AM5801: Computational Lab
Assignment 7

Date: October 7, 2025

Deadline: October 13, 2025 Max mark: 50

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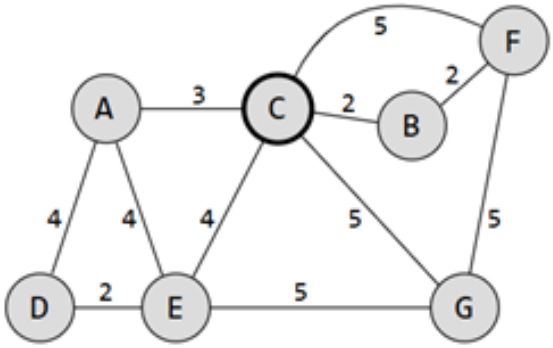
1. Using Dijkstra's algorithm to find the shortest paths from vertex C in this graph: What is the next vertex to be visited after C is visited? (20)



2. A newly planned smart city needs to establish an underground power cable network connecting all its local power substations. Each substation must be connected either directly or indirectly to every other substation so that electricity can flow between any two locations. The city's planning department has surveyed the area and estimated the installation cost (in lakhs) for laying cables between pairs of substations. However, due to terrain constraints, not all substations can be connected directly, meaning some possible connections are unavailable. As a data structures engineer, you are assigned to design an efficient program to determine the layout of cables that minimizes the total installation cost while ensuring full connectivity. Model the substations and possible connections as a weighted, undirected, connected graph where nodes represent substations and edge weights represent cable installation costs. Implement Prim's algorithm to determine the set of edges forming the Minimum Spanning Tree (MST), ensuring the network remains fully connected with the least cost. Your program should output the edges included in the MST and the corresponding total installation cost. Additionally, identify one more edge not included in the MST whose inclusion would form a cycle but would increase the total cost minimally.

   Input Format: The first line contains two integers, N (number of substations) and E (number of possible connections), followed by E lines each containing three values u v w, where u and v are the substations (node numbers) and w is the installation cost between them. Output Format: Display the edges included in the MST in the

form u - v : cost, followed by the total minimum installation cost, and then print one additional edge not in the MST that would form a cycle with minimal increase in cost along with the new total cost.

Hint: Use a priority queue (min-heap) to efficiently select the next edge with the smallest weight during Prim's algorithm, maintain a visited set for substations, and to identify the extra edge, check all edges not in the MST and find the one whose inclusion would create a cycle with the smallest possible increase in total cost. (30)