Reg. No.																

Question Paper Code	14202

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fourth Semester

Computer Science and Engineering

(Common to Information Technology, Artificial Intelligence and Machine Learning & Computer Science and Engineering (AIML))

20ITPC401 - DESIGN AND ANALYSIS OF ALGORITHMS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	A recursive function executes 3 recursive calls in each step and reduces the problem size by half. What is its recurrence relation? (a) $T(n) = 2T(n/2) + O(n)$ (b) $T(n) = 3T(n/2) + O(1)$ (c) $T(n) = T(n-1) + O(n)$ (d) $T(n) = 3T(n/3) + O(n)$	1	K1	CO1
2.	Which of the following is the most efficient time complexity? (a) $O(n)$ (b) $O(n^2)$ (c) $O(2^n)$ (d) $O(\log n)$	1	K1	CO1
3.	The closest pair problem involves finding the closest two points in: (a) A sorted array (b) A convex hull (c) A set of points in a plane (d) A list of strings	1	K1	CO2
4.	Which of the following is the simplest string matching algorithm? (a) KMP Algorithm (b) Rabin-Karp Algorithm (c) Boyer-Moore Algorithm (d) Brute Force Algorithm	1	K1	CO2
5.	Define the process of restructuring a heap after removing the root element: (a) Heapification (b) Merging (c) Sorting (d) Partitioning	1	K1	CO3
6.	Analyze the time complexity of the closest-pair algorithm in 2D space: (a) $O(n \log n)$ (b) $O(n^2)$ (c) $O(\log n)$ (d) $O(n)$	1	K1	CO3
7.	Name the alternative name for Prim's algorithm. (a) Kruskal algorithm (b) Knapsack (c) Dijkstra–Scholten algorithm (d) DJP Algorithm	1	K1	CO4
8.	Floyd Warshall Algorithm belongs to ---? (a) Greedy method (b) Branch and Bound (c) Divide and Conquer (d) Dynamic method	1	K1	CO4
9.	Determine the primary goal of the iterative improvement algorithm in optimization problems: (a) To generate all possible solutions. (b) To iteratively enhance partial solutions. (c) To apply heuristics for quick results. (d) To minimize the search space.	1	K1	CO5
10.	Identify the correct requirement of the Hamiltonian Circuit Problem. (a) Visit every vertex at least once (b) Visit every edge exactly once (c) Visit every vertex exactly once and return to the starting vertex (d) Minimize the total cost of travel	1	K2	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

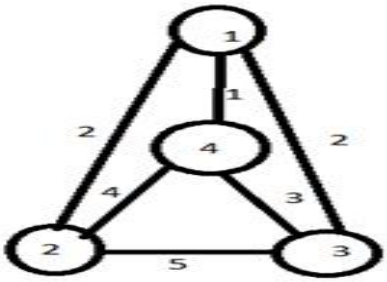
		Marks	K – Level	CO
11.	Write Euclid's Algorithm for computing the gcd(m, n).	2	K2	CO1
12.	List and categorize the most important types of problems addressed by algorithms.	2	K1	CO1
13.	Define the brute force approach and mention its advantages and disadvantages.	2	K2	CO2
14.	Outline the primary objective of the knapsack problem.	2	K1	CO2
15.	Infer the impact of increasing array size on the efficiency of binary search.	2	K2	CO3

16.	Show how different pivot selection strategies affect the performance of quicksort.	2	K2	CO3
17.	Justify why the 0/1 Knapsack Problem is not always solvable using a Greedy approach.	2	K2	CO4
18.	Compute the Binomial Coefficient using an appropriate method.	2	K2	CO4
19.	Write brief notes on simplex method in linear programming.	2	K1	CO5
20.	Define graph coloring.	2	K1	CO5
21.	State the reason why a search path may be terminated at the current node in Branch and Bound.	2	K1	CO6
22.	Distinguish between Feasible and Optimal Solutions in the context of optimization problems.	2	K2	CO6

PART - C (6 × 11 = 66 Marks)

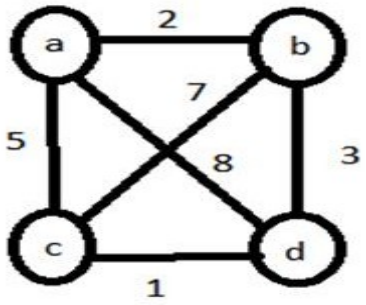
Answer ALL Questions

23.	a)	Illustrate the concepts of Big O Notation, Omega Notation, and Theta Notation. Evaluate their relationships, represent them graphically, and provide an explanation.	11	K2	CO1
		OR			
	b)	Develop a general plan for analyzing the time efficiency of non-recursive algorithms and assess the time complexity for identifying a unique element in an array.	11	K2	CO1
24.	a)	Examine and find the optimal solution for the Travelling Salesman Problem using brute force.	11	K2	CO2



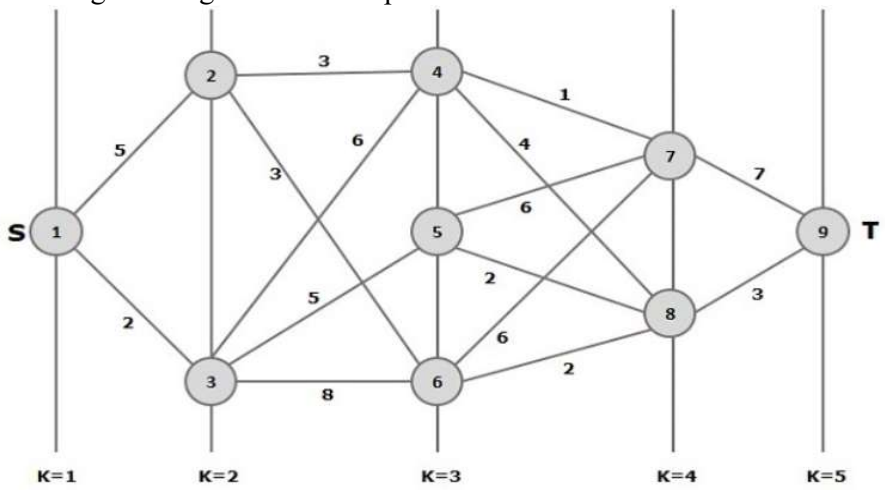
OR

	b)	Determine the shortest Hamiltonian circuit using the brute force technique. Justify the solution with proper reasoning.	11	K2	CO2



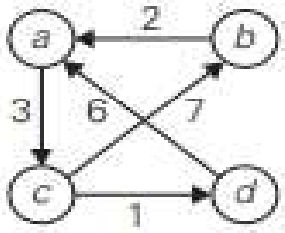
25.	a)	Outline the working of the merge sort algorithm and solve the following sorting problem using merge sort: Unsorted Array: [38, 27, 43, 3, 9, 82, 10] Show the stepwise merging process.	11	K3	CO3
		OR			
	b)	Explain the heap sort algorithm and construct a max heap from the following array: Given Array: [4, 10, 3, 5, 1] Perform heap sort and show each step.	11	K3	CO3

26. a) Illustrate the step-by-step method to solve a Multi-Stage Graph problem using Dynamic Programming with an example. *11 K3 CO4*

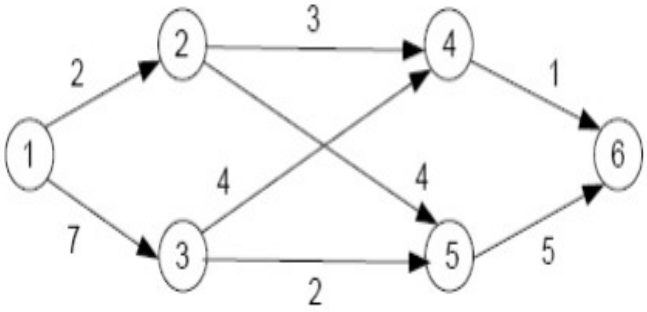


OR

b) Implement Floyd's Algorithm for All-Pairs Shortest Path using the given weighted graph. Analyze its time complexity. *11 K3 CO4*

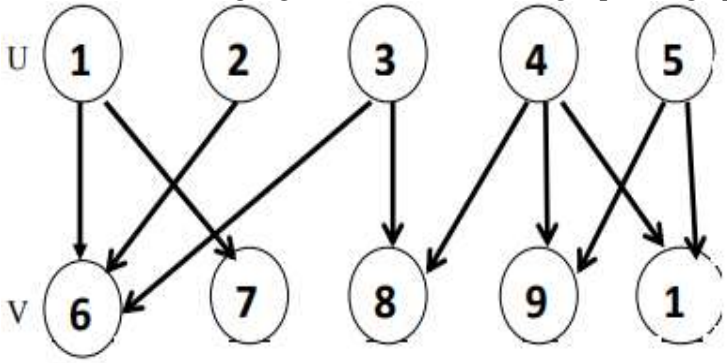


27. a) Illustrate pictorially the Ford –Fulkerson method by showing the flow augmenting paths in bold for the given flow network *11 K3 CO5*



OR

b) Apply the maximum-matching algorithm is the following bipartite graph. *11 K3 CO5*



28. a) Apply the Branch and Bound method to solve the 0/1 Knapsack Problem with the following data: *11 K3 CO6*

- Items:
  - Item 1: Weight = 2, Profit = 40
  - Item 2: Weight = 3, Profit = 50
  - Item 3: Weight = 4, Profit = 65
- Knapsack Capacity: 5
- Use a bounding function to estimate node values.
- Show the state space tree traversal and final solution.

OR

b) You are given a set of characters and their frequencies as observed in a text dataset. Your task is to apply the Huffman coding algorithm to reduce the number of bits required to store or transmit the data. *11 K3 CO6*

Character	A	B	C	D	E	F
Frequency	5	9	12	13	16	15

Compute the total number of bits required using Huffman encoding. Compare this with a fixed-length encoding scheme (3 bits per character) and determine the number of bits saved.