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

School of Computer Science and Engineering

Winter Semester 2023-2024

Continuous Assessment Test – II

Programme Name & Branch : **B.Tech – (BCB/BCE/BCI/BCT/BDS/BKT)** **SLOT :A1+TA1**

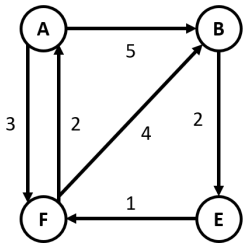
Course Name & code : **BCSE204L – Design and Analysis of Algorithms**

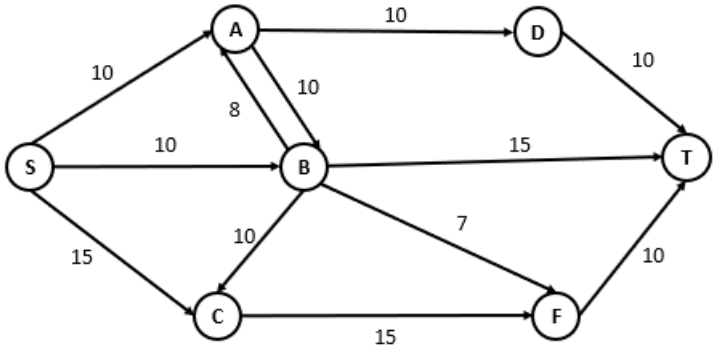
Class Number (s) : **ALL**

Faculty Name : **ALL**

Exam Duration : **90 Min.** **Maximum Marks: 50**

ANSWER ALL THE QUESTIONS(5X10=50 Marks)

<table>
<tr><th>Q.No</th><th>Question</th><th>Max Mark</th></tr>
<tr><td>1</td><td>Solve the Knapsack Problem using FIFOBB, assume knapsack capacity is W =8. Show how queue is used for node creation in the state space tree.
<table>
<tr><th>Item</th><th>Profit</th><th>Weight</th></tr>
<tr><td>1</td><td>13</td><td>4</td></tr>
<tr><td>2</td><td>15</td><td>2</td></tr>
<tr><td>3</td><td>14</td><td>4</td></tr>
<tr><td>4</td><td>16</td><td>6</td></tr>
</table></td><td>10</td></tr>
<tr><td>2</td><td>Find the existence of a pattern P in the given string S (assign digits A-C as 0-2), using Rabin Karp algorithm. For hash function use Mod 13. Find out how many spurious hits does the algorithm encounter in the Text =ABCBBCABCBAAABCCAACB when looking for the pattern Pattern = CCA?</td><td>10</td></tr>
<tr><td>3</td><td>Consider a logistics manager tasked with optimizing transportation routes for a delivery company that operates in a city with a complex network of roads. Your goal is to minimize the distance for packages to reach their destinations by finding the shortest paths between all pairs of locations. The transportation route is represented as weighted directed graph given below. Find the shortest paths between all pairs of locations, considering the varying distance, which helps company to delivery operation.

</td><td>10</td></tr>
</table>

4	In water distribution systems, we need to find the maximum amount of water that can be supplied from source S to destination T through a network pipes with capacity limitations. Given a directed graph G=(V,E) representing a water distribution system, where V is set of vertices and E is the set of edges, each edge (u,v) has a capacity c(u,v) representing the maximum water flow that can be supplied through the network pipe. Use Push Relabel algorithm to find the maximum water flow that can be supplied from node S to node T using given graph.  	10
5	Find whether the following line segments intersect or not using cross product. a. L1 :{**(1,23) & (10,15)**} and L2 :{**(4,10) & (6,20)**} b. L3 :{**(4,5) & (7,10)**} and L4 :{**(1,1) & (5,5)**} c. L5 :{**(1,1) & (10,10)**} and L6 :{**(3,3) & (5,5)**} d. L7 :{**(1,1) & (10,10)**} and L8 :{**(5,8) & (3,3)**}	10

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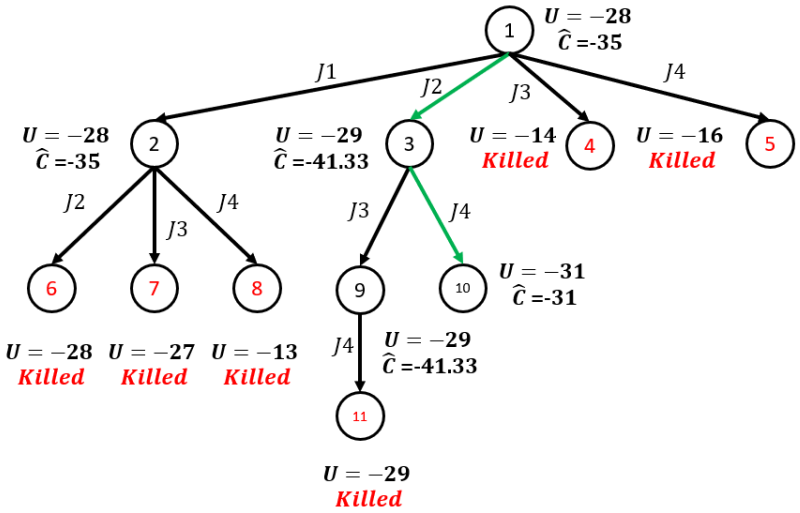
Q.No	Question	Module	Max Mark	CO	BL
1	Solve the Knapsack Problem using FIFOBB, assume knapsack capacity is W =8. Show how queue is used for node creation in the state space tree.	2	10	CO2	BL6

Item	Profit	Weight
1	13	4
2	15	2
3	14	4
4	16	6

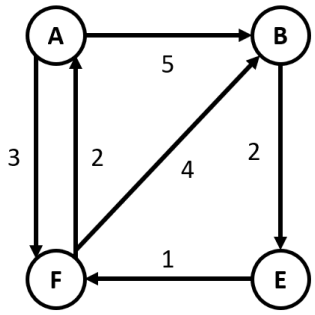
Ans:

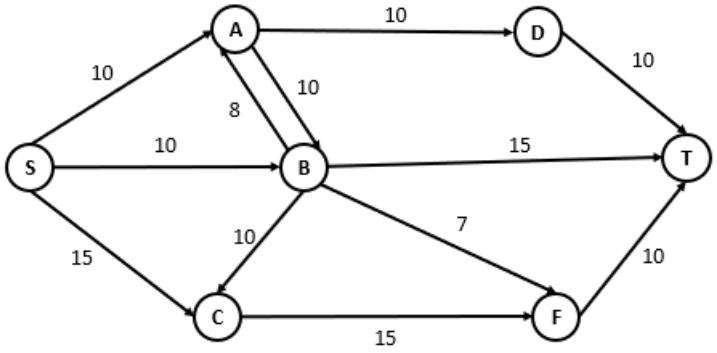
Job 1, Job 2, Job 3 are selected with profit 12

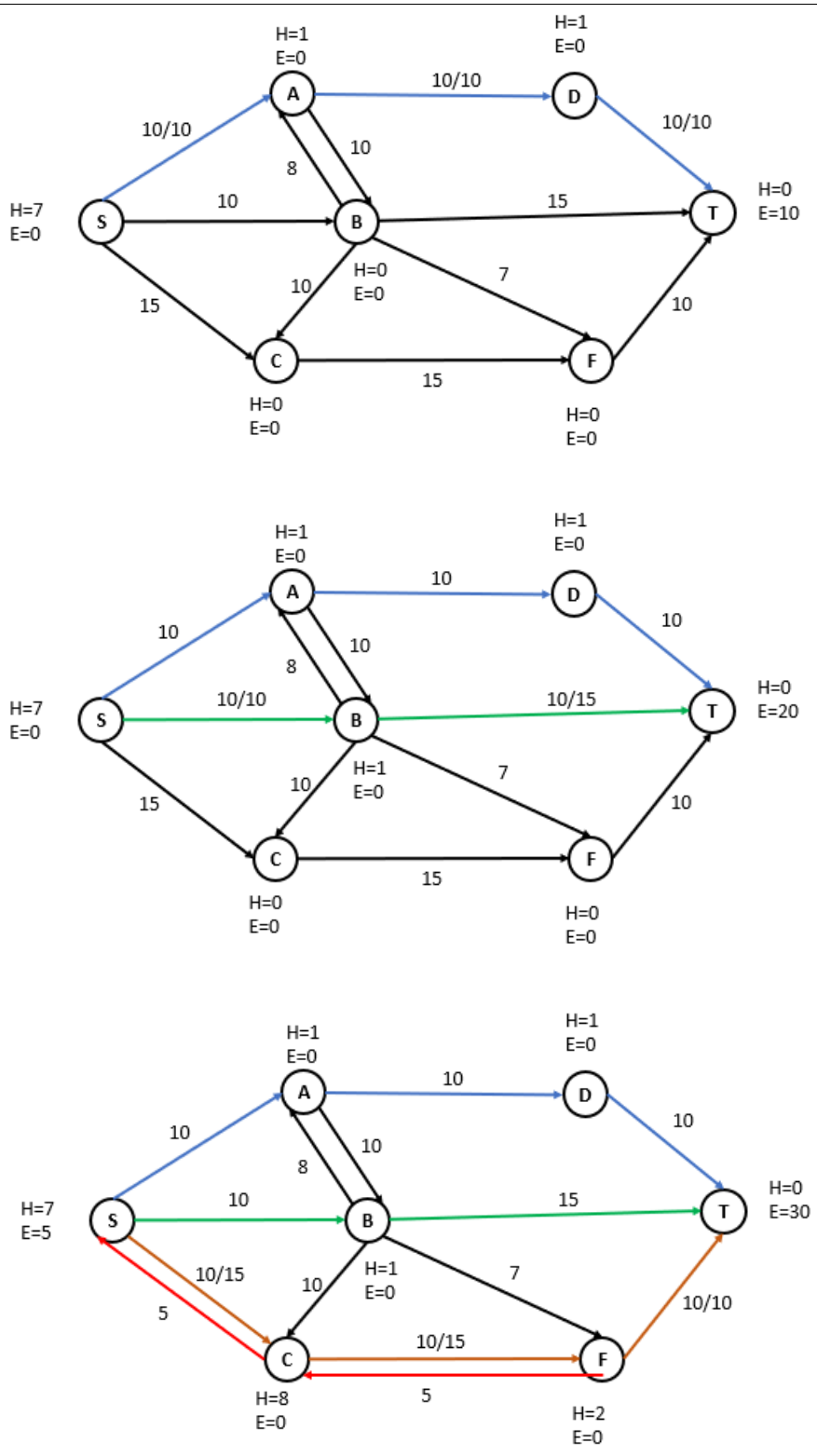


Node 1:

	$U = -(13 + 15) = -28$, Upper = -28 $\hat{C}$ = -(28+(8-(4+2))14/4) =-35 , Node 2, 3, 4, 5 created **Node 2:** $U = -(13 + 15) = -28$, $\hat{C}$ = -(28+(8-(4+2))14/4) =-35 , Node 6,7,8 created **Node 3:** $U = -(15 + 14) = -29$, Upper = -29 $\hat{C}$ = -(29+(8-(2+4))16/2) =-41.33 , Node 9,10 created **Node 4:** $U = -(14) = -14$, Node killed U> Upper **Node 5:** $U = -(16) = -16$, Node killed U> Upper **Node 6:** $U = -(13 + 15) = -28$, Node killed U>Upper $\hat{C}$ = -(28+(8-(4+2))14/4) =-35 , Node 2, 3, 4, 5 created **Node 7:** $U = -(13 + 14) = -27$, Node killed U> Upper **Node 8:** $U = -(13) = -13$, Node killed U> Upper $\hat{C}$ = -(29+(8-(2+4))16/2) =-41.33 , Node 9,10 created **Node 9:** $U = -(15 + 14) = -29$, $\hat{C}$ = -(29+(8-(2+4))16/2) =-41.33 , Node 11 created **Node 10:** $U = -(15 + 16) = -31$, Upper=-31 $\hat{C}$ = -(31+(8-(2+6))) =-31 **Node 11:** $U = -(15 + 14) = -29$, Node killed U> Upper Answer: Job2 amd Job4 are selected with **Maximum profit = 31**				
2	Find the existence of a pattern P in the given string S (assign digits A-C as 0-2), using Rabin Karp algorithm. For hash function use Mod 13. Find out how many spurious hits does the algorithm encounter in the **Text =ABCBBCABCBAAABCCAACB** when looking for the pattern **Pattern = CCA**? Ans H(X) = {P[2]*10^2+P[1]*10^1+P[0]}mod 13. Assign value A=0, B=1, C=2 H(P) = (200+20+0)mod 13 =220=12. Text: **ABCBBCABCBAAABCCAACB** ABC 12 MOD 13 = 12 spurious hits BCB 121 MOD 13 = 4 CBB 211 MOD 13 = 3 BBC 112 MOD 13 = 8 BCA 120 MOD 13 = 3 CAB 201 MOD 13 = 6 ABC 12 MOD 13 = 12 spurious hits	2	10	CO2	BL6

	BCB 121 MOD 13 = 4 CBA 210 MOD 13 = 2 BAA 100 MOD 13 = 9 AAA 0 MOD 13 = 0 AAB 1 MOD 13 = 1 ABC 12 MOD 13 = 12 spurious hits BCC 122 MOD 13 = 5 CCA 220 MOD 13 = 12 Hit CAA 200 MOD 13 = 5 AAC 2 MOD 13 = 2 ACB 21 MOD 13 = 8 Total number of spurious hits is 3 for the patten CCA.				
3	Consider a logistics manager tasked with optimizing transportation routes for a delivery company that operates in a city with a complex network of roads. Your goal is to minimize the distance for packages to reach their destinations by finding the shortest paths between all pairs of locations. The transportation route is represented as weighted directed graph given below. Find the shortest paths between all pairs of locations, considering the varying distance, which helps company to delivery operation.  Ans:	3	10	CO3	BL6

	A^0 **a** b e f **a** **0** **5** ∞ **3** b ∞ 0 2 ∞ e ∞ ∞ 0 1 f **2** 4 ∞ 0 A^A a **b** e f a 0 **5** ∞ 3 **b** ∞ **0** **2** ∞ e ∞ ∞ 0 1 f 2 **4** ∞ 0 A^B a b **e** f a 0 5 **7** 3 b ∞ 0 **2** ∞ **e** ∞ ∞ **0** **1** f 2 4 **6** 0 A^E a b e **f** a 0 5 7 **3** b ∞ 0 2 **3** e ∞ ∞ 0 **1** **f** **2** **4** **6** **0** A^F a b e f a 0 5 7 3 b 5 0 2 **3** e 3 5 0 1 f 2 4 6 0				
4	In water distribution systems, we need to find the maximum amount of water that can be supplied from source S to destination T through a network pipes with capacity limitations. Given a directed graph G=(V,E) representing a water distribution system, where V is set of vertices and E is the set of edges, each edge (u,v) has a capacity c(u,v) representing the maximum water flow that can be supplied through the network pipe. Use Push Relabel algorithm to find the maximum water flow that can be supplied from node S to node T using given graph.  Ans: • Max flow 30	4	10	C03	BL6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Ans:

a. $P11 \times (\overline{P12\ P21})$

$$= \begin{vmatrix} (4-1) & (10-1) \\ (10-23) & (15-23) \end{vmatrix} = \begin{vmatrix} 3 & 9 \\ -13 & -8 \end{vmatrix} = +ve$$

$P11 \times (\overline{P12\ P22})$

$$= \begin{vmatrix} (6-1) & (10-1) \\ (20-23) & (15-23) \end{vmatrix} = \begin{vmatrix} 5 & 9 \\ -3 & -8 \end{vmatrix} = -ve$$

$L1\ and\ L2\ intersect$

b. $P31 \times (\overline{P32\ P41})$

$$= \begin{vmatrix} (1-4) & (7-4) \\ (1-5) & (10-5) \end{vmatrix} = \begin{vmatrix} -3 & 3 \\ -4 & 5 \end{vmatrix} = -ve$$

$P31 \times (\overline{P32\ P42})$

$$= \begin{vmatrix} (5-4) & (7-4) \\ (5-5) & (10-5) \end{vmatrix} = \begin{vmatrix} 1 & 3 \\ 0 & 5 \end{vmatrix} = +ve$$

$L3\ and\ L4\ intersect$

c. $P51 \times \left(\overline{P52\ P61}\right)$

$$= \begin{vmatrix} (3-1) & (10-1) \\ (3-1) & (10-1) \end{vmatrix} = \begin{vmatrix} 2 & 9 \\ 2 & 9 \end{vmatrix} = 0$$

$P51 \times \left(\overline{P52\ P62}\right)$

$$= \begin{vmatrix} (5-1) & (10-1) \\ (5-1) & (10-1) \end{vmatrix} = \begin{vmatrix} 4 & 9 \\ 4 & 9 \end{vmatrix} = 0$$

Bounding Box for L5

$$\widehat{P51} = \{\min(1,10), \min(1,10)\} = \{(1,1)\}$$

$$\widehat{P52} = \{\max(1,10), \max(1,10)\} = \{(10,10)\}$$

Bounding Box for L6

$$\widehat{P61} = \{\min(3,5), \min(3,5)\} = \{(3,3)\}$$

$$\widehat{P62} = \{\max(3,5), \max(3,5)\} = \{(5,5)\}$$

If $\left\{P51, P52, \widehat{P51}, \widehat{P52}\right\}$ *and* $\left\{P61, P62, \widehat{P61}, \widehat{P62}\right\}$ (10>3) and (5>1) and (10>3) and (5>1) hence $L5\ and\ L6\ intersect$

d. $P71 \times (\overline{P72\ P81})$

$$= \begin{vmatrix} (5-1) & (10-1) \\ (8-1) & (10-1) \end{vmatrix} = \begin{vmatrix} 4 & 9 \\ 7 & 9 \end{vmatrix} = -ve$$

$P71 \times (\overline{P72\ P82})$

$$= \begin{vmatrix} (3-1) & (10-1) \\ (3-1) & (10-1) \end{vmatrix} = \begin{vmatrix} 2 & 9 \\ 2 & 9 \end{vmatrix} = 0$$

$L1\ and\ L2\ intersect$