

CBCS SCHEME

15CS43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021 Design and Analysis of Algorithms

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the worst case, best case and average case efficiencies of an algorithm, with an example each case. (08 Marks)
- b. Explain the method of comparing the order of growth of two functions using limits, compute the order of growth of: (i) $\log_2 n$ and \sqrt{n} (ii) 2^n and $n!$ (08 Marks)

OR

- 2 a. Define Big Oh notation. Prove that if $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$ (08 Marks)
- b. Explain the general plan for analyzing the efficiency of a recursive algorithm by considering Tower of Hanoi problem as an example. (08 Marks)

Module-2

- 3 a. Explain the concept of divide and conquer. Design an algorithm for merge sort. (08 Marks)
- b. Apply Strassen's matrix multiplication algorithm to compute product of following two matrices: $\begin{bmatrix} 4 & 5 \\ 5 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$ (08 Marks)

OR

- 4 a. Discuss how Quick sort works to sort an array. Trace Quick sort algorithm for the following data set: 2, -4, 1, 0, 3, 5, -7. Also derive the worst case time complexity of Quick sort. (08 Marks)
- b. Design and analyse an algorithm for finding the maximum and minimum of an elements using Divide and Conquer Approach. (08 Marks)

Module-3

- 5 a. Write the algorithm to find optimal solution for job sequencing problem with deadline. Apply the same algorithm for the following dataset and find an optimal solution.
 $n = 4$, Profit $(p_1, p_2, p_3, p_4) = (100, 10, 15, 27)$,
 Deadlines: $(d_1, d_2, d_3, d_4) = (2, 1, 2, 1)$ (08 Marks)
- b. Write a Kruskal's algorithm to find minimum cost spanning tree and obtain minimum spanning tree for the graph shown in Fig.Q5(b).

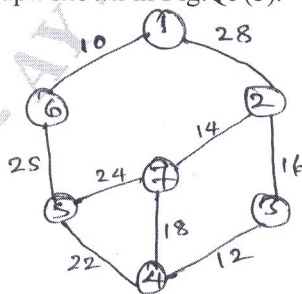


Fig.Q5(b)

(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 6 a. What is an Heap? Write an algorithm to sort the elements using Heap Sort. (08 Marks)
 b. Obtain the shortest distance cost and paths from node 5 to other nodes from the graph shown in Fig.Q6(b).

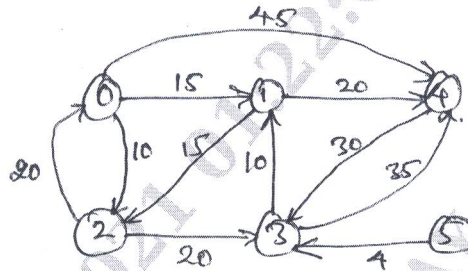


Fig.Q6(b)

(08 Marks)

Module-4

- 7 a. Write Warshall's algorithm and find the transitive closure of the matrix given below:

$$R = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

(08 Marks)

- b. Explain multistage graphs with example. Write multistage graph algorithm using forward approach. (08 Marks)

OR

- 8 a. Using dynamic programming, solve the following knapsack instance:
 $n = 4$, $[w_1, w_2, w_3, w_4] = [2, 1, 3, 2]$,
 $[p_1, p_2, p_3, p_4] = [12, 10, 20, 15]$ and $M = 5$ (08 Marks)
 b. Solve the following traveling sales person problem using dynamic programming.

$$\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$$

starting city 1.

(08 Marks)

Module-5

- 9 a. Discuss the general backtracking algorithm. Draw the state space tree for 4 – Queen's problem. (08 Marks)
 b. Solve the following instance of Knapsack problem using Branch and Bound Approach,
 $n = 4$, $[w_1, w_2, w_3, w_4] = [4, 7, 5, 3]$, $[v_1, v_2, v_3, v_4] = [40, 42, 25, 12]$
 The knapsack's capacity w is 10. (08 Marks)

OR

- 10 a. Define P, NP, NP – complete and NP – Hard classes. (08 Marks)
 b. Solve the following instances of assignment problem using Branch and Bound.

$$C = \begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix} \begin{array}{l} \text{person a} \\ \text{person b} \\ \text{person c} \\ \text{person d} \end{array}$$

(08 Marks)
