:

Grade	**A**	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**	**D+**	**D**	**F**
Marks	**>= 85**	**80 - 84**	**75 - 79**	**71 - 74**	**68 - 70**	**64-67**	**61-63**	**58-60**	**54-57**	**<50-53**	**<50**
Cr. Point	**3.67-4.00**	**3.34-3.66**	**3.01-3.33**	**2.67-3.00**	**2.34-2.66**	**2.01-2.33**	**1.67-2.00**	**1.31-1.66**	**1.01-1.30**	**0.1-1.0**	**0.0**

- **Missing Exam:** No makeup exam will be given for final exam under any circumstance. When a student misses the mid-term exam for a legitimate reason (such as medical emergencies), his grade for this exam will be determined based on the Department policy. Further, the student must provide an official excuse within one week of the missed exam.
- **Academic Integrity:** All CUI policies regarding ethics apply to this course. The students are advised to discuss their grievances/problems with their counsellors or course instructor in a respectful manner.
- **Plagiarism Policy:** Plagiarism, copying and any other dishonest behavior is prohibited by the rules and regulations of CUI. Violators will face serious consequences.

Signature:---------- Signature:---------- Signature:--------

Course Instructor:
Tahreem Saeed

Area Head:
Dr. Zafar Iqbal

Head of Department:
Dr. Tariq Ali