

USN

Course Code

22CS/AI/CA/CD44

Fourth Semester B.E. Degree Examinations, July 2026

ANALYSIS AND DESIGN OF ALGORITHMS

Duration: 3 hrs

Max. Marks: 100

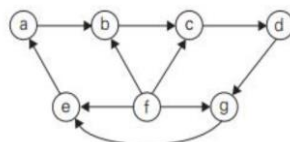
Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

Q. No	Question	Marks	(RBTL:CO: PI)
<u>Module-1</u>			
1.	a. Define algorithm. With the help of the flowchart, explain the various steps of algorithm design and analysis process.	06	(2.1.1.3.1)
	b. Discuss the general plan for analyzing the efficiency of non-recursive algorithms. Suggest an algorithm to find whether the elements in an array are distinct. Analyze its efficiency.	08	(2.1.1.3.1)
	c. What are the various basic asymptotic efficiency classes? Explain Big Oh, Big Omega, and Big Theta asymptotic notations.	06	(2.1.1.3.1)
(OR)			
2.	a. Consider the following algorithm. ALGORITHM Mystery(n) //Input: A nonnegative integer n $S \leftarrow 0$ for $i \leftarrow 1$ to n do $S \leftarrow S + i * i$ return S (i) What does this algorithm compute? (ii) What is its basic operation? (iii) How many times is the basic operation executed? (iv) What is the efficiency class of this algorithm?	06	(2.1.1.3.1)
	b. Construct an algorithm to determine the maximum values in an array of integers. Find its time complexity.	06	(2.1.1.3.1)
	c. Discuss the general plan for analysing the efficiency of a recursive algorithm. Write an algorithm to compute $n!$ Recursively. Set up a sum expression for the algorithm's basic operation and solve it.	08	(3.1.1.3.1)
<u>Module-2</u>			
3.	a. Write a Bubble sort algorithm and analyse its time complexity.	07	(3.2.1.6.1)
	b. Write a note on Master's theorem and explain its various efficiency classes. Write a non-recursive binary search algorithm and derive its time complexity.	07	(3.2.1.6.1)
	c. Apply brute force technique to solve the following Knapsack problem $N=3$, $M=20$, $W=\{18,15,10\}$ and $V=\{30,21,18\}$	06	(2.2.1.6.1)

(OR)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

4. a. Discuss **decrease and conquer algorithms** technique. Explain its variations. 06 (2.2.1.6.1)
- b. Write an algorithm for **insertion sort** and derive its time complexity. Apply the same to sort the given list 74, 32, 93, 17, 73, 31, 44, 55, 20 06 (3.2.1.6.1)
- c. Apply topological sorting methods **DFS-BASED and SOURCE REMOVAL** for the following graph and write the topological sequence. 08 (3.2.1.3.1)



Module-3

- 5 a. Outline the algorithm for heap sort and apply **heap sort** by using array representation of heaps for sorting following sequence of elements in ascending order. 08 (3.3.1.6.1)
- 3,2,4,1,6,5
- b. Apply **Strassens's matrix multiplication** algorithm to multiply the following matrices 06 (3.3.1.3.1)

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 6 & 5 \\ 5 & 6 \end{bmatrix}$$

- c. Write a **binary search algorithm** using divide and conquer approach and derive its time complexity. 06 (2.3.1.3.1)

(OR)

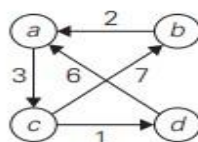
- 6 a. Apply **quicksort** to sort the following list in ascending order. Draw its recursive partition tree 07 (3.3.1.3.1)
- 8, 3, 7, 9, 5, 2, 4, 1
- b. Using the **divide-and-conquer method**, write an algorithm to find the **maximum and minimum** elements in a given array. Derive its time complexity. 07 (2.3.1.6.1)
- c. Write an algorithm for **merge sort** and derive its time complexity. 06 (3.3.1.6.1)

Module-4

- 7 a. Given the **knapsack of capacity 5 kg**, solve the following instance of knapsack problem using greedy technique. 10 (3.4.1.3.1)

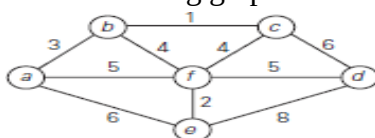
Items	1	2	3	4
Weight	1	3	2	2
Profit	5	9	4	8

- b. Apply **Floyd's Algorithm** to find all pair shortest path for the following graph. 10 (3.4.1.3.1)



(OR)

8. a. Apply **Prim's algorithm** to the following graph. 10 (3.4.1.3.1)

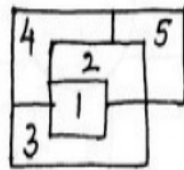


- b. Solve the given **Knapsack Problem** using a **dynamic programming** approach and find the optimal solution. **Capacity W=05** **10 (3.4.1.6.1)**

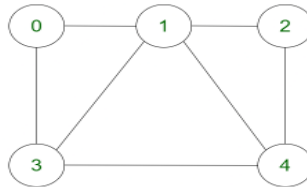
Item	Weight	Profit
1	2	\$12
2	1	\$10
3	3	\$20
4	2	\$15

Module-5

9. a. Apply backtracking approach for **4-Queens Problem** to find all possible solutions with appropriate state space tree structure. **08 (2.5.1.6.1)**
- b. Apply backtracking approach to assign colour for the following graph. **06 (2.5.1.3.1)**
M=3, {RED, GREEN, BLUE}



- c. Define the **Hamiltonian cycle**. Using the backtracking approach, check whether the Hamiltonian cycle exists for the following graph. **06 (2.5.1.3.1)**



(OR)

10. a. Describe branch and bound technique with suitable example. Solve job assignment problem using branch and bound technique. **10 (3.5.1.6.1)**
- b. Write a note on **10 (2.5.1.3.1)**
(i) P (ii) NP (iii) NP-Complete (iv) NP-Hard problems

** ** *