B/E/TZ

Reg. No: 24BRS0125

VIT
Vellore Institute of Technology

Final Assessment Test – April 2026

Course: **CBS3003 - Design and Analysis of Algorithms**

Class NBR(s): **2386/2417** Slot: **D2**

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

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

COs	CO Statements
CO1	Analyse worst-case running times of algorithms using asymptotic analysis.
CO2	Identify suitable algorithmic paradigm for solving the given problem.
CO3	Understand and apply various graph-based algorithms.
CO4	Understand the classes of complexity.
CO5	Introduction to approximation, randomized and quantum algorithms.
CO6	Describe various Algorithm strategies, analysis and their implementation

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) Define asymptotic notation and explain Big-O notation with example. **[3]** **CO1** **BL2**

   b) Illustrate time–space trade-off using Recursive and iterative method, considering generation of Fibonacci sequence (or) merge sort. **[7]**

2. a) In a Travelling Salesman Problem (TSP) with n cities, how many possible tours exist using the brute-force approach? Derive the formula and compute the number of tours when n = 5. **[4]** **CO2** **BL2**

   b) Solve the 0/1 Knapsack problem using LC Branch and Bound (Best First Search). Construct the state space tree, compute the upper bound at each node, and determine the optimal solution. **[6]**

Item	Profit	Weight
1	40	2
2	30	5
3	50	10
4	10	5

Knapsack capacity W = 16.

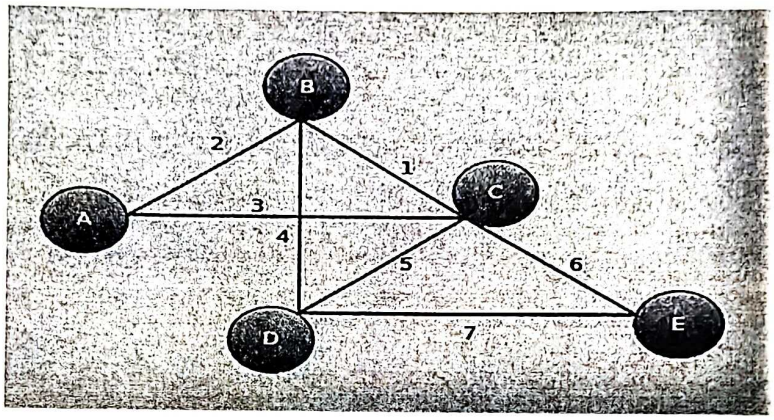
3. a) Discuss the differences between divide and conquer with dynamic programming. Consider a sample test case in solving the same. **[4]** **CO6** **BL3**

b) Construct Huffman Code for given frequencies. **[6]**

Character	Frequency
A	5
B	9
C	12
D	13
E	16
F	45

Show the Huffman tree and the corresponding codes for each character.

4. a) Consider the following undirected weighted graph with vertices V = {A, B, C, D, E}. **[4]** **CO3** **BL3**



Using Kruskal's Algorithm:

1. Construct the Minimum Spanning Tree (MST).
2. Show the step-by-step edge selection process.
3. Calculate the total weight of the Minimum Spanning Tree.

b) For the graph given above, apply Floyd warshall algorithm to calculate the shortest distance, iterate the steps by considering 'a' as the starting node. **[6]**

5. A data processing system performs a sequence of matrix operations. The dimensions of the matrices are given below: **CO6** **BL4**

Matrix	Dimension
A1	10 × 30
A2	30 × 5
A3	5 × 60
A4	60 × 15

Matrix multiplication cost is calculated as:

Number of scalar multiplications = a × b × c

when multiplying matrices of dimension (a × b) and (b × c).

Answer the following:

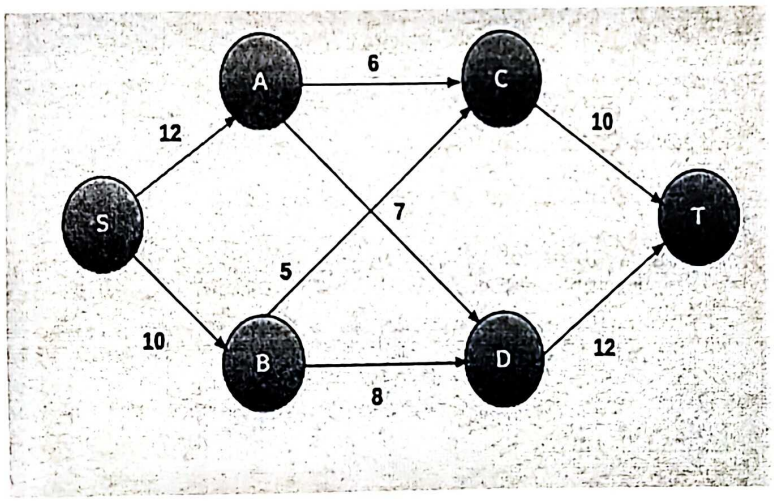
a) Construct the dynamic programming cost table for Matrix Chain Multiplication. **[3]**

b) Determine the minimum number of scalar multiplications required. **[3]**

c) Identify the optimal parenthesization of the matrices. **[2]**

d) Write the recurrence relation used in Matrix Chain Multiplication. **[2]**

6. A Video streaming platform distributes content from a central server S to a destination server T through intermediate routing nodes. Each communication link has a maximum bandwidth capacity (in MB/s) as shown below. **CO3 BL4**



Based on the above flow network, answer the following:

a) Identify the augmenting paths from source S to sink T in the network. **[3]**

b) Using the Ford–Fulkerson method, determine the maximum flow from S to T. Clearly show the flow sent through each augmenting path. **[5]**

c) Explain the role of the residual graph in updating the flow during the Ford–Fulkerson algorithm. **[2]**

7. Consider the 3cnf → $(x_1 \vee \overline{x_2} \vee \bar{x}_3) \wedge (x_3 \vee \overline{x_5} \vee x_6) \wedge (x_3 \vee \overline{x_6} \vee x_4) \wedge (x_4 \vee x_5 \vee x_6)$, prove how it is reduced to clique, mention the maximum size of clique. **CO4 BL4**

8.	For the given data, {20, 5, 3, 25, 10, 8, 42, 35} sort using randomized Quick sort Algorithm. Illustrate the steps involved.	CO5	BL3
9.a)	Explain the 2-Approximation algorithm for Vertex Cover and prove that it produces a solution within twice the optimal solution.	CO5	BL4
	OR		
9.b)	Explain Approximation algorithm for TSP and derive its approximation ratio.	CO5	BL4
10.a)	With a suitable examples, discuss the steps involved in solving the structure of Quantum algorithm.	CO5	BL3
	OR		
10.b)	Explain Grover's Search Algorithm and compare with classical search.	CO5	BL3

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