

K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

Nov – Dec 2025		
(B. Tech / M. Tech.) Program: Artificial Intelligence and Data Science Scheme III		
Regular Examination SY Semester: III		
Course Code: AIC303 and Course Name: Design and Analysis of Algorithms		
Date of Exam: 02-12-2025	Duration: 02.5 Hours	Max. Marks: 60

Instructions:

- (1) All questions are compulsory.
- (2) Draw neat diagrams wherever applicable.
- (3) Assume suitable data, if necessary.

Q. No.	Question	Max. Marks	CO	BT level
Q 1	Solve any two questions out of three: (05 marks each)	10		
a)	Explain various asymptotic notations with examples.		CO1	U
b)	Explain the relationship among P, NP, NP-Hard and NP-Complete problems.		CO1	U
c)	Define recurrence relations. Solve $T(n)=4T(n/4)+n^2$ using recurrence tree method.		CO1	U
Q 2	Solve any two questions out of three: (05 marks each).	10		
a)	Write an algorithm to find the minimum and maximum element from a given list and analyze its time complexity. [10,18,7,26,45,35,13,21]		CO2	AP
b)	Apply the Binary Search algorithm to determine whether the element 65 is present or not in the sorted list [10, 15, 25, 35, 45, 55, 65, 75, 85]. Show all mid-index calculations and comparisons step-by-step.		CO2	AP
c)	Given a set of positive integers $S = \{10, 7, 5, 18, 12, 20, 15\}$ and a target sum $M = 35$, apply the Sum of Subsets backtracking algorithm to find all subsets of S that sum to M. Show the state space tree and mark the pruned branches.		CO5	AP
Q.3	Solve any two questions out of three. (10 marks each).	20		
a)	Solve the job sequencing with deadlines problem for profits (3,5,22,18,1,6,30) and deadlines (1,3,4,3,2,1,2). Give the final schedule with time slots, the total profit, and explicitly state which jobs remain unexecuted?		CO3	AP
b)	Apply the KMP algorithm to find the pattern ABABCABAB in the text ABABDABACDABABCABAB. Construct the LPS (Longest Prefix Suffix)		CO6	AP

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	table and show the pattern matching process step by step.																						
c)	Apply the Bellman–Ford algorithm to find the shortest path from source vertex A to all other vertices in the given weighted directed graph. <table> <tr> <td>Edge</td> <td>Weight</td> <td>Edge</td> <td>Weight</td> </tr> <tr> <td>A → B</td> <td>6</td> <td>C → D</td> <td>3</td> </tr> <tr> <td>A → C</td> <td>5</td> <td>D → E</td> <td>2</td> </tr> <tr> <td>B → C</td> <td>−2</td> <td>C → E</td> <td>8</td> </tr> <tr> <td>B → D</td> <td>4</td> <td></td> <td></td> </tr> </table> Perform the following: 1. Show the distance table after each iteration. 2. Write the final shortest distance from vertex A to all vertices. 3. Verify whether the graph contains any negative weight cycle.	Edge	Weight	Edge	Weight	A → B	6	C → D	3	A → C	5	D → E	2	B → C	−2	C → E	8	B → D	4			CO4	AP
Edge	Weight	Edge	Weight																				
A → B	6	C → D	3																				
A → C	5	D → E	2																				
B → C	−2	C → E	8																				
B → D	4																						
Q.4	Solve any two questions out of three. (10 marks each)	20																					
a)	Solve 0/1 Knapsack problem using dynamic programming for items: (v,w) = {(18,3),(25,5),(27,4),(10,3),(15,6)}		CO4 AP																				
b)	Write an algorithm for the N-Queen problem and demonstrate for N=4.		CO5 AP																				
c)	Write and apply Rabin-Karp algorithm to find the substring pattern 'ABAB' in text 'ABABCABABA'.		CO6 AP																				
