Daffodil International University

Department of Software Engineering

Faculty of Science & Information Technology

Final Examination, Summer 2025

Course Code: SE214; Course Title: Algorithm Design and Analysis

Sections & Teachers: FE(A,B,C), MHS(D), CP(E), AJE(F,G), MMSI(H, I), AF(J)

Time: 2:00 Hrs **Marks: 40**

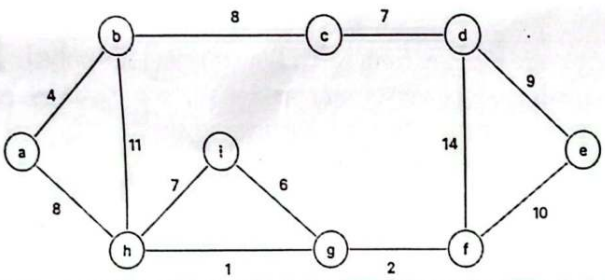
Answer ALL Questions

[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)*	**Differentiate** between a graph and a tree by explaining their key differences in structure and properties.	[Marks-3]	CLO-3 *Level-4*
	b)	**Explain** how BFS and DFS visit nodes in a graph differently, and mention which one is better for finding the shortest path in an unweighted graph.	[Marks-3]	
	c)	You are given two sequences of genetic markers from two different patients. Apply an appropriate algorithm to **determine** the Longest Common Subsequence (LCS) between the given sequences and show the detailed simulation step-by-step. **Identify** one of the longest common subsequences. **Sequence 1:** ACGTGTA **Sequence 2:** GCTAGTA	[Marks-7]	
	d)	You are preparing for a hiking trip and have 5 items to pack. Each item has a weight (in kilograms) and a usefulness rating. Your backpack can carry up to 7 **kilograms**. You want to maximize the total usefulness of the items you pack without exceeding the weight limit. You must either take the whole item or leave it (no partial packing).	[Marks-7]	

Item Name	Weight(Kg)	Usefulness
Hiking Boots	4	8
Water Bottle	3	7
Trail Map	1	5
First Aid Kit	2	6
Portable Stove	5	9

Using a dynamic programming approach, **determine** which hiking items should be packed into a backpack with a maximum weight capacity of 7 kg to maximize the total usefulness value.

2.	***a)***	As part of the university's tech innovation challenge, you are tasked with creating a walking-route planner that finds the quickest path between campus locations. The campus has: **Library (L), Laboratory (Lab), Administration (A), Central Garden (CG), Gym (G), Cafeteria (C),** and **Bookstore (B).**These locations are connected by walkways, and the travel times (in minutes) between them are affected by distance and foot traffic.You are given the following information: From the Library, it takes **4 minutes** to walk to the Laboratory and **6 minutes** to the Administration Office. The Laboratory is connected to the Gym in **5 minutes** and to the Cafeteria in **8 minutes**. The Administration Office is **3 minutes** from the Cafeteria and **2 minutes** from the Central Garden. Walking from the Central Garden to the Gym takes **4 minutes**, and from the Gym to the Cafeteria takes **6 minutes**. The Cafeteria is **7 minutes** from the Bookstore, while the Central Garden is **5 minutes** from the Bookstore. **Determine** the shortest path and total travel time from the Library (L) to the Bookstore (B) using Dijkstra's algorithm by showing step by step implementation on the weighted graph constructed using the given information.	**[Marks-7]**	**CLO-4** ***Level-5***
	b)	**Determine** the Minimum Spanning Tree (MST) of the given undirected, weighted graph using Prim's algorithm, showing each step until the minimum total cost is obtained. Also, **justify** why it is called a *Minimum Spanning Tree* in the context of graph theory.  	**[Marks-6]**	
	c)	You are given a 20-character message. The frequency of each letter in that message is listed below: **E- 1** **N- 3** **C- 4** **R- 1** **Y- 2** **P- 5** **T- 4** Now answer the following questions. **i) Illustrate** a Huffman tree and assign variable-length binary codes, ensuring that characters with higher frequencies get shorter codes and those with lower frequencies get longer codes. **ii) Investigate** the total number of bits required for transmitting and decoding the message using Huffman encoding. **iii) Compare** the bit-length of the Huffman encoded message with the bitlength required without compression, assuming standard ASCII encoding, where each character is represented using 8 bits.	**[Marks-7]**	