MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

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Model Question Paper

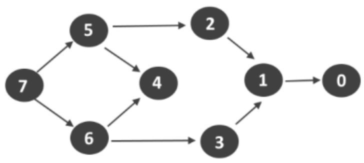
Second Semester MCA Degree Examination, 2025-26

Design and Analysis of Algorithms

Time: 3 Hours **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

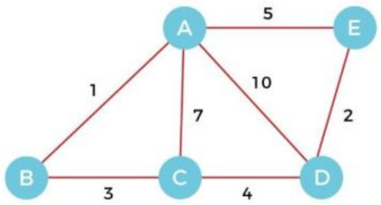
		Module -1	M	L	C
Q1	a.	Apply the fundamental stages of problem solving to design an algorithm for finding the average of n numbers.	10	L3	CO1
	b.	Given two functions $t_1(n)$ and $t_2(n)$ such that: • $t_1(n) \in O(g_1(n))$ • $t_2(n) \in O(g_2(n))$ Prove that their sum satisfies: $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$	10	L3	CO1
		OR			
Q2	a.	Develop a recursive algorithm for the Towers of Hanoi problem and prove that the efficiency of this algorithm is exponential.	10	L3	CO1
	b.	Apply asymptotic analysis to determine the time complexity of linear search and binary search algorithms for a given input size.	10	L3	CO1
		Module- 2			
Q3	a.	Apply divide and conquer strategy to construct a binary search algorithm. Solve the given problem of searching an element 15 in the array: {5, 8, 10, 12, 15, 20, 25} Analyze its worst-case efficiency.	10	L3	CO2
	b.	Apply decrease and conquer approach to perform topological sorting on the following graph:  	10	L3	CO2
		OR			
Q4	a.	Develop the Quick Sort algorithm and utilize it to sort the following given list of numbers: 45, 23, 89, 12, 78, 34, 56	10	L3	CO2
	b.	Apply Strassen's matrix multiplication method to compute the product of the following two matrices. Compare the efficiency of Strassen's method with the conventional (direct) matrix multiplication method and justify which is better. The given matrices are as follows:	10	L3	CO2

$$A = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix} \quad B = \begin{bmatrix} 8 & 4 \\ 6 & 2 \end{bmatrix}$$

Module – 3

Q5

a. Apply Kruskal's algorithm to construct the Minimum Spanning Tree for: — 10 — L3 — CO3

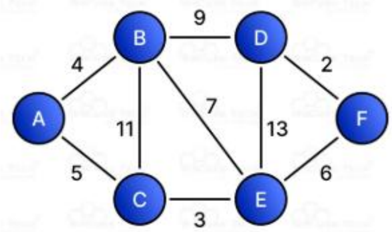


b. Apply greedy method to solve the fractional knapsack problem: — 10 — L3 — CO3
Given Capacity = 50
Weights = {10, 20, 30}
Profits = {60, 100, 120}

OR

Q6

a. Make use of Dijkstra's algorithm to solve the shortest path from source node S: — 10 — L3 — CO3



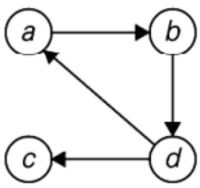
b. Given the following set of jobs, deadlines, and profits, construct an optimal schedule that maximizes profit using a greedy approach. Determine whether all jobs are completed and compute the maximum profit. — 10 — L3 — CO3

Job	J1	J2	J3	J4	J5	J6	J7	J8	J9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

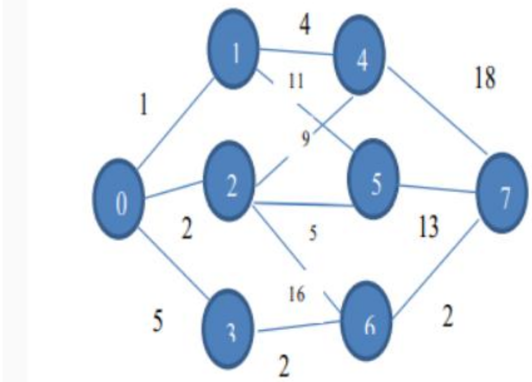
Module – 4

Q7

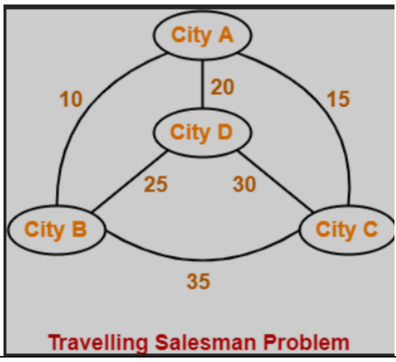
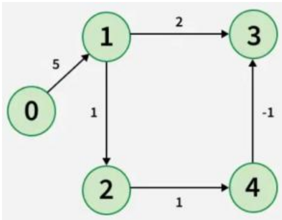
a. Apply Warshall's algorithm to construct the transitive closure for the graph: — 10 — L3 — CO4



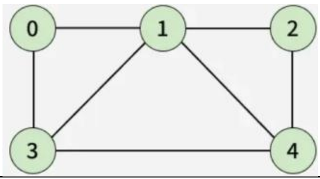
b. Develop a dynamic programming solution to solve the multistage graph problem given below. Find the optimal path. — 10 — L3 — CO4



OR

Q8	a.	Develop dynamic programming solution to solve the Travelling Salesman Problem for 4 cities as shown in the following figure and analyze the optimal cost.  	10	L3	CO4
	b.	Apply Bellman-Ford algorithm to compute shortest paths from source vertex S for the given graph:  	10	L3	CO4

Module – 5

Q9	a.	State the N-Queens problem. Apply the backtracking technique to solve the 4-Queens problem and illustrate the solution using a state space tree.	10	L3	CO5
	b.	Apply backtracking to find Hamiltonian cycle for a given graph and construct the state space tree.  	10	L3	CO5

OR

Q10	a.	Apply backtracking to solve Sum of Subsets problem for: S = {3, 5, 6, 7}, Target = 12. Organize the solution space.	10	L3	CO5
	b.	Develop a branch and bound method to solve the Assignment Problem given below and compute the optimal cost.	10	L3	CO5

	Job 1	Job 2	Job 3	Job 4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

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