

Name of the Student... Rahul AgarwalScholar Number... 231201268**MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY BHOPAL****DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING****EXAMINATION: MIDTERM****MONTH and YEAR: March, 2025****Course: B. Tech Semester: IV Branch: Computer Science and Engineering****Subject Code: CSE221****Subject Name: Algorithm Design & Analysis****Maximum Marks: 20 marks****Duration: 90 minutes****Date: 19-03-2025****Time: 9:30 am-11:00 am****Note: 1. Attempt all questions, 2. Assume necessary data, if required, and mention it clearly.**

Q. No.	Questions	Marks	COs
Q1	(a) Solve the following recurrence relation using the substitution method: $T(n) = 3T(n/2) + n \log n$. Find the asymptotic complexity $T(n)$.	(3)	CO1
	(b) Determine the asymptotic complexity (using Theta notation) for the number of times the statement $x = x + 1$ is executed in the following code: <pre> j = n; while (j >= 1) { for (i = 1 to j) { x = x + 1; } j = j / 3; } </pre>	(2)	CO1
Q2	(a) Prove or disprove the following asymptotic complexity statement: $2^n = O(n!)$. Justify your response with a detailed explanation.	(2)	CO1
	(b) Let $A[1 \dots n]$ be an array of n distinct numbers. A is unimodal, i.e., for some i , $1 \leq i \leq n$, $A[1] < \dots < A[i]$ and $A[i] > A[i+1] > \dots > A[n]$. Design and analyze an efficient algorithm to find i . It will be okay to write the idea in plain text instead of writing in formal algorithm format.	(2.5)	CO2
Q3	(a) Mr. John is a chemist who receives ten medicine boxes with batch numbers 35, 33, 42, 10, 14, 19, 27, 44, 26, 31 printed on them. He always arranges the boxes manually and gets frustrated every time. He thought he would have a lot of problems in the future arranging the boxes if the number of boxes of medicine was large. He wants to make this task easier. As you are a good programmer, Mr. John is asking for your help. Write an optimal quick sort algorithm to arrange the boxes in increasing order of batch numbers and show each step of the algorithm in detail using the above sequence of batch numbers. Also, write the best case and worst case time complexity of the algorithm?	(4)	CO2
	(b) Consider the following message : aabbbbabbcccddeeeccceeeeddee. Find the no. of bits required for huffman coding of above message? Also find the average bits required to represent a character?	(2.5)	CO3
Q4	Consider the following complete undirected graph. Find out Minimum spanning tree using Prim's algorithm & Kruskal's algorithm. Also find shortest path spanning tree from vertex 1.	(4)	CO4

