# GURU NANAK INSTITUTE OF TECHNOLOGY
## An Autonomous Institute under MAKAUT
## 2021
## DESIGN & ANALYSIS OF ALGORITHMS (Backlog)
## 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***

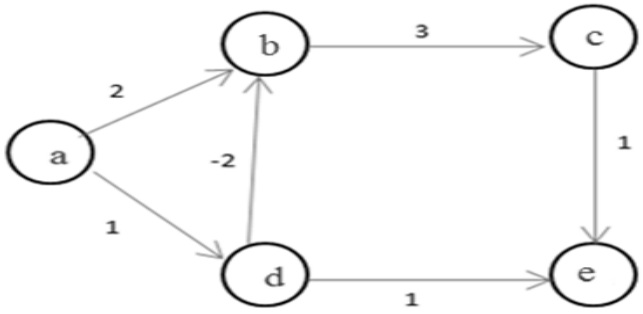
**GROUP – A**
**(Multiple Choice Type Questions)**

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

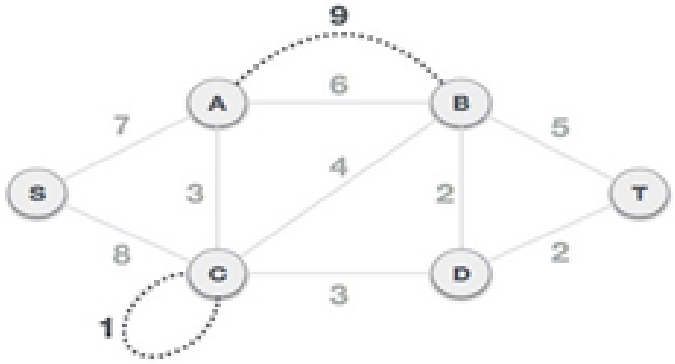
| | | | Marks | CO No. |
|---|---|---|---|---|
| 1. | (i) | The running time of Floyd-Warshall algorithm is<br>a) Θ (n)<br>b) Θ ($n^3$)<br>c) Θ ($n^2$)<br>d) Θ (n log n) | 1 | CO4 |
| | (ii) | Which of the following algorithm solve fractional knapsack problem most efficiently?<br>a) Divide and conquer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

| | | | |
|---|---|---|---|
| (viii) | Which of the following sorting algorithm does not have a worst-case running time of $O(n^2)$<br>a) Insertion sort<br>b) Merge sort<br>c) Quick sort<br>d) Bubble sort | 1 | CO5 |
| (ix) | 8-queen problem is the example of<br>a) Divide & conquer<br>b) b) dynamic programming<br>c) backtracking<br>d) greedy method | 1 | CO4 |
| (x) | What is the time complexity of Huffman Coding?<br>a) O(N)<br>b) O(NlogN)<br>c) O(N(logN)^2)<br>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<br>a) $n^3$-1<br>b) n-1<br>c) $n^2$-1<br>d) log n-1 | 1 | CO2 |
| (xii) | Given two sequences X and Y : X = < a, b, c, b, d, a, b > Y = < b, d, c, a, b, a > . The longest common subsequence of X and Y is :<br>a) < b, c, a><br>b) < c, a, b><br>c) < b, c, a, a><br>d) < b, c, b, a> | 1 | CO2 |

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

| | | Marks | CO No. |
|---|---|---|---|
| 2. | Consider the following graph:<br>  <br><br>Use Bellman Ford Algorithm to find the minimum cost to travel from node A to node C. | 5 | CO5 |
| 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 |

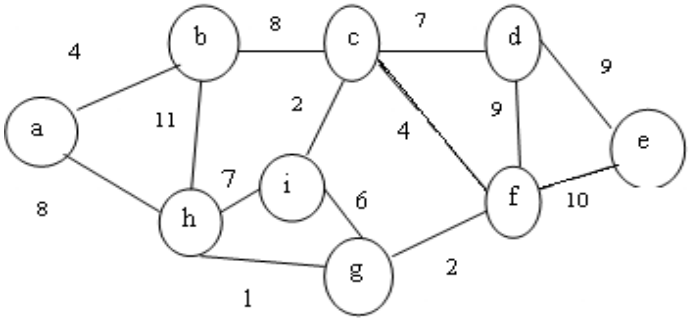
## GROUP – C
## (Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

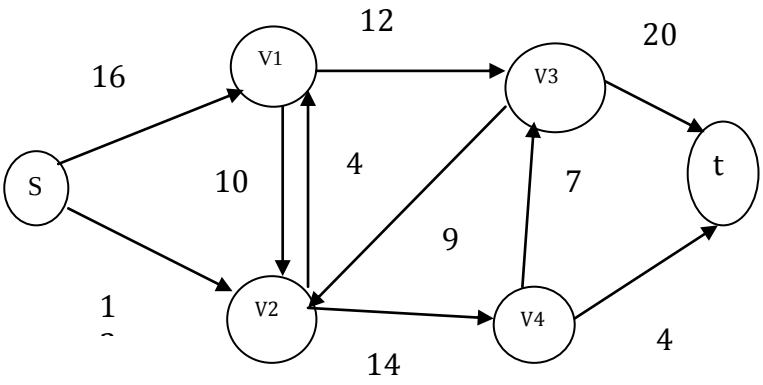
| | | | Marks | CO No. |
|---|---|---|---|---|
| 7. | (a) | Multiply the following two matrices using Stressen's Matrix multiplication: $\begin{bmatrix}2 & 3\\4 & 5\end{bmatrix} * \begin{bmatrix}1 & 3\\4 & 5\end{bmatrix}$ | 8 | CO3 |
| | (b) | Explain quick sort algorithm and simulate it for the following 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:<br>A1 (4x10) A2 (10x3) A3 (3x12) A4 (12x20) | 9 | CO2 |
| 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 |

| 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 = **abaa** in the string y = **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 that 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 |