Daffodil International University

Department of Computer Science and Engineering

Faculty of Science & Information Technology

Final Examination, Spring 2025

Course Code: CSE123, Course Title: Data Structures

Level:1 Term:2 Batch: ALL

Time: 2.0 Hours **Marks: 40**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	a)	Explain the role of **Balancing in Binary Search Trees (BST)** and why AVL trees are preferred over unbalanced BSTs. Provide an example.	5	CO1
	b)	**Problem Scenario: Efficient Student Record Management Using BST** *A university wants to efficiently manage student records using a **Binary Search Tree (BST)**. Each node in the BST represents a student and contains the following information:* • **Student ID** (int) – serves as the unique key • **Name** (string) • **CGPA** (float) The system must support the following operations: 1. **Insertion:** New student records should be inserted while maintaining BST properties. 2. **Searching:** Given a **Student ID**, find and display the corresponding student's Name and CGPA. 3. **Deletion:** If a student record is deleted, ensure that the BST remains valid (i.e., replacing with inorder successor or predecessor). **Tasks:** i) **(2 Marks)** Define the BST node based on the above requirements. ii) **(3 Marks)** Illustrate step-by-step how the following Student IDs are inserted into an initially empty BST: **(105, 120, 90, 75, 110, 95, 130, 125, 140)** • Draw the BST after each insertion.	10	CO3

		iii) **(3 Marks)** Suppose the Student ID **120** needs to be deleted. Show the updated BST after performing deletion while maintaining BST properties. iv) **(2 Marks)** Analyze the worst-case and average-case time complexity of **insertion, searching, and deletion** in a BST. Discuss how an **unbalanced BST** can affect performance and propose an alternative approach to improve efficiency. (*Full correct implementation: 10 marks, Partial correctness: 6-8 marks, Minor issues: 3-5 marks*)		
2.		a) (i) Explain the differences between **In-order, Pre-order, and Post-order traversal** of a Binary Tree with an example? (ii) How a **MinHeap** is different from **MaxHeap**. Give an example. **b)** Write a **C program** to implement an **AVL Tree** with the following functionalities: 1. **Insertion of a node** (Ensure the balance factor is maintained). 2. **Left and Right Rotation functions** to maintain balance. 3. **Display the tree in In-order traversal** to verify balancing. ***Requirements:*** (1) Explain the importance of the balance factor. (2) Demonstrate with an example how an imbalance is corrected using rotations. (*Full correct implementation: 10 marks, Partial correctness: 6-8 marks, Minor issues: 3-5 marks*)	**5** **10**	**CO1** **CO3**
3.		**Problem Solving (Analysis & Evaluation Level):** A traffic navigation system **needs to efficiently manage road networks where each intersection is a node, and roads are weighted edges (distance/time). The system should be able to:** 1. **Find the shortest path** between two locations. 2. **Identify the best route** when certain roads are closed due to maintenance. **Task:** 1. **Propose a Graph-based model** for this system. 2. **Explain how this Graph can be used** for shortest path calculation. 3. **Draw a diagram** to represent the structure of this system. (*Solution approach: 5 marks, Diagram: 3 marks, Explanation: 2 marks*)	**10**	**CO3**

Good Luck

Anaf Tahmid