Daffodil International University

Department of Computer Science and Engineering

Faculty of Science & Information Technology

Semester Final Examination, Fall 2024

Course Code: CSE123, Course Title: Data Structures

Level:1 Term:2 Batch: ALL

Time: 2 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.		The Election Commission of Bangladesh is analyzing the connectivity between polling stations in a district to optimize ballot transportation. Each polling station is represented as a node, and each road connecting two polling stations is represented as an edge with a weight (time in minutes). The connectivity is stored using an **adjacency matrix**. The current connectivity graph is represented as follows: **Station A B C D** **A** 0 10 15 0 **B** 10 0 5 20 **C** 15 5 0 25 **D** 0 20 25 0 **Problem Statement:** **Question a: Graph Representation (3 Marks):** o Explain how the above adjacency matrix represents the graph. o How would you interpret the value `15` in the matrix at position `(A, C)`? **Question b: Path Analysis (4 Marks):** o If Station A is selected as the starting point, list all directly connected stations and the respective travel times. o Write the pseudocode for finding all directly connected stations for any given station in this adjacency matrix. **Question c: Why Graph data structure plays a vital role in computing. (3 marks)**	7 3	CO2 CO1
2.		You are a software engineer working for the **Election Commission of Bangladesh** to develop digital solutions for efficient election management. With the upcoming elections, the Election Commission needs help managing electoral divisions, organizing candidate data, and optimizing routes between polling stations.	4 12	CO3 CO3

		The Election Commission manages a large amount of **candidate data** organized by unique candidate IDs. To enable fast retrieval and management, you need to store candidate data in a Binary Search Tree (BST). **Question a: Design a Binary Search Tree (BST)** in C to store candidate IDs, where each node represents a candidate. **Question b:** Implement the following functions: 1. Insert a new candidate ID into the BST. 2. Search for a candidate by ID to determine if they are in the system. 3. Display all candidate IDs in **in-order traversal** (ascending order of IDs).		
3.		An emergency response team uses a **priority queue** to handle incoming incidents based on their severity. Incidents with higher priority values are addressed first. The system is implemented using a **Max-Heap**. Each incident is represented by a priority value. The following two functions handle the core operations of the priority queue: 1. **Insert**: Adds a new incident to the heap while maintaining the Max-Heap property. 2. **Extract Max**: Removes and returns the incident with the highest priority from the heap. Here's the initial state of the heap: Heap: [40, 30, 20, 15, 10] Size: 5 □ After inserting a new incident with priority 35, the heap is updated. **Question a**: Show the step-by-step transformation of the heap after inserting 35. Explain how the Max-Heap property is restored. (3 Marks) □ The highest-priority incident is now resolved, and the **Extract Max** operation is performed. **Question b**: Show the heap after removing the highest-priority element. Explain how the heap is adjusted to restore the Max-Heap property. (4 Marks)	7	CO2
4		Reflecting on your course project experience in Data Structures, describe how you applied a specific data structure (such as a linked list, stack, queue, or binary tree) to solve a problem within your project. In your answer, include: **Question a: Description of the Problem (2 Marks)**: Briefly explain the problem or requirement that led you to select this particular data structure. **Question b: Data Structure Selection (2 Marks)**: Explain why you chose this data structure over others. What advantages did it offer for solving the problem? **Question c: Implementation and Challenges (3 Marks)**: Describe the implementation approach you followed and any challenges you faced. How did you overcome these challenges?	7	CO4

Good Luck