GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
DESIGN AND 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**

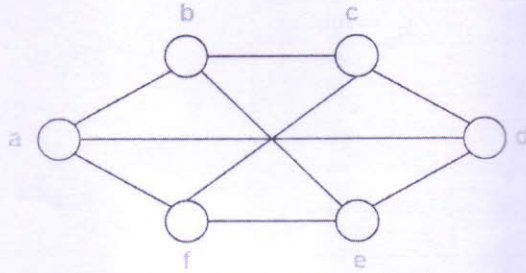|			Marks	CO No

1. (i) 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 :   **1**   **CO2**
   a) < b, c, a>
   b) < c, a, b>
   c) < b, c, a, a>
   d) < b, c, b, a>

   (ii) Which of the following is/are property/properties of a dynamic programming problem?   **1**   **CO1**
   a) Optimal substructure
   b) Overlapping subproblems
   c) Greedy approach
   d) Both optimal substructure and overlapping subproblems

   (iii) What does the given figure depict?   **1**   **CO5**

   a) min cut problem
   b) max cut problem
   c) maximum flow problem
   d) flow graph

   (iv) Which data structure is used for implementing a LIFO branch and bound strategy?   **1**   **CO3**
   a) stack
   b) queue
   c) array
   d) linked list

   (v) Which of the following methods can be used to solve the Bellman-Ford problem?   **1**   **CO4**
   a) Recursion
   b) Dynamic programming
   c) Greedy programming
   d) None of the mentioned

(vi) What is recurrence for worst case of QuickSort? 1 CO1
a) $T(n) = T(n-2) + O(n$
b) $T(n) = T(n-1) + O(n)$
c) $T(n) = 2T(n/2) + O(n)$
d) $T(n) = T(n/10) + T(9n/10) + O(n)$

(vii) The tightest lower bound on the number of comparisons, in the worst case, for 1 CO2
comparison-based sorting is of the order of
a) N
b) N^2
c) NlogN
d) $N(logN)^2$

(viii) In a binary max heap containing n numbers, the smallest element can be found in 1 CO3
time
a) $\Theta(n)$
b) $\Theta(logn)$
c) Θ (loglogn)
d) Θ (1)

(ix) What is the time complexity of Huffman Coding? 1 CO4
a) O(N)
b) O(NlogN)
c) $O(N(logN)^2)$
d) $O(N^2)$

(x) What is the time complexity of Floyd Warshall algorithm to calculate all pair 1 CO5
shortest path in a graph with n vertices?
a) O(n2logn)
b) Θ(n2logn)
c) Θ(n4)
d) Θ(n3)

(xi) The problem of finding a list of integers in a given specific range that meets certain 1 CO1
conditions is called?
a) Subset sum problem
b) Constraint satisfaction problem
c) Hamiltonian circuit problem
d) Travelling salesman problem

(xii) Which of the following is true? 1 CO4
a) Prim's algorithm initializes with a vertex
b) Prim's algorithm initializes with a edge
c) Prim's algorithm initializes with a vertex which has smallest edge
d) Prim's algorithm initializes with a forest

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

			Marks	CO No
2.	(a)	State Master's Theorem.	2	CO3
	(b)	Find the time complexity for the following recurrence : $T(n) = 2T(n/2) + 10n$	3	CO3

|				
3.		What is N-Queens problem? Draw state space tree to show all possible solution for 4-Queens problem.	5	CO2
4.		Compare and contrast the best and worst case time complexity of Quick Sort.	5	CO1
5.		Sort the following sequence in ascending order using heapsort method: <3, 5, 2, 7, 1, 4, 8>.	5	CO4
6.			5	CO5

Find chromatic number of the following graph by drawing state space tree.

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

			Marks	CO No
7.	(a)	What is the significance of Big-oh (O), Big-theta (Θ), and Big-omega (Ω)?	5	CO1
	(b)	Compare Divide-and-Conquer method, Dynamic Programming, and Greedy Technique.	5	CO1
	(c)	What is meant Lower Bound Theory? Explain.	5	CO1
8.	(a)	Find out All pair of Shortest path for following graph using Floyd Warshall Algorithm.	5	CO5
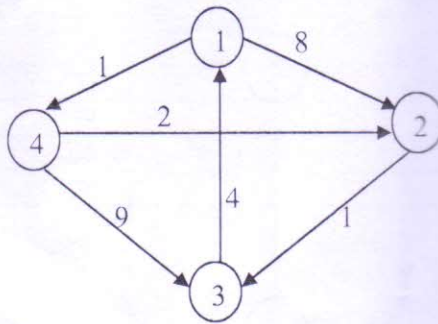
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	(b)	A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency:	5	CO5

Character	Frequency
a	5
b	9
c	12
d	13
e	16
f	45

Note that each character in input message takes 1 byte.
If the compression technique used is Huffman Coding, how many bits will be saved in the message?

(c)	Find the longest common sub-sequence of the following two sequences S1 = BDCABA and S2 = BABB, using dynamic programming.	5	CO5

9. (a) What is fractional knapsack problem? For the given set of items and knapsack capacity = 60 kg, find the optimal solution for the fractional knapsack problem making use of greedy Approach.   5   CO4

Item	Weight	Value
1	5	30
2	10	40
3	15	45
4	22	77
5	25	90

(b) 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   CO4
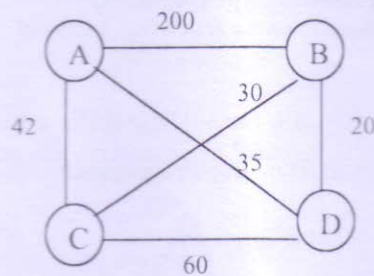
(c) For the given graph, find out the shortest path from Vertex a using bellman Ford Algorithm.   5   CO4
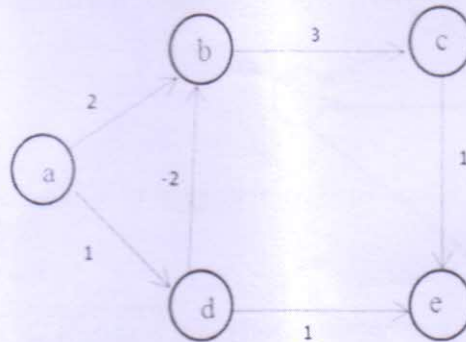
10. (a) Given the jobs, their deadlines and associated profits as shown-   4   CO3

Jobs	J1	J2	J3	J4	J5	J6
Deadline	5	3	3	2	4	2
Profits	200	180	190	300	120	100

Answer the following questions-
1. Write the optimal schedule that gives maximum profit.
2. Are all the jobs completed in the optimal schedule?
3. What is the maximum earned profit?

(b)   Find the minimal spanning tree of the weighted graph of the following figure   4   CO3
using Prim's algorithm.
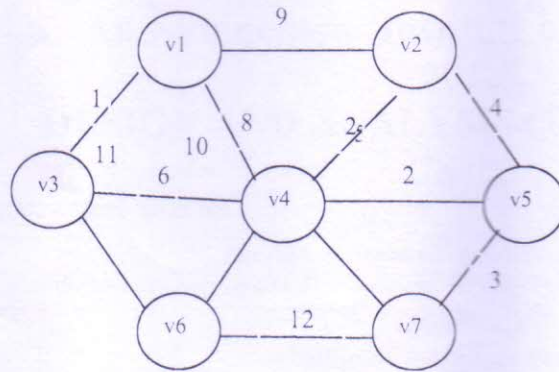
(c)   Determine the optimal parenthesization of matrix chain multiplication for   7   CO3
following matrices:

A1	A2	A3	A4	A5
(2x3)	(3x6)	(6x4)	(4X2)	(2X7)

11.   (a)   Define and discuss with diagram the relations among P class, NP class, NP-hard   3   CO1
class, and NP-complete class.

(b)   Using recursion tree method, solve the following recurrences   3   CO3
$T(n)=T(n/3)+T(2n/3)+n$

(c)   Trace the mergesort algorithm for the given set of numbers: <25, 15, 40, 55, 10,   4   CO4
30>

(d)   Solve the given 0/1 knapsack problem. Maximum Capacity of Knapsack is 10.   5   CO5

Item	Weight	Value
I1	6	6
I2	10	2
I3	3	1
I4	5	8
I5	1	3
I6	3	5