3Q

REG.NO.:

SLOT: F2

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

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

Programme Name & Branch	**: M.Tech. (Integrated) Computer Science and Engineering, Datascience (MIC & MID)**
Course Code and Course Name	**: CSI2003 - Advanced Algorithms**
Faculty Name(s)	**: Dr. Lakshmanan K, Dr. Adaline Suji, Dr. Sunija. A P**
Class Number(s)	**: VL2025260102348, 2491, 2581**
Date of Examination	**: 22/08/2025**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions.
- If any notation is not explained, then it refers to the standard notation for the problem.

<table>
<tr><th>Q. No</th><th>Question</th><th>M</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>a) Find an optimal solution to the fractional knapsack problem using greedy strategy for an instance with number of items n=5, Capacity of the sack W=14, profit associated with the items (p1, p2, p3, p4, p5) and weight associated with each item (w1, w2, w3, w4, w5) are given in the table below. Workout the steps involved in the process of finding the solution.
<table>
<tr><td>Items</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Weight</td><td>2</td><td>3</td><td>5</td><td>7</td><td>1</td></tr>
<tr><td>Profit</td><td>10</td><td>5</td><td>15</td><td>7</td><td>6</td></tr>
</table>
Solution: 39

b) Recall the Huffman coding algorithm. The algorithm you learnt in the class works for the binary alphabet {0,1}. Suppose you are asked to modify the algorithm that works for ternary alphabet {0,1,2} and construct a tree accordingly such that each node can have a maximum of three children. Below is the half-filled code of the new algorithm for the ternary alphabet, where C is the character set and f(p) are the frequency of the character p, p = {x, y, z} and Q is the data structure queue. Your job is to fill in the blanks of the code mentioned in the lines 3,6,7,8 and 9.
1 n ← |C|
2 Q ← C
3 for i ← 1 to (n-1)/2
4 do allocate a new node w
5 left[w]← EXTRACT-MIN(Q)
6 center[w] ← EXTRACT-MIN(Q)
7 right[w]← EXTRACT-MIN(Q)
8 f [w]← f[x] + f[y] + f[z]
9 INSERT(Q, W)
10 return EXTRACT-MIN(Q)</td><td>6+4</td><td>1</td><td>2</td></tr>
<tr><td>2.</td><td>Given two DNA strings X = DDABCCA and Y= DABBDCAC you need to find a third string Z with maximum length that appear in both original strings of X and Y in the same order by deleting arbitrary letters of X and Y. Which effective method you use to solve the given problem and find a solution using such a method.</td><td>10</td><td>1</td><td>2</td></tr>
</table>

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Depict how you are tracing back to the solution from the table. What is the time-complexity of your method.

		D	A	B	B	D	C	A	C
	0	0	0	0	0	0	0	0	0
D	0	1	1	1	1	1	1	1	1
D	0	1	1	1	1	2	2	2	2
A	0	1	2	2	2	2	2	3	3
B	0	1	2	3	3	3	3	3	3
C	0	1	2	3	3	3	4	4	4
C	0	1	2	3	3	3	4	4	5
A	0	1	2	3	3	3	4	5	5

DABCC/DABCA

3. Consider a 0/1 Knapsack Problem with the following data: — 10 — 1 — 2

Item	Weight	Profit
1	2	10
2	3	15
3	4	14

The knapsack capacity is 6 units

i. Construct the State-Space Tree using the FIFO Branch and Bound method. Clearly indicate:

• Bounding function(s)

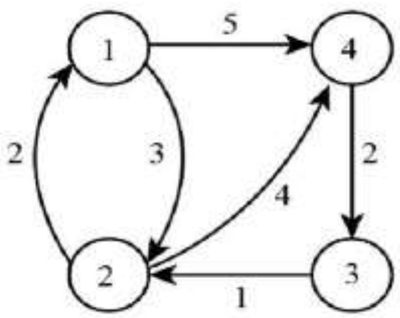
The order of node expansions.

• Nodes that are pruned (not expanded further under which BF is failed).

ii. Find the Optimal Solution (subset of items chosen and the maximum profit achieved).

Solution: 25

4. Compute the shortest path between all vertices for the given graph, using Floyd Warshall algorithm and mention its time complexity. — 10 — 2 — 3



Solution:

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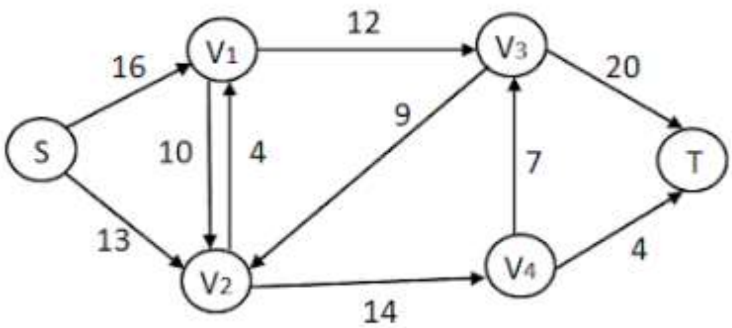
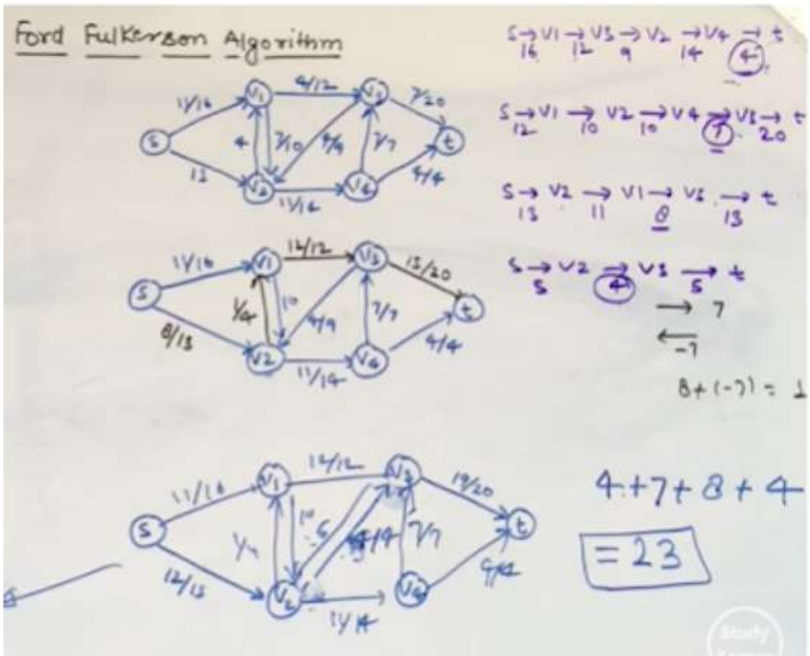
	$A^4 = \begin{array}{c c} & \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} & \begin{bmatrix} 0 & & & 5 \\ & 0 & & 4 \\ & & 0 & 5 \\ 5 & 3 & 2 & 0 \end{bmatrix} \end{array} \longrightarrow \begin{array}{c c} & \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} & \begin{bmatrix} 0 & 3 & 7 & 5 \\ 2 & 0 & 6 & 4 \\ 3 & 1 & 0 & 5 \\ 5 & 3 & 2 & 0 \end{bmatrix} \end{array}$			
5.	Find maximum flow from source S to sink T using the Ford- Fulkerson algorithm. Specify any two major properties that a flow can satisfy.  	10	2	3

VIT

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