REG.NO.:

SLOT: F1 + TF1

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

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

Programme Name & Branch	**: B.Tech.**
Course Code and Course Name	**: BCSE204L – Design and Analysis of Algorithms**
Faculty Name(s)	**: All Faculty**
Class Number(s)	**: All Batches**
Date of Examination	**: 22.03.2026**
Exam Duration	**: 90 minutes**

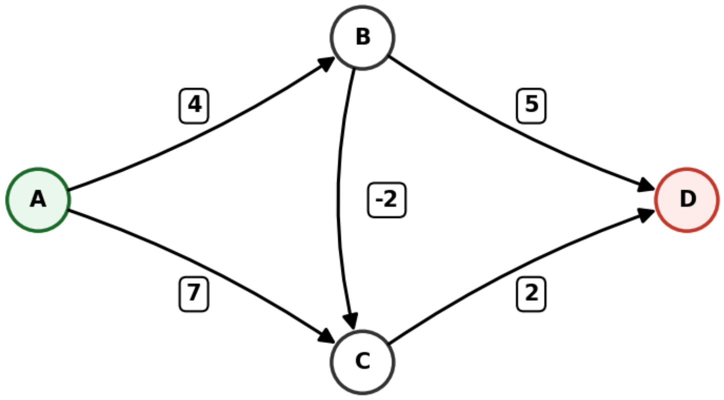
Maximum Marks: 50

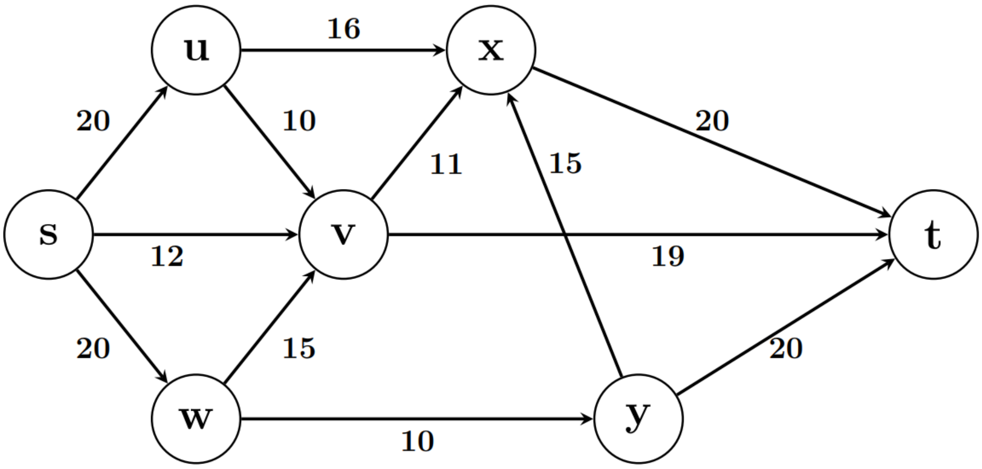
General instruction(s):

- 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)

<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) A delivery company must select items to load into a transport container with a maximum capacity of 15 kg. Each item can either be selected or rejected (a 0–1 decision). The items available are:
<table>
<tr><th>Attribute</th><th>I1</th><th>I2</th><th>I3</th><th>I4</th><th>I5</th></tr>
<tr><td>Weight (kg)</td><td>2</td><td>5</td><td>6</td><td>4</td><td>3</td></tr>
<tr><td>Profit</td><td>20</td><td>30</td><td>35</td><td>25</td><td>15</td></tr>
</table>
Apply the <i>FIFO (First-In-First-Out) Branch and Bound strategy</i> to solve the above <i>problem</i>. Illustrate the state-space tree until optimal solution is determined. For every generated node, clearly compute and show the <i>current weight (W)</i>, <i>current profit (V)</i>, <i>upper bound (UB)</i> using the fractional knapsack bound, and the <i>current global best profit (GB)</i>. Clearly <i>identify the nodes that are pruned with justification</i> and mark the <i>optimal set of items and the maximum achievable profit</i>. [7 M]

b) Finally, <i>differentiate between Backtracking and Branch & Bound algorithms</i> by presenting <i>any three key differences in tabular form</i>. [3 M]</td><td>10</td><td>2</td><td>3</td></tr>
<tr><td>2.</td><td>Consider the text $T = ABABACABACAB$ and the target pattern $P = ABAC$. Solve for the LPS (Longest Prefix Suffix) array for the pattern P. Next, execute the Knuth–Morris–Pratt (KMP) algorithm on text T using your computed LPS array to identify all occurrences</td><td>10</td><td>3</td><td>3</td></tr>
</table>

	of the pattern. **Illustrate** your step-by-step trace by clearly indicating the text and pattern indices being compared, the specific shift **performed** after each mismatch, and the action taken after a successful match. Then estimate the total number of character comparisons that would be required *as per Naïve string-matching algorithm*. Finally, **demonstrate** how your KMP trace actively avoids the redundant comparisons inherent in the Naïve approach, and explicitly state the starting indices of all pattern occurrences found in the text.			
3.	**a)** Consider the following weighted directed graph with vertices. Using the **Bellman–Ford algorithm**, compute the shortest path distances from source vertex **A** to all other vertices after **each relaxation iteration**. Show the distance values after every iteration. After completing the algorithm, **identify the shortest path from A to D** and its total cost. ***[6 Marks]***  	5	3	2
	b) Briefly explain **why Bellman–Ford is suitable for this graph instead of Dijkstra's algorithm**. Explain how the order in which edges are processed in the Bellman–Ford algorithm can influence the speed of convergence. Briefly illustrate your explanation using the given graph for two iterations. **[4 Marks]**	5		

<table>
<tr><td>4.</td><td>a) A data centre network routes data packets from a source server s to a destination server t through intermediate routers. Each directed link has a maximum transmission capacity (in units per second).

Apply the Edmonds–Karp algorithm to determine the first three augmenting paths using following conditions:
i) In the first and second step, the route with the highest residual capacity should be prioritized.
ii) In the third step, the route with the shortest augmenting path (smallest number of intermediate nodes) should be chosen for transportation.
In your answer, clearly present the following: the original flow network with all edge capacities indicated; the augmenting path selected in the first iteration (write the path as a sequence of vertices and do not mark it on the graph); the flow network after the first augmentation and the corresponding residual graph. Repeat the same process for the second and third iterations, showing in each case the selected augmenting path, the updated flow network after augmentation, and the corresponding residual graph. [9 M]</td><td>5</td><td rowspan="2">3</td><td rowspan="2">3</td></tr>
<tr><td></td><td>b) Explain how the Edmonds–Karp algorithm improves upon the Ford–Fulkerson method for solving the maximum flow problem. [1 M]</td><td>5</td></tr>
</table>

<table>
<tr>
<td>5.</td>
<td>
A geographic monitoring system models underground cable routes as line segments on a 2D plane. The system records four cable segments with the following endpoints:
<table>
<tr><td>L_1:</td><td>L_2:</td><td>L_3:</td><td>L_4:</td></tr>
<tr><td>$(1,4) \rightarrow (6,1)$,</td><td>$(2,1) \rightarrow (5,5)$,</td><td>$(3,4) \rightarrow (7,3)$,</td><td>$(4,0) \rightarrow (4,6)$.</td></tr>
</table>
a) Compute the orientation values for the necessary ordered triplet's for the pair of line segments given below and determine whether the following pairs of line segments intersect. Show all intermediate calculations: [3 M]
i) L_1 and L_2 ii) L_1 and L_3 iii) L_2 and L_4
b) If a pair of segments intersects, compute the intersection point(s) using the equations of the corresponding lines. [3 M]
c) Finally, briefly explain how the orientation method efficiently detects intersections among multiple line segments and compare it with a naïve approach that checks every pair of segments. [4 M]
</td>
<td>10</td>
<td>3</td>
<td>3</td>
</tr>
</table>

****