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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**

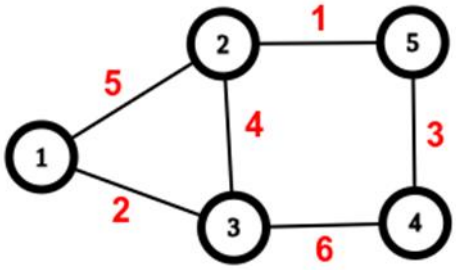
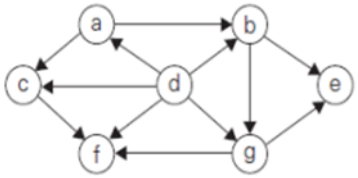
Course Code: 22AM4PCDAA **Max Marks: 100**

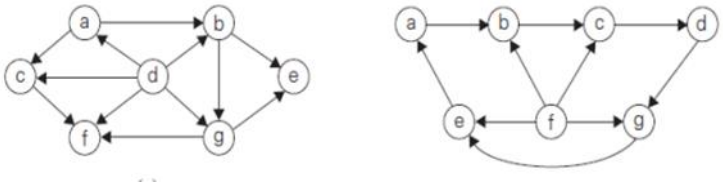
Course: Design and Analysis of algorithm

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			UNIT - I	CO	PO	Marks
1	a)		Define an algorithm. Explain the framework for analyzing the efficiency of an algorithm with an example.	CO1	PO 2	**5**
	b)		Perform a mathematical analysis of a non-recursive algorithm (e.g., Linear Search) to derive its time complexity.	CO1	PO2	**5**
	c)		Differentiate between Big-O, Omega -Ω, and Theta-Θ notations. Provide examples to illustrate their use.	CO1	PO2	**10**
			OR			
2	a)		Analyze the asymptotic notations used for best case, average case and worst-case analysis of algorithms and write an algorithm for finding maximum element of an array perform best, worst and average case complexity with appropriate order notations.	CO1	PO2	**10**
	b)		Discuss in detail about fundamentals of algorithmic problem solving	CO1	PO2	**10**
			UNIT - II			
3	a)		Illustrate Merge sort algorithm and discuss its time complexity with suitable example.	CO2	PO2	**10**
	b)		State the master theorem with its cases. For each of the following recurrences, give an expression for the runtime T (n) if the recurrence can be solved with the Master Theorem. Otherwise, indicate that the Master Theorem does not apply. 1. T (n) = 3T (n/2) + n 2 2. T (n) = 4T (n/2) + n 2 3. T (n) = T (n/2) + 2n 4. T (n) = 2nT (n/2) + n^n 5. T (n) = 16T (n/4) + n 6. T (n) = 2T (n/2) + n log n	CO2	PO2	**10**

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			OR			
	4	a)	What Is a Minimum Spanning Tree? Find the Minimum Spanning Tree for the given graph.  	*CO1*	*PO2*	**10**
		b)	Illustrate the Quick sort algorithm with suitable example.	*CO1*	*PO2*	**10**
			UNIT - III			
	5	a)	Define topological sorting. Apply the source-removal algorithm to solve the topological sorting problem for the following digraph:  	*CO1*	*PO2*	**10**
		b)	Write Horspool Algorithm for String matching. Trace the algorithm to find the pattern "BARBER" in the text "JIM_SAW_ME_IN_A_BARBER"	*CO1*	*PO2*	**10**
			OR			
	6	a)	Maze can be modeled by having a vertex for a starting point, a finishing point, dead ends, and all the points in the maze where more than one path can be taken, and then connecting the vertices according to the paths in the maze. a. Construct such a graph for the following maze. b. Which traversal—DFS or BFS helps in reaching the destination from source and why? c. Try in imitating the steps followed as an algorithm for the traversal. 	*CO1*	*PO2*	**10**

		b)	Apply the DFS-based algorithm to solve the topological sorting problem for the following digraphs.  	*CO2*	*PO2*	**10**
			UNIT - IV			
	7	a)	Explain **Heapsort** and demonstrate how a heap is constructed for sorting a list of numbers.	*CO2*	*PO2*	**10**
		b)	Discuss and derive an equation for solving the 0/1 Knapsack problem using dynamic programming method. Design and analyze the algorithm for the same	*CO2*	*PO2*	**10**
			OR			
	8	a)	Apply Warshall's algorithm to find the transitive closure of the diagraph defined by the following adjacency matrix. i. Prove that the time efficiency of warshall's algorithm is cubic. $\begin{matrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{matrix}$ ii. Explain why the time efficiency of warshall's algorithm is inferior to that of the traversal-based algorithm for space graphs represented by their adjacency lists.	*CO3*	*PO2*	**10**
		c)	Explain **Floyd's Algorithm** for finding shortest paths between all pairs of vertices in a graph with an example.	*CO3*	*PO2*	**10**
			UNIT - V			
	9	a)	Explain Backtracking Method. What is N-Queens Problem? Give solution of 4- Queens Problem using Backtracking Method.	*CO3*	*PO2*	**10**
		b)	Define Decision Trees. Explain their role in analyzing algorithm complexity with an example.	*CO3*	*PO2*	**05**
		c)	What is **P, NP, and NP-Complete Problems**? Provide examples and explain their significance.	*CO3*	*PO2*	**05**
			OR			
	10	a)	Explain the concept of NP-completeness. Why is the **Traveling Salesman Problem (TSP)** considered NP-complete	*CO3*	*PO2*	**05**
		b)	i.Apply backtracking to solve the following instance of the subset sum problem: A = {3, 5, 6, 7} and d = 15 ii. Will the backtracking algorithm work correctly if we use just one of the two inequalities to terminate a node as nonpromising?	*CO3*	*PO2*	**10**

		c)	Compare polynomial-time algorithms and non-deterministic polynomial-time algorithms with examples.	*CO3*	*PO2*	**05**

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