CBCS SCHEME

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17CS43

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

Time: 3 hrs. Max. Marks: 100

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



### Module-1

1 a. What is algorithm? Design an algorithm to print all possible permutations of the set. **(06 Marks)**

b. Prove that if $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$, then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$. **(06 Marks)**

c. Design the recursive algorithm to solve towers of Hanoi problem and derive its time complexity function. **(08 Marks)**

**OR**

2 a. Design an algorithm to search for an element in an array using sequential search. Discuss its worst cases best case and average case time complexity. **(08 Marks)**

b. Design an algorithm to check whether all the elements in a given array are unique and analyze for its worst case efficiency. **(06 Marks)**

c. Discuss adjacency matrix and adjacency list representation of a graph with suitable example. **(06 Marks)**

### Module-2

3 a. Design a recursive algorithm to find the maximum and minimum element from a list. Also derive its time complexity. **(10 Marks)**

b. Apply divide and conquer method to multiply the matrices.

$$\begin{bmatrix} 5 & 2 & 6 & 1 \\ 0 & 6 & 2 & 0 \\ 3 & 8 & 1 & 4 \\ 1 & 8 & 5 & 6 \end{bmatrix} \begin{bmatrix} 7 & 5 & 8 & 0 \\ 1 & 8 & 2 & 6 \\ 9 & 4 & 3 & 8 \\ 5 & 3 & 7 & 9 \end{bmatrix}$$

**(05 Marks)**

c. Apply DFS algorithm and source vertex removal method to find the topological sequence of the graph shown in Fig.Q.3(c).

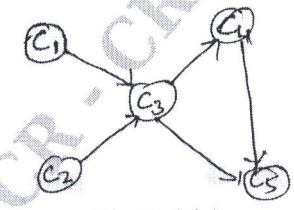


Fig.Q.3(c)

**(05 Marks)**

**OR**

4 a. Write a recursive binary search algorithm. Apply binary search for the following numbers: -15, -6, 0, 7, 9, 23, 54, 82, 101, 112, 125, 131, 142, 151. **(07 Marks)**

b. Apply merge sort for the following numbers: 310, 285, 179, 652, 351, 423, 861, 254, 450, 520). Write the recurrence relation and obtain its time complexity. **(05 Marks)**

c. Explain Strassen's matrix multiplication. Apply Strassen's matrix multiplication to multiply the following matrices.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}.$$

**(08 Marks)**

## Module-3

5 a. Define feasible solution and optimal solution. Write an algorithm to solve knapsack problem using greedy technique. Find the optimal solution to the knapsack instance n = 5, m = 10, w = (2, 1, 5, 14), p = (4, 2, 2, 6, 1). **(10 Marks)**

b. Apply Prim's and Kruskal's method to find the minimum cost spanning tree for the graph shown in Fig.Q.5(b).

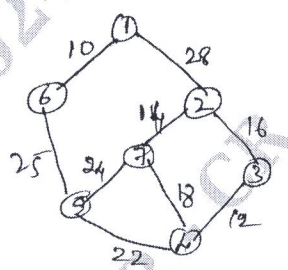


Fig.Q.5(b)

Write the algorithm to solve single source shortest path problem. **(10 Marks)**

**OR**

6 a. Find the shortest distance from vertex 1 to all nodes in G shown in Fig.Q.6(a) using single source shortest path algorithm. **(10 Marks)**

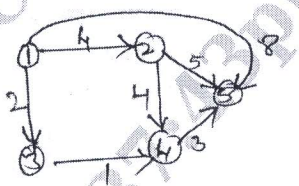


Fig.Q.6(a)

b. Define Heap. Write bottom-up heap construction algorithm. Construct heap for the list 2, 9, 7, 6, 5, 8. **(10 Marks)**



## Module-4

7 a. Write a note on multi-stage graphs. Write the algorithm for forward approach to obtain minimum cost path from source t to terminal t. **(06 Marks)**

b. Apply Floyd's algorithm to find all pairs shortest paths for the graph of Fig.Q.7(b). **(06 Marks)**

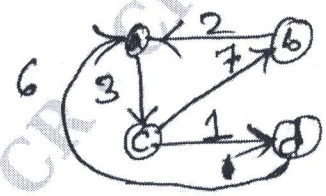


Fig.Q.7(b)

c. Find the minimum-cost tour for the graph of Fig.Q.7(c) with initial and end vertex as 2 using dynamic programming.

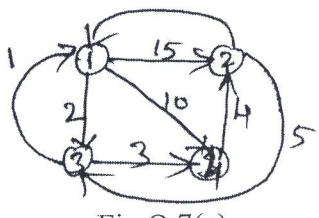


Fig.Q.7(c)

**(08 Marks)**

**OR**

8 a. Define transitive closure of a directed graph. Find the transitive closure matrix for the graph whose adjacency matrix is given: $\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$. Write the algorithm for the same. **(10 Marks)**

b. Construct optimal binary search tree for the following data: **(10 Marks)**

| Key | A | B | C | D |
|---|---|---|---|---|
| Probability | 0.1 | 0.2 | 0.4 | 0.3 |

## Module-5

9 a. Construct a state-space to solve four queens problem using backtracking. **(05 Marks)**

b. Solve the following assignment problem using branch-and-bound technique. **(09 Marks)**

$$\begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix}.$$

c. Apply the branch-and bound technique to solve travelling salesman problem of the graph of Fig.Q.9(c). **(06 Marks)**

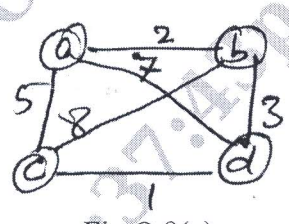


Fig.Q.9(c)



**OR**

10 a. State sum of subset problem. Using backtracking, obtain a solution to the subset sum problem, taking and d = 16, s = {6, 8, 2, 14}. **(06 Marks)**

b. Discuss graph coloring problem. Draw a state-space tree for the graph shown in Fig.Q.10(b) using 3 colors.

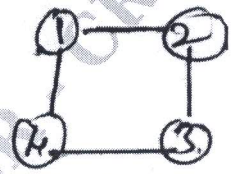


Fig.Q.10(b)

**(08 Marks)**

c. Explain NP-complete and NP-Hard problems. **(06 Marks)**

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