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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.]*

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|---|---|---|---|
| 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**.<br><br>The current connectivity graph is represented as follows:<br><br>**Station A B C D**<br>**A** 0 10 15 0<br>**B** 10 0 5 20<br>**C** 15 5 0 25<br>**D** 0 20 25 0<br><br>**Problem Statement:**<br>**Question a: Graph Representation (3 Marks):**<br>o Explain how the above adjacency matrix represents the graph.<br>o How would you interpret the value `15` in the matrix at position `(A, C)`?<br><br>**Question b: Path Analysis (4 Marks):**<br>o If Station A is selected as the starting point, list all directly connected stations and the respective travel times.<br>o Write the pseudocode for finding all directly connected stations for any given station in this adjacency matrix.<br><br>**Question c: Why Graph data structure plays a vital role in computing. (3 marks)** | 7<br>3 | CO2<br>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<br>12 | CO3<br>CO3 |

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|---|---|---|---|---|
| | | 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).<br><br>**Question a: Design a Binary Search Tree (BST)** in C to store candidate IDs, where each node represents a candidate.<br><br>**Question b:** Implement the following functions:<br>1. Insert a new candidate ID into the BST.<br>2. Search for a candidate by ID to determine if they are in the system.<br>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.<br><br>The following two functions handle the core operations of the priority queue:<br><br>1. **Insert**: Adds a new incident to the heap while maintaining the Max-Heap property.<br>2. **Extract Max**: Removes and returns the incident with the highest priority from the heap.<br><br>Here's the initial state of the heap:<br>Heap: [40, 30, 20, 15, 10]<br>Size: 5<br><br>□ After inserting a new incident with priority 35, the heap is updated.<br>**Question a**: Show the step-by-step transformation of the heap after inserting 35. Explain how the Max-Heap property is restored. (3 Marks)<br><br>□ The highest-priority incident is now resolved, and the **Extract Max** operation is performed.<br>**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:<br><br>**Question a: Description of the Problem** (2 Marks): Briefly explain the problem or requirement that led you to select this particular data structure.<br><br>**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?<br><br>**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*