RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

USN | | | | | | | | | | |

R V College of Engineering

R V Vidyanikethan Post
Mysuru Road Bengaluru - 560 059

IV Semester BE Regular /Supplementary Examinations June/July - 2025.
(Common to CS/CD/CY/IS/AI&ML)
Course : Design and Analysis of Algorithms-CD343AI

Time : 3 Hours **Maximum Marks : 100**

Instructions to the students

1. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2, is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, and 9 and 10.

Part A

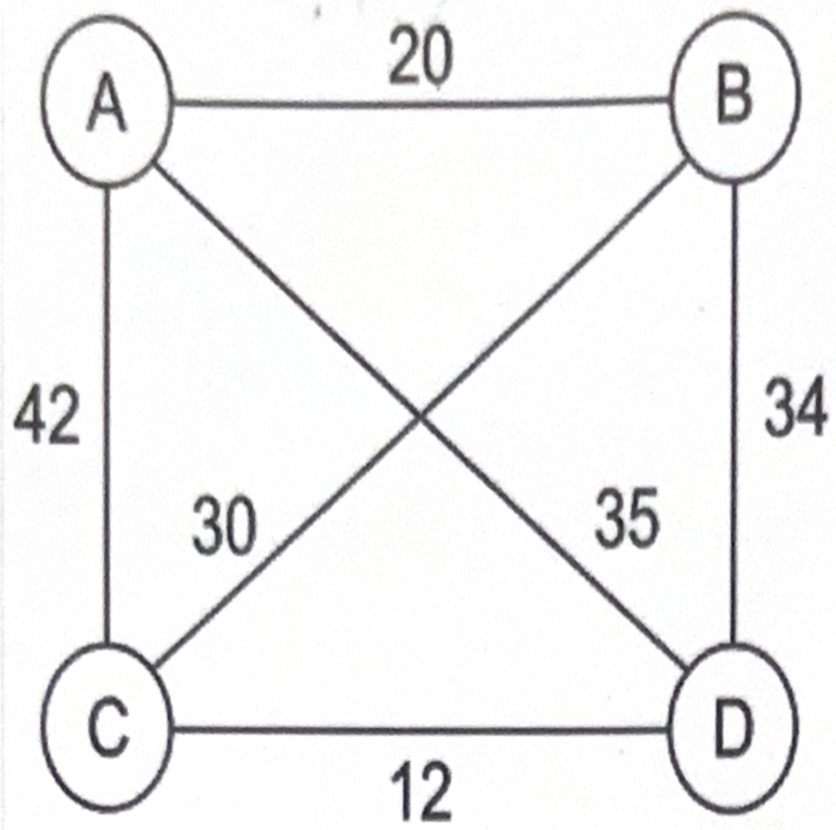
Question No	Question	M	CO	BT
1.1	Explain how the time complexity of an algorithm can be affected by changes in input size and algorithmic optimizations, giving an example.	02	1	2
1.2	What is the difference between internal and external sorting?	02	1	2
1.3	What does it mean when we say that an algorithm X is asymptotically more efficient than Y?	02	1	3
1.4	How does using the median of the array as the pivot in Quick Sort improve its performance in scenarios where the array is nearly sorted, potentially avoiding the typical degradation to $O(n^2)$ time complexity seen in standard Quick Sort implementations? What will be the time complexity?	02	2	3
1.5	What is the time complexity of following recurrence relation? $T(n) = 3T(n/2) + n^2$	02	2	2
1.6	What is the disadvantage of a space-time trade-off?	02	1	1
1.7	Provide an example of Instance Simplification in the Transform-and-Conquer strategy	01	1	1
1.8	Indicate whether each of the following properties is true for every Huffman code.	02	1	2

	a. The code words of the two least frequent symbols have the same length. b. The code word's length of a more frequent symbol is always smaller than or equal to the code word's length of a less frequent one.			
1.9	What does the term 'memory function' refer to in the context of dynamic programming?	02	1	2
1.10	Define the leaf structure of a state space tree.	02	2	2
1.11	The problem of determining if a number is prime is in class _____.	01	1	1

Part B

Question No	Question	M	CO	BT
2a	Prove that $O(f(n)) \subseteq O(g(n))$ if $f(n) \in O(g(n))$.	06	1	3
2b	For a given algorithm with time complexity O(n^2+nlogn), what is the simplified time complexity and why?	06	1	3
2c	With an example analyze the asymptotic time complexity of selection sort in worst case	04	2	2
3a	Write the recurrence relation for divide and conquer long integer multiplication algorithm and solve for its time complexity.	08	2	4
3b	Analyse any three scenarios where Binary Search is not an optimal choice.	08	2	4
	OR			
4a	In a software project, the following source files have dependencies: • main.cpp depends on ui.cpp and core.cpp • ui.cpp depends on graphics.cpp and config.cpp • core.cpp depends on utils.cpp and config.cpp • utils.cpp depends on log.cpp a) Represent the above dependencies using a directed graph. b) Determine a valid compilation order of the source files using topological sorting.	08	4	3
4b	Write the Quick Sort algorithm and demonstrate its working on the following list of elements: `10, 80, 30, 90, 40, 50, 70`. Use the **last element** as the pivot during partitioning.	08	4	3

5a	Apply Boyer Moore algorithm to search for the pattern: P = "ABCDABD" in the text T = "ABC-ABCDAB-ABCDABCDABDE"	08	3	3	
5b	Consider the problem of Checking element uniqueness in an array. Design a presorting-based algorithm for solving this problem. Compare its efficiency with the brute-force approach in terms of time complexity.	08	3	3	
	OR				
6a	Given the input array A = [14, 2, 2, 18, 36, 18, 1,17,2], demonstrate step-by-step how Comparison Counting Sort works to produce the sorted array and discuss its efficiency	08	2	3	
6b	Describe variations of Transform-and-Conquer algorithmic strategy. In what scenarios is Transform-and-Conquer preferable over Brute Force and divide-and conquer? Support your answer with suitable examples.	08	2	2	
7a	Explain how one can generate a Huffman code without an explicit generation of a Huffman coding tree.	08	4	4	
7b	Compare Dynamic Programming and Greedy Design technique	08	3	4	
	OR				
8a	Design a linear-time algorithm for solving the single-source shortest-paths problem for DAG (Directed Acyclic Graph) represented by their adjacency lists.	08	4	6	
8b	Apply 0/1 Knapsack Memory Functions, find the maximum profit, write recurrence Relation Objects (n): 1, 2, 3 Weight: 2, 3, 2 Profit: 5, 10, 8 Knapsack size 5	08	3	3	
9a	The following map shows set of cities and distance between them. ABC travels is planning to visit the cities A, B, C and D. Solve using "branch and bound technique", to find the shortest possible route that visits every city exactly once and returns to the starting point. Consider City D as the starting point.	10	4	3	



9b	Explain the P vs NP problem and its implications in computational complexity.	06	2	2	
	OR				
10a	There are 3 workers and 3 jobs. The cost of assigning each worker to each job is given by the cost matrix: Job 1 / Job 2 / Job 3 Worker 1: 9, 2, 7 Worker 2: 6, 4, 3 Worker 3: 5, 8, 1 Write "branch and bound technique" based algorithm to solve the given problem. Using the same solve the problem to assign each worker to one job (no repeats) such that the total cost is minimized.	10	3	3	
10b	Solve the N-Queens problem for N = 4 using backtracking. Explain the backtracking steps and provide the board configuration(s).	06	4	2	