



JK Lakshmipat University, Jaipur

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End-Term Examination, May 2026

B. Tech. in CSE, Semester IV

Roll No.....

CS1105: Design and Analysis of Algorithms

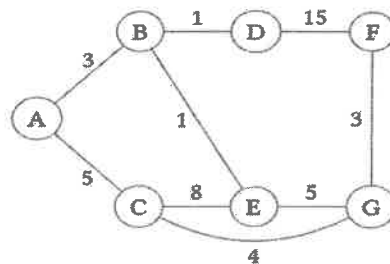
Time: 3 hours

Max. Marks: 60

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. COs refers to the learning outcomes of the course structure.
5. Calculator (any model) permitted.

1. Construct the minimum cost spanning tree for the following graph using Prim's and Kruskal's algorithmic concept. Construct the minimum cost spanning tree step by step, and finally represent the minimum cost.



Marks

COs

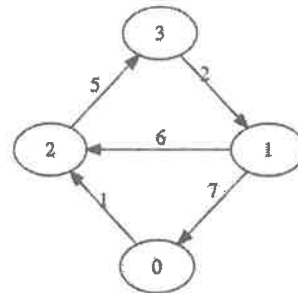
3+3
= 6

CO3

2. Determine A_0 , A_1 , A_2 , A_3 , and A_4 for the following graph using Floyd Warshall's Algorithm.

Use the following equation for determining intermediate results.

$A_k(i, j) = \min\{A_{k-1}(i, j), A_{k-1}(i, k) + A_{k-1}(k, j)\}$, where $k \geq 1$.



6

CO2

CO4

3. Consider the following travelling salesman cost matrix and solve the problem using LC branch and bound method. Also, construct the state space tree generated by LCBB.

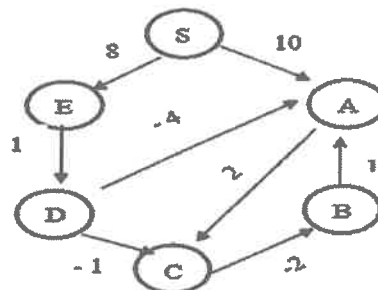
∞	20	30	10
15	∞	16	4
3	5	∞	2
16	4	7	∞

6+4
= 10

CO2

CO5

4. For the following graph, find the shortest path from source node S to all the vertices using the most appropriate method out of Dijkstra's and Bellman-Ford. Justify your selection.



6

CO3

CO4

5. Given a set of numbers with value -10,15,20,55.

a) How many possible BSTs can be formed using these 4 numbers.

$$1+5+3 \\ = 8$$

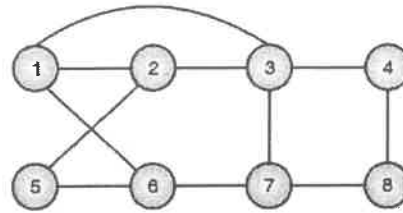
b) Let the frequency of searches for the numbers are given as : 2,4,3,1 respectively. Using tabular method form the Optimal Binary Search Tree showing the minimum search cost and displaying the tree (with roots and the respective branches).

c) Show the procedure step by step with a suitable pseudocode.

6. Solve the following:

a) How is backtracking advantageous in comparison to brute force method – show using an example.

b) In the following graph form the all possible Hamiltonian path using backtracking. Display the tree diagram (with necessary pruning) for solving the above problem.



$$3+5 \\ = 8 \quad \text{CO5}$$

7. Consider a B-tree of order “m” = 5. The tree is initially empty. Perform the following sequence of operations in the given order:

$$4+1+1+2 \\ = 8 \quad \text{CO1}$$

Insert: 50, 30, 80, 20, 40, 70, 90, 10, 25, 35, 60, 75, 85, 95, 5, 15, 45, 65.

Delete: 70, 40, 30, 80.

For each operation that causes a structural change (node split, merge, or redistribution), draw the resulting B-tree. After all operations, answer the following:

a) What is the height of the final B-tree?

b) How many node splits occurred during the entire sequence?

c) If each node access counts as one disk I/O, and all nodes are initially on disk, calculate the total number of I/O operations incurred by the **delete** operations alone (assume that locating the key for deletion requires traversing from root to leaf, and any subsequent modifications also require node writes).

Justify each step of your insertion and deletion process, especially when handling underflow or overflow conditions.

8. Solve the following:

a) Given a max-heap of size n, you want to find all elements greater than a given value X. Design an algorithm that runs in O(k) time where k is the number of output elements, without scanning the entire heap. Explain why your algorithm does not exceed O(k) time. (Hint: Use a stack/recursive traversal from the root.)

$$4+4 \\ = 8 \quad \text{CO1} \\ \text{CO3}$$

b) You have a knapsack that can hold a maximum weight of 50 kg. There are three items available, each with a certain value and weight:

Values = < ₹60, ₹100, ₹120 >

Weights = < 10, 20, 30 > in Kg

You are allowed to take fractional parts of an item. Find the optimal solution for maximum total value you can obtain?