VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.:

SLOT: D1

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2025-2026

Programme Name & Branch	: B.Tech & CSE(BS)
Course Code and Course Name	: CBS3003 & Design and Analysis of Algorithms
Faculty Name(s)	: Dr.Gopinath M
Class Number(s)	: VL2025260502359
Date of Examination	: 30.01.2026
Exam Duration	: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)
  CO1: Analyse worst-case running times of algorithms using asymptotic analysis
  CO2: Identify suitable algorithmic paradigm for solving the given problem
  CO6: Describe various algorithmic strategies, analysis and their implementation

Q. No	Question	Module	Marks	CO	BL
1.	a) Using asymptotic notations, verify whether each of the following statements is correct. For each one, provide a clear justification using definition or limit comparison. (i) $5n^2 - 6n = O(n^2)$ (ii) $n! = O(n^n)$ (iii) $n^3 + 10n^2 = \Theta(n^3)$ (iv) $2n^2 \cdot 2^n + n\log n = \Theta(n^2 \cdot 2^n)$	1	8	CO 1	4
	b) Solve the following recurrence relation $T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + 3n, & n > 2 \\ 2, & n = 2 \end{cases}$	1	2		
2.	a) A system contains three storage units and n data blocks of different sizes initially placed on the first unit in increasing order of size from top to bottom. Only one block can be moved at a time, and a larger block cannot be placed on a smaller one. Formulate a recursive algorithm to transfer all the blocks from the first storage unit to the third unit using the second unit as an auxiliary. Derive the recurrence relation for the number of moves required, solve it to obtain a closed-form expression, and analyze the time complexity of the algorithm.	1	7	Co 1	4
	b) Distinguish between Little-o (o) notation and Little-ω (ω) notation used in asymptotic analysis. Clearly explain their definitions, mathematical meaning, and significance in algorithm analysis with suitable examples.	1	3		
3.	Consider the following weighted graph representing a Travelling Salesman Problem (TSP), where A, B, C, D and E are cities and the edge	2	10	Co 2	4

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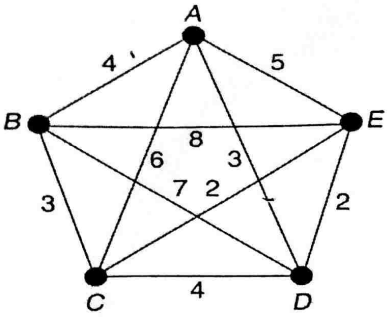
	weights denote the distance between them. Using the Branch and Bound technique, construct the state space tree, compute the lower bound at each node showing all intermediate calculations, apply appropriate branching and pruning to eliminate non-promising paths, and hence determine the optimal tour along with the minimum total travel cost.  				
4.	a) For a knapsack with capacity 20 and items with weights [5,10,12,8] and values [50,60,65,40], apply the Branch and Bound approach to find the maximum profit. Show the solution tree, upper bound calculations, and explain where bounding was used.	2	5	CO 2	4
	b) Solve the 4-Queens problem using Backtracking. Place 4 queens on a 4x4 chessboard such that no two queens threaten each other. Show the solution tree with algorithm and identify points where backtracking was necessary to achieve the final solution.	2	5		
5.	a) A thief has a knapsack with a weight limit of 50 kg and the following items available. Solve using fractional knapsack methods. Item | 1 | 2 | 3 Weight | 10 | 20 | 30 Value | $60 | $100 | $120	3	5	CO 6	3
	b) Let A = {l/119, m/96, c/247, g/283, h/72, f/77, k/92, j/19} be the letters and its frequency of distribution in a text file. Compute a suitable Huffman coding to compress the data effectively.	3	5		

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