

CBCS SCHEME

BCS401

USN

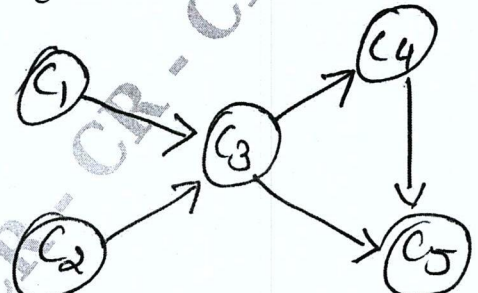
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Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026 Analysis and Design of Algorithms

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

| Module – 1 | | | M | L | C |
|---|----|---|----|----|-----|
| Q.1 | a. | Define algorithm with the help of flow chart, explain the various stages of algorithm's design and analysis process. | 10 | L2 | CO1 |
| | b. | Compare the order of $1/2 \cdot n(n-1)$ and n^2 . | 4 | L3 | CO1 |
| | c. | List and explain asymptotic notations used to compare the orders of growth of an algorithm, with an example each. | 6 | L3 | CO1 |
| OR | | | | | |
| Q.2 | a. | Give the general plan for analyzing the time efficiency of recursive algorithm show that efficiency of tower of Hanoi is exponential. | 10 | L2 | CO1 |
| | b. | Prove that if $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$, then $t_1(n) + t_2(n) \in O\{\max g_1(n), g_2(n)\}$. | 4 | L3 | CO1 |
| | c. | Solve the following recurrence $x(n) = x(n-1) + 5$ for $n > 1$, $x(1) = 0$ | 6 | L3 | CO1 |
| Module – 2 | | | | | |
| Q.3 | a. | Define Divide and Conquer. Design an algorithm for merge sort and sort the list "EXAMPLE" in alphabetical order using merge sort. | 10 | L3 | CO2 |
| | b. | Design an algorithm for quick sort. Sort the list 65, 70, 75, 80, 85, 60, 55, 50, 45. Also derive the worst case complexity of quick sort. | 10 | L3 | CO2 |
| OR | | | | | |
| Q.4 | a. | Define decrease and conquer technique. What are the three major variations of decrease and conquer technique? Obtain the topological ordering for the following graph. Using source removal method. | 10 | L3 | CO2 |
|  <pre> graph TD C1((C1)) --> C3((C3)) C2((C2)) --> C3 C3 --> C4((C4)) C3 --> C5((C5)) C4 --> C5 </pre> <p style="text-align: center;">Fig.Q.4(a)</p> | | | | | |

| | | | | | |
|--|----|---|----|----|-----|
| | b. | Design an algorithm to sort N number of elements using insertion sort. Illustrate the tracing of insertion sort algorithm for the following set of numbers 25, 10, 72, 18, 40, 11, 64, 58, 32, 9. | 10 | L3 | CO2 |
|--|----|---|----|----|-----|

Module – 3

| | | | | | |
|-----|----|---|----|----|-----|
| Q.5 | a. | What is heap? Design an algorithm to construct a heap for the elements of the given array by bottom up approach. Show heap construction of the given list 2, 9, 7, 6, 5, 8 by successive insertion using bottom up procedure. | 10 | L2 | CO3 |
| | b. | What is AVL tree? Explain the four types of rotations used to construct the AVL tree. Construct AVL tree for the set 5, 6, 8, 3, 2, 4, 7 by successive insertion. | 10 | L3 | CO3 |

OR

| | | | | | |
|-----|----|--|----|----|-----|
| Q.6 | a. | Apply Horse Pool's algorithm to search for the pattern DEMOCRATIC from the text INDIA_IS_A_DEMOCRATIC_COUNTRY. Explain its working along with a neat shift table and algorithm to find the pattern string. | 10 | L3 | CO3 |
| | b. | Design an algorithm for comparison counting sort. Apply the same to sort the list 62, 31, 84, 96, 19, 47. | 10 | L3 | CO3 |

Module – 4

| | | | | | |
|-----|----|--|----|----|-----|
| Q.7 | a. | Apply Kruskal's algorithm to find minimum cost spanning tree to the graph shown below source = a ; | 10 | L3 | CO4 |
|-----|----|--|----|----|-----|

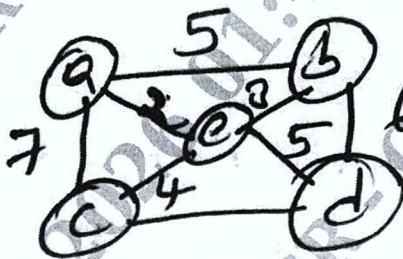


Fig.Q.7(a)

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| | | | | | |
|--|----|---|----|----|-----|
| | b. | Explain the Warshall's algorithm to find the transitive closure of a directed graph. Apply it to the following graph. | 10 | L3 | CO4 |
|--|----|---|----|----|-----|

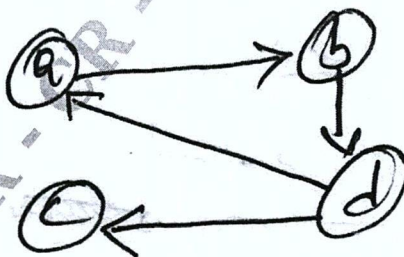


Fig.Q.7(b)

OR

- Q.8 a. Construct a minimum cost spanning tree using prim's algorithm for the following graph source = 'a'. 10 L3 CO4

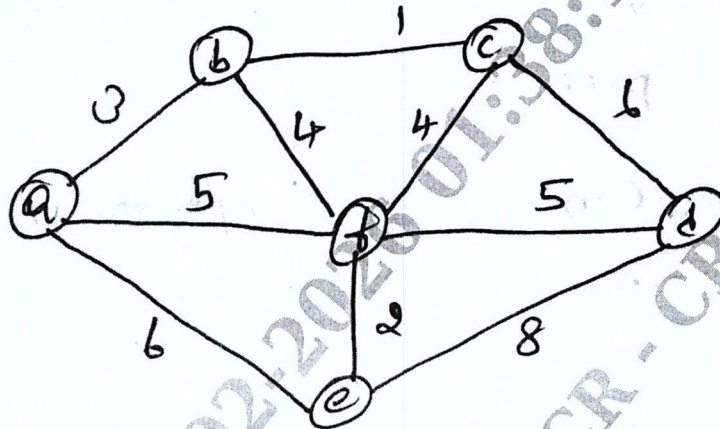


Fig.Q.8(a)

- b. What is Huffman Tree? Explain the algorithm to construct the Huffman tree. Construct the Huffman tree for the following data: 10 L3 CO4

| Character | A | B | C | D | - |
|-------------|------|-----|-----|-----|------|
| Probability | 0.35 | 0.1 | 0.2 | 0.2 | 0.15 |

Module - 5

- Q.9 a. Using Branch and Bound technique solve the below instance of knapsack problem. 10 L3 CO6

| Item | Weight | Value |
|------|--------|-------|
| 1 | 2 | 12 |
| 2 | 1 | 10 |
| 3 | 3 | 20 |
| 4 | 2 | 5 |

Capacity = 5

- b. Define Backtracking. Apply backtracking to solve the instance of the sum of subset problem $s = \{3, 5, 6, 7\}$ and $d = 15$. 10 L3 CO6

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OR

- Q.10 a. Explain the concept of P, NP, NP - complete and NP-Hard problem. 10 L2 CO5

- b. What are Decision Trees? Explain with example, how decision trees are used in sorting algorithms. 10 L2 CO6
