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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.]***

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| 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**<br><br>*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:*<br><br>• **Student ID** (int) – serves as the unique key<br>• **Name** (string)<br>• **CGPA** (float)<br><br>The system must support the following operations:<br><br>1. **Insertion:** New student records should be inserted while maintaining BST properties.<br>2. **Searching:** Given a **Student ID**, find and display the corresponding student's Name and CGPA.<br>3. **Deletion:** If a student record is deleted, ensure that the BST remains valid (i.e., replacing with inorder successor or predecessor).<br><br>**Tasks:**<br>i) **(2 Marks)** Define the BST node based on the above requirements.<br>ii) **(3 Marks)** Illustrate step-by-step how the following Student IDs are inserted into an initially empty BST:<br>**(105, 120, 90, 75, 110, 95, 130, 125, 140)**<br><br>• Draw the BST after each insertion. | **10** | **CO3** |

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| | | iii) **(3 Marks)** Suppose the Student ID **120** needs to be deleted. Show the updated BST after performing deletion while maintaining BST properties.<br><br>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.<br><br>*(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. | 5 | **CO1** |
| | | b) Write a **C program** to implement an **AVL Tree** with the following functionalities:<br><br>1. **Insertion of a node** (Ensure the balance factor is maintained).<br>2. **Left and Right Rotation functions** to maintain balance.<br>3. **Display the tree in In-order traversal** to verify balancing.<br><br>***Requirements:*** (1) Explain the importance of the balance factor. (2) Demonstrate with an example how an imbalance is corrected using rotations.<br><br>*(Full correct implementation: 10 marks, Partial correctness: 6-8 marks, Minor issues: 3-5 marks)* | 10 | **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:**<br><br>1. **Find the shortest path** between two locations.<br>2. **Identify the best route** when certain roads are closed due to maintenance.<br><br>**Task:**<br><br>1. **Propose a Graph-based model** for this system.<br>2. **Explain how this Graph can be used** for shortest path calculation.<br>3. **Draw a diagram** to represent the structure of this system.<br><br>*(Solution approach: 5 marks, Diagram: 3 marks, Explanation: 2 marks)* | 10 | **CO3** |

*Good Luck*

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