**CSC241 Final**

**Question 1 (24 points):** A networking company uses a compression technique to encode the message before transmitting over the network. The message contains the following characters with their frequency. Assume that initially (before encoding) all characters require 3 bits to represent (C = 000, D = 001...). If the compression technique used is Huffman Coding,

• How these bits will be represented (show the tree)?

Diagram

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• Decode this message according to the Huffman tree you have constructed: 11111100101

**KEEL**

**Question 2 (8 Points):** Determine which of the followings are true or false. Justify your answer.

1. Kruskal’s and Prim’s Algorithms may not produce the optimal spanning tree, especially if the graphs contains a lots of cycles. **True, if the graph contains cycles and the weights of edges are not coherent, then the optimal spanning tree may not be produced.**
2. II. If you randomly start with any node while working with Prim’s algorithm, it may not generate the optimal result. **False, Prim’s algorithm will always select the edge with the smallest weight and add it to the tree.**
3. III. If you randomly start with any edge while working with Kruskal’s algorithm, it may not generate the optimal result. **True, if the algorithm starts with a vertice with higher weighted edges, the optimal result will not be produced.**
4. IV. An adjacency matrix is always symmetric. **True, since the graph is undirected, every vertex will have an edge to another edge, and vice versa.**

**Question 3 (16 points):** In Bangladesh (A small country in South Asia) Dhaka, Khulna, Rangpur, Rajshahi, Sylhet, Chittagong, Barishal are the major cities. Government in Bangladesh decided to construct a railway connection between these cities. Here is the description of distances:

Dhaka – Sylhet (199km), Dhaka – Chittagong (211km), Dhaka – Rangpur (255km), Rajshahi – Rangpur (264km), Rajshahi – Sylhet (455km), Barishal – Rangpur (212km), Barishal – Khulna (169km), Barishal – Chittagong (267km), Khulna – Sylhet (450km).

They will construct a rail line in such a way so that all the cities are reachable from any other cities.

1. To reduce cost how they should connect the cities? Express it w.r.t. to a graph and show distance among the cities. Diagram

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2. II. If constructing 1km rail line costs 2000 usd what will be the minimum cost?

**Total Length= 1322km \* 2000/km = 2,644,000 USD.**

**Question 4 (18 Points):** Consider the following equation and write the prefix and postfix version of this equation: ((3 ∗ z − x) ∗ y) + 2 ∗ 𝑦 𝑦 + 𝑧 – 𝑥

**Prefix: + \* - \* 3 z x y / \* 2 y -+ y z x**

**Postfix: 3 z \* x - y \* 2 \* y y z + x - /+**

**Question 5 (14 Points):** Given a function 𝐹(𝑛) = 2 n+5, verify the following claims: This is an O(2n ) function. You must provide justification behind your claim. Hint: Follow the strategy that is shown in the class.

**=2^(n+5) <= 2^n**

**=2^(n+5) <= (2^n) + 5**

**This proves that our equation F(n) = 2^(n+5) grows no faster than 2^n. This means that the equation is in fact an O(2^n) equation.**

**Question 6 (20 Points):** Consider the following Binary tree. Now do the following:

1. Convert the following Binary tree into a binary search tree. Show the updated tree

A picture containing text, metalware

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1. ii. Delete Node 5, then delete node 15. Show the final updated tree.

Diagram

Description automatically generated with medium confidence