Name: **Enrolment No:**	

UPES

End Semester Examination, Dec 2024

Course: Design and Analysis of Algorithms **Semester: III**

Program: B.Tech (CSE)/BCA/B.Sc.(CS) **Time : 03 hrs.**

Course Code: CSEG 2021 **Max. Marks: 100**

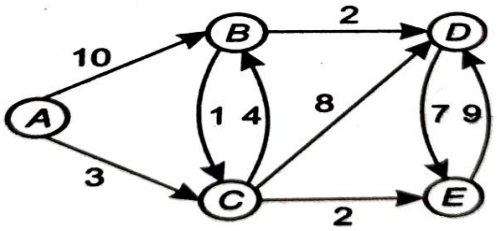
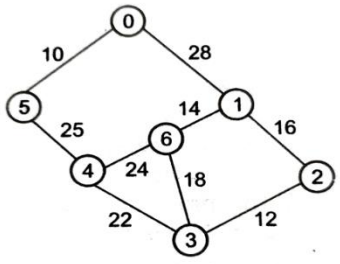
Instructions:

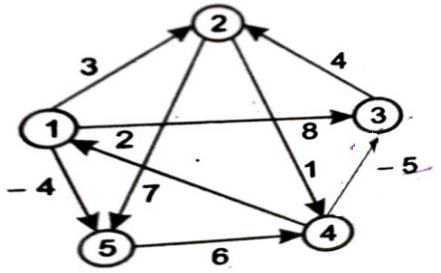
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the process for determining an algorithm's running time, and derive the recurrence relations for the best-case, worst-case, and average-case time complexities of the binary search algorithm.	**4**	**CO1**
Q 2	An array $A(n)$ contains n elements of the same value that means $A[1] = A[2] = A[3] = ... = A[n] = x$. Calculate the complexity of sorting A(n) using quick sort?	**4**	**CO1**
Q 3	**A)** Demonstrate that the following equations are correct: I) $10n^2+9=O(n^2)$ II) $6n^3/ (\log n +1) =O(n^3)$ **B)** Solve the following recurrences using the Recursion Tree method: I) $T(n)=T(n/3) +T(2n/3) +n$ II) $T(n)=T(n/2) +T(n/4) +T(n/8) +n$	**4**	**CO1**
Q 4	Describe the algorithm for merging two sorted arrays of size 'm' and 'n'.	**4**	**CO1**
Q 5	Can the Master Method be applied to the following recurrences? Justify your answer in each case and provide an asymptotic upper bound for the recurrence if possible. a) $T(n)=4T(n/3) +n^2 \log n$ b) $T(n)=4T(n/2) +n^2\sqrt{n}$	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Discuss the single-source shortest path problem. Present Dijkstra's algorithm for finding the shortest path, perform a runtime analysis of the algorithm, and apply it to determine the shortest path in a given graph."	**10**	**CO2**

			
Q7	Outline the key elements of dynamic programming. Provide a brief overview of the "Longest Common Subsequence" (LCS) problem. Given two sequences, X=ABCBDAB and Y=BDCABA, calculate their LCS using a dynamic programming approach.	**10**	**CO3**
Q8	Consider the matrices P, Q, R, and S, which have dimensions 6x5, 5x7, 7x3, and 3x9, respectively. Determine the minimum number of scalar multiplications required to multiply the four matrices. Compute the optimal multiplication sequence and the corresponding optimal parenthesization. Additionally, design algorithms to find the optimal sequence and parenthesization, and analyze their space and time complexity.	**10**	**CO3**
Q9	Given the following jobs, each with a profit and a deadline: [(J1, 35, 3), (J2, 30, 4), (J3, 25, 4), (J4, 20, 2), (J5, 15, 3), (J6, 12, 1), (J7, 5, 2)], apply a greedy approach to schedule the jobs within their respective deadlines in order to maximize the total profit. Outline each step of your scheduling process, explain how you select the jobs at each step, and determine the final job schedule along with the maximum profit.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	**A)** Given the graph, calculate the weight of the Minimum Spanning Tree (MST) using Prim's algorithm. Additionally, state whether the MST is unique for the given graph, and provide justification for your answer.  **B)** Illustrate the Sum of Subsets problem . Find all possible subsets of the set w={3,4,5,6} that sum to m=9. Also, draw the state space tree generated during the process using backtracking approach.	**(10+10)**	**(CO2+ CO4)**

Q11	**A)** Discuss all pair shortest path problem. Apply Floyd-warshall algorithm for constructing shortest path. Show the matrices $D^{(k)}$ computed by the Floyd-warshall algorithm for the graph.  **B)** Define and compare the complexity of classes P, NP and NP Complete. How are they related to each other. Explain the significance of deterministic polynomial time in P and nondeterministic polynomial time in NP, with examples of problems belonging to each class. **OR** **A)** Provide the formulation of the modified Knapsack problem using the branch and bound technique and find the optimal solution using the least-cost branch and bound approach. Given n=4, m=15, profits (p1, p2, p3, p4) = (15,15,17,23) and weights (w1, w2, w3, w4)=(3,5,6,9), solve for the optimal solution. **B)** Formulate and analyze the Rabin Karp Algorithm for string matching and comment on its running time. For string matching working module q=11 ,how many spurious hits does the Rabin Karp matcher encounter in the text T=3141592653589793, when looking for the pattern P=26?	**(15+5)** **OR** **(10+10)**	**(CO3+ CO4)**