

GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
DESIGN & ANALYSIS OF ALGORITHMS
CS402

TIME ALLOTTED: 3 HOURS

FULL MARKS: 70

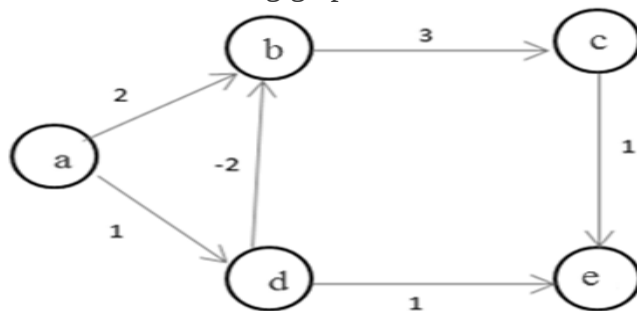
*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable***GROUP – A****(Multiple Choice Type Questions)**Answer any **ten** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No.
1.	(i) The running time of Floyd-Warshall algorithm is	1	CO4
	a) $\Theta(n)$		
	b) $\Theta(n^3)$		
	c) $\Theta(n^2)$		
	d) $\Theta(n \log n)$		
	(ii) Which of the following algorithm solve fractional knapsack problem most efficiently?	1	CO4
	a) Divide and conquer		
	b) Dynamic programming		
	c) Greedy algorithm		
	d) Backtracking		
	(iii) Which of the following algorithm design technique is used in the quick sort algorithm?	1	CO1
	a) Dynamic programming		
	b) Backtracking		
	c) Divide-and-conquer		
	d) Greedy method		
	(iv) What is the objective of the knapsack problem?	1	CO2
	a) To get maximum total value in the knapsack		
	b) To get minimum total value in the knapsack		
	c) To get maximum weight in the knapsack		
	d) To get minimum weight in the knapsack		
	(v) Kruskal's algorithm is used to _____	1	CO4
	a) a) find minimum spanning tree		
	b) find single source shortest path		
	c) find all pair shortest path algorithm		
	d) traverse the graph		
	(vi) Which of the following is true	1	CO5
	a) P is subset of NP		
	b) NP is subset of P		
	c) P and NP are equal		
	d) NP is subset of NP hard		
	(vii) The asymptotically tight bound is	1	CO1
	a) O notation		
	b) notation		
	c) Ω notation		
	d) none of the above		

- | | | | |
|--------|---|---|-----|
| (viii) | Which of the following sorting algorithm does not have a worst-case running time of $O(n^2)$
a) Insertion sort
b) Merge sort
c) Quick sort
d) Bubble sort | 1 | CO5 |
| (ix) | 8-queen problem is the example of
a) Divide & conquer
b) dynamic programming
c) backtracking
d) greedy method | 1 | CO4 |
| (x) | What is the time complexity of Huffman Coding?
a) $O(N)$
b) $O(N \log N)$
c) $O(N(\log N)^2)$
d) $O(N^2)$ | 1 | CO4 |
| (xi) | If every square of the board is visited, then the total number of knight moves of n-queen problem is
a) n^3-1
b) $n-1$
c) n^2-1
d) $\log n-1$ | 1 | CO2 |
| (xii) | Given two sequences X and Y : $X = \langle a, b, c, b, d, a, b \rangle$ $Y = \langle b, d, c, a, b, a \rangle$. The longest common subsequence of X and Y is :
a) $\langle b, c, a \rangle$
b) $\langle c, a, b \rangle$
c) $\langle b, c, a, a \rangle$
d) $\langle b, c, b, a \rangle$ | 1 | CO2 |

GROUP – B**(Short Answer Type Questions)**Answer any **three** from the following: $3 \times 5 = 15$

2. Consider the following graph:

**Marks**
5**CO No.**
CO5

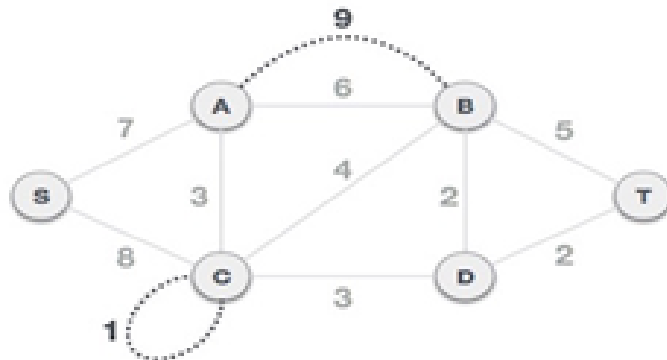
Use Bellman Ford Algorithm to find the minimum cost to travel from node A to node C.

3. Solve the following recurrence relation using Master's Theorem:
-
- $T(n) = 3T(n/4) + n \log n$
- .

5

CO1

4. Using Prim's Algorithm construct the MST from the given graph. 5 CO4

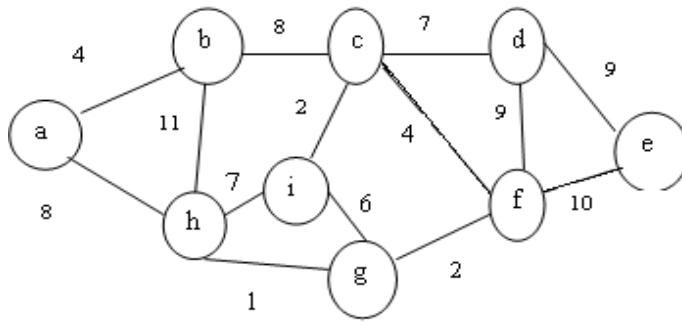


5. Apply Heap sort to sort the following unsorted Array: {10, 12, 3, 5, 17, 9} 5 CO3
6. Derive the worst-case complexity of merge sort. 5 CO3

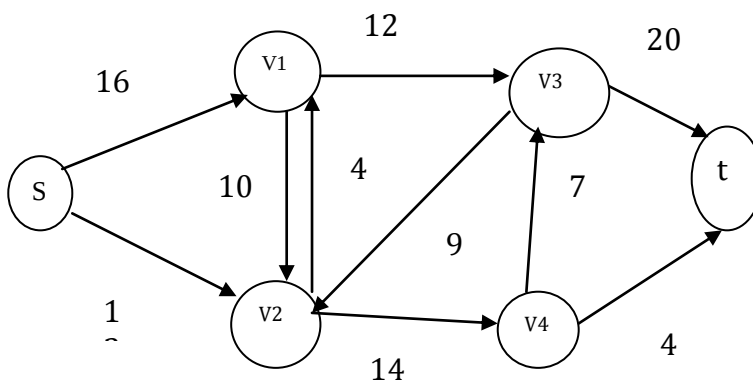
GROUP – C
(Long Answer Type Questions)
 Answer any *three* from the following: 3×15=45

- | | | | Marks | CO No. | | | | | | | | | | | | | | | | | | |
|-----|----------|---|-------|----------|--------|----|---|-----|----|---|----|----|---|----|----|---|----|----|---|----|--|--|
| 7. | (a) | Multiply the following two matrices using Strassen's Matrix multiplication: | 8 | CO3 | | | | | | | | | | | | | | | | | | |
| | | $\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} * \begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$ | | | | | | | | | | | | | | | | | | | | |
| | (b) | Explain quick sort algorithm and simulate it for the following data: {20, 5, 10, 16, 54, 21} | 7 | CO2 | | | | | | | | | | | | | | | | | | |
| 8. | (a) | Find an optimal schedule for the job sequencing problem of 7 jobs, where profits = (3, 5, 20, 18, 1, 6, 30) and deadlines = (1, 3, 4, 3, 2, 1, 2). | 6 | CO2 | | | | | | | | | | | | | | | | | | |
| | (b) | Determine the optimal parenthesization of matrix chain multiplication for the following matrices: | 9 | CO2 | | | | | | | | | | | | | | | | | | |
| | | A1 A2 A3 A4
(4x10) (10x3) (3x12) (12x20) | | | | | | | | | | | | | | | | | | | | |
| 9. | (a) | What will be the items in the knapsack for the given fractional knapsack problem? n = 5 w = 60 kg (w1, w2, w3, w4, w5) = (5, 10, 15, 22, 25) (b1, b2, b3, b4, b5) = (30, 40, 45, 77, 90) | 5 | CO3 | | | | | | | | | | | | | | | | | | |
| | (b) | What will be job sequence for the given problem where dmax = 3? | 5 | CO3 | | | | | | | | | | | | | | | | | | |
| | | <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Job</th> <th>Deadline</th> <th>Profit</th> </tr> </thead> <tbody> <tr><td>j2</td><td>1</td><td>100</td></tr> <tr><td>j1</td><td>2</td><td>60</td></tr> <tr><td>j4</td><td>2</td><td>40</td></tr> <tr><td>j3</td><td>3</td><td>20</td></tr> <tr><td>j5</td><td>1</td><td>20</td></tr> </tbody> </table> | Job | Deadline | Profit | j2 | 1 | 100 | j1 | 2 | 60 | j4 | 2 | 40 | j3 | 3 | 20 | j5 | 1 | 20 | | |
| Job | Deadline | Profit | | | | | | | | | | | | | | | | | | | | |
| j2 | 1 | 100 | | | | | | | | | | | | | | | | | | | | |
| j1 | 2 | 60 | | | | | | | | | | | | | | | | | | | | |
| j4 | 2 | 40 | | | | | | | | | | | | | | | | | | | | |
| j3 | 3 | 20 | | | | | | | | | | | | | | | | | | | | |
| j5 | 1 | 20 | | | | | | | | | | | | | | | | | | | | |

- (c) Consider the graph $G = (V, E)$ given below. Find the minimum cost spanning tree by kruskal's algorithm 5 CO3



10. (a) Find out the occurrence of the string $x = \mathbf{abaa}$ in the string $y = \mathbf{ababbaabaaab}$ using KMP algorithm (Each step should be shown clearly) 6 CO4
- (b) What is the complexity of the KMP algorithm? 1 CO4
- (c) Why KMP algorithm is better than Naive string matching algorithm? 2 CO4
- (d) Find the maximum flow from the following graph. 6 CO4



11. (a) What do you mean by the term "Backtracking"? 1 CO3
- (b) Find out the optimal solution of 4-queen problem using Backtracking. 4 CO3
- (c) Discuss with diagram the relations among P class, NP class, NP-hard class, and NP-complete class. 5 CO5
- (d) A salesman has to travel to few cities as described in the following graph. Find out the route the salesman should follow to achieve minimum travel starting from city A. 5 CO5

