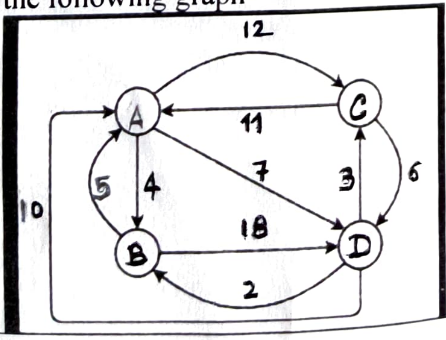
Name of the Student.........Tanish.... Scholar Number.[illegible]

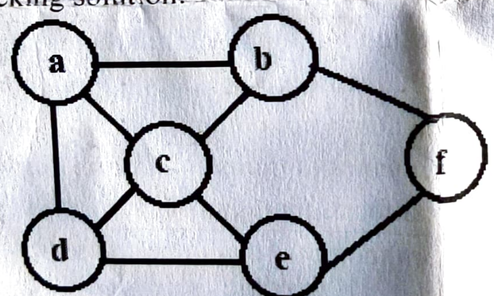
MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY BHOPAL
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

EXAMINATION: End Semester Examination **MONTH and YEAR:** May 2025

Course: BTech. **Semester:** IV **Branch:** Computer Science and Engineering **Subject Code:** CSE221
Subject Name: Analysis and Design of Algorithms **Maximum Marks:** 50
Duration: 3 hours **Date:** 13 May 2025 **Time:** 8:00 AM to 11:00 AM

Note: *All questions are compulsory.*

Q. No.	Questions	Marks	COs
1	Determine and explain the functionality of the following code fragment: `int function1 (int a[], int n, int x)` `{` `int i;` `for (i = 0; i < n && a[i] != x; i++);` `if (i == n) return -1;` `else return i;` `}` `int function2 (int a[], int n, int x)` `{` `int i, j, k;` `i = 0; j = n -1;` `while (i <= j) {` `k = (i + j)/2;` `if (x == a[k]) return k;` `if (x > a[k]) i = k + 1;` `else j = k - 1;` `}` `return -1;` `}` Compute the best case, the worst case and average case time complexity of the above function1 and function2. Explain your answers.	5	CO1
2	Given a set of intervals, you need to assign a color to each interval such that no two intersecting intervals have the same color. Design an efficient algorithm find a coloring with minimum number of colors. To put the problem another way, given arrival and departure times of trains at a station during the day, what is the minimum number of platforms that is sufficient for all trains.	5	CO1, CO2
3	How to make Merge sort to perform O(n) comparisons in best case? Sort the following elements using merge sort. Write the recursion tree for: 70,20,30,40,10,50,60	5	CO1, CO2
4	Discuss how quicksort works to sort an array & trace for the following dataset. Draw the tree of recursive calls made: 65,70.75,80,85,60,55,50,45	5	CO1, CO2
5	Solve Travelling Salesman Problem using Branch and Bound Algorithm in the following graph-  	5	CO3, CO4

<table>
<tr><td>6</td><td>Compute the minimum number of scalar multiplications required to multiply a chain of matrices using the Matrix Chain Multiplication method, given the following matrices: $M_{20,20}$, $M_{20,30}$, $M_{30,40}$, $M_{40,20}$ and $M_{20,50}$
Where, $M_{m,n}$ is $m \times n$ dimensional matrix.</td><td>5</td><td>CO3</td></tr>
<tr><td>7</td><td>(a) Apply the Set and Tabular (Dynamic Programming) approaches to solve the 0/1 Knapsack Problem with a knapsack capacity W=5. The details of the available items are given below:
<table>
<tr><th>Item</th><th>Weight</th><th>Value</th></tr>
<tr><td>1</td><td>2</td><td>$12</td></tr>
<tr><td>2</td><td>1</td><td>$10</td></tr>
<tr><td>3</td><td>3</td><td>$20</td></tr>
<tr><td>4</td><td>2</td><td>$15</td></tr>
</table>
(b) For the bottom-up dynamic programming algorithm for the knapsack problem, prove that,
1. Its time complexity is in $\theta(nW)$
2. Its space complexity is in $\theta(nW)$</td><td>5</td><td>CO3</td></tr>
<tr><td>8</td><td>Given the set w = {5,7,10,12,15,18,20} and a target sum m = 35, find all possible subsets of w whose elements sum to m. Solve this problem using the Sum of Subsets (SumOfSub) backtracking algorithm, and explain and justify the condition used in the bounding function of the algorithm.</td><td>5</td><td>CO4, CO5</td></tr>
<tr><td>9</td><td>Apply the backtracking algorithm to solve the 3-coloring problem for the given graph. Additionally, perform a time complexity analysis of the backtracking solution.

</td><td>5</td><td>CO1, CO4</td></tr>
<tr><td>10</td><td>Prove that if there exists a polynomial time algorithm for any NP-complete problem, then P=NP.</td><td>5</td><td>CO5</td></tr>
</table>

**********END**********