

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2024

FIRST YEAR [BATCH 2024-26]

COMPUTER SCIENCE

Paper : CC 3

Date : 19/12/2024

Time : 11.00 am – 1.00 pm

Full Marks : 50

Answer any five questions:

[5×10]

1. Insert the following data into an AVL tree.
10, 20, 30, 40, 50, 25, 7, 9, 8
Clearly show every step with balancing. Delete 50 from this tree and show the steps. [7+3]
2. a) Define ADT of stack.
b) Explain proof of correctness of finding minimum element of an integer array.
c) Write the advantages and disadvantages of Strassen's matrix chain multiplication algorithm. [2+4+4]
3. a) What are the differences between B-tree and B+ tree? Which one is more adaptable in large database maintenance and why?
b) Solve the all-pairs shortest path problem for the following graph using Floyd-Warshall's algorithm. The graph has vertices {A,B,C,D} and edges with weights:
A→B : 3, B→C : 1, C→A : 4, A→D : 7, D→B : -1.
Show the intermediate matrix after each phase of the algorithm. [4+6]
4. a) Design a B-tree of order 3 having the following data.
18, 15, 19, 17, 12, 16, 14, 13.
b) Deduce time complexity of N-queen's problem using backtracking. [7+3]
5. a) Define NP-complete problems. Explain why the subset sum problem is NP-complete.
b) Solve the following 0-1 knapsack problem using dynamic programming. Number of items = 4,
Maximum capacity of the knapsack = 5 units, Weight of each item = 2, 3, 4, 5 units respectively,
Profit of each item = 3, 4, 5, 6 units respectively. [(2+3)+5]
6. a) Solve the following recurrence relation using substitution method.
$$T(n) = \frac{n}{n+1} T(n-1) + 1$$

b) Given the character frequencies {a:5, b:9, c:12, d:13, e:16, f:45}, Construct the Huffman tree and determine the code for each character. [6+4]
7. a) Discuss the concept of polynomial-time reduction. Provide an example of how the 3-SAT problem can be reduced to another NP-complete problem.
b) Apply Dijkstra's Algorithm to calculate the shortest paths from A to every other node. [(2+3)+5]

