21CS42

USN

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Design and Analysis of Algorithms

Time: 3 hrs.   Max. Marks: 100

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

Module-1

1 a. Design an algorithm to search an element in an array using sequential search. Discuss its efficiency in best, worst and average cases.   **(08 Marks)**

b. Give the general plan for analyzing any non recursive algorithm. Write an algorithm to check whether array elements are distinct. Discuss its efficiency.   **(08 Marks)**

c. Define Big Oh (O) and Big Omega (Ω) notations.   **(04 Marks)**

OR

2 a. Discuss the various steps in algorithm design and analysis process with the flow diagram. What are the criteria satisfied by any algorithm.   **(08 Marks)**

b. Give the general plan for analyzing any recursive algorithm. Write and solve the recurrence relation to find the solution for Tower's of Hanoi problem.   **(08 Marks)**

c. Write an algorithm to sort 'n' number using selection sort method.   **(04 Marks)**

Module-2

3 a. Design an algorithm to sort 'n' numbers using Quick sort. Apply the algorithm for the data 35, 20, 15, 45, 10, 60, 15, 70.
Each time, show the splitting position.   **(08 Marks)**

b. Discuss the general Divide and Conquer method along with control abstraction. Write the recurrence relation for divide and conquer.   **(06 Marks)**

c. Write an algorithm sort the numbers using insertion sort. Discuss its efficiency.   **(06 Marks)**

OR

4 a. Obtain the Topological sequence for the following graph using i) Source removal method ii) DFS based algorithm. [Refer Fig.Q4(a)]
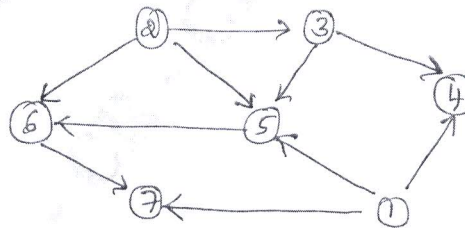

Fig.Q4(a)   **(07 Marks)**

b. Design an algorithm to sort numbers using merge sort. Write the complexity of merge sort.   **(07 Marks)**

c. Write recursive algorithm to find maximum and minimum element in an array. Construct tree of recursive call for the data,
22, 13, -5, -8, 15, 60, 17, 31, 47   **(06 Marks)**

Module-3

5 a. Write an algorithm to solve Greedy knapsack problem. Find an optimal solution to the knapsack instance $n = 7$, $m = 15$, $(P_1, P_2 \ldots..P_7) = (10, 5, 15, 7, 6, 18, 3)$ and $(w_1, w_2 \ldots.w_7) = (2, 3, 5, 7, 1, 4, 1)$ using Greedy method. **(10 Marks)**

   b. Design Prim's algorithm to find the minimum cost spanning tree. Apply Pr_1
   Write an algorithm to construct heap using Bottom-up approach. Apply both bottom-up and Top down method to construct the max heap for the data 12, 23, 45, 28, 55, 15, 67, 33.
   (10 Marks)

OR

6 a. Design Prim's Algorithm to find the minimum cost spanning tree. Apply Prim's algorithm for the following graph in Fig.Q6(a).
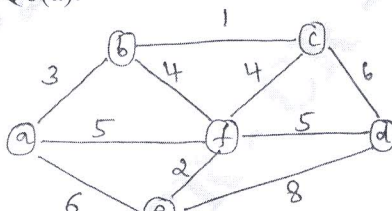

Fig.Q6(a) **(10 Marks)**

   b. Write Huffman's algorithm. Construct Huffman tree and find the code for each character.

Characters :	A	B	C	D	E
Probability :	0.4	0.1	0.2	0.15	0.15

(10 Marks)

Module-4

7 a. Write Floyd's Algorithm to solve all pairs shorted path problem. Apply Floyd's algorithm for the following graph in Fig.Q7(a).
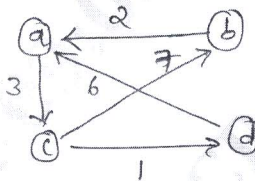

Fig.Q7(a) **(10 Marks)**

   b. Write the pseudocode for comparison counting sort. Discuss its efficiency. **(06 Marks)**

   c. Write Bellman and Ford Algorithm to compute the shortest path. **(04 Marks)**

OR

8 a. Discuss general dynamic programming approach. Find the optimal tour for the salesperson if he starts from city 1, using dynamic programming. Graph and the distance matrix are given. [Refer Fig.Q8(a)]
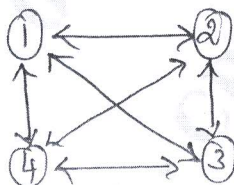

Fig.Q8(a)

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array}\begin{array}{cccc} 1 & 2 & 3 & 4 \\ \begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix} \end{array}$$

(10 Marks)

   b. Write pseudocode for Horspool's string matching algorithm. **(06 Marks)**

   c. Write Warshall's algorithm to compute Transitive closure. **(04 Marks)**

Module-5

9 a. Discuss general Backtracking technique. Construct state space tree to solve Four Queens problem. **(08 Marks)**

b. Discuss the following :
i) Graph coloring problem and its solution using Backtracking.
ii) Branch and Bound technique to solve knapsack problem. **(12 Marks)**

OR

10 a. Discuss general branch and bound technique. Construct state space tree to solve the following assignment problem with 4 jobs and 4 persons. Assignment cost is given.

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

(08 Marks)

b. Discuss the following :
i) Sum of subset problem and solution using backtracking.
ii) P, NP and NP complete problem. **(12 Marks)**

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