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13MCA41

Fourth Semester MCA Degree Examination, Aug./Sept.2020
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define and algorithm. Briefly explain the steps in design and analysis of an algorithm. **(08 Marks)**

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

c. Consider the following algorithm:

```
Algorithm element
Input: An array A[0... n-1]
O/P: Returns true if all elements are unique, false otherwise
for i ← 0 to n – 2
    for j ← i + 1 to n – 1
        if A[i] = A[j] return false
return true.
```

i) What is the basic operation?
ii) What is the time complexity of the algorithm in best case?
iii) Analyze the time complexity in worst case and show the steps in detail. **(06 Marks)**

2 a. Solve the recurrence relation:

$$x(n) = \begin{cases} 0, & \text{if } n = 0 \\ x(n-1) + n & \text{otherwise} \end{cases}$$ **(06 Marks)**

b. Write a non-recurrence algorithm to sort n elements using selection sort. Analyze the time complexity of the algorithm and show the steps in detail. **(06 Marks)**

c. Apply string pattern matching algorithm to search "RITH" in the string ALGORITHMS. Trace the algorithm and show the steps in detail. **(08 Marks)**

3 a. Discuss divide and conquer strategy for designing an algorithm. **(03 Marks)**

b. Apply merge sort to sort 60, 50, 25, 10, 35, 25, 75, 30 and show the steps in detail. **(07 Marks)**

c. Write a recursive quick sort algorithm. Analyze the time complexity for the best case using master theorem. **(10 Marks)**

4 a. Traverse the following graph using BFS. Start the traversal at vertex a and resolve ties by alphabetical order. Also trace the algorithm and show the steps in detail. (Refer Fig.Q.4(a)). **(10 Marks)**

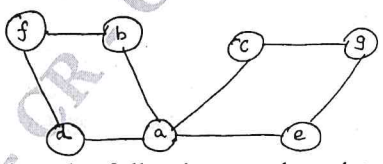

Fig.Q.4(a)

b. Apply source removal method to the following graph and topologically order it. Write an algorithm for the same and show the steps in detail. (Refer Fig.Q.4(b)). **(10 Marks)**

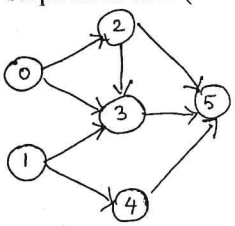

Fig.Q.4(b)

5 a. Explain input enhancement technique. Write an algorithm to sort elements using comparison counting and analyse its time complexity. **(10 Marks)**

b. Apply Horspool algorithm to search for the pattern "POOL$S" in the string "HORSPOOL$STRING". Show the steps in detail. **(10 Marks)**

6 a. Apply Warshall algorithm to compute transitive closure for the graph given below. Show the intermediate steps in detail. (Refer Fig.Q.6(a)) **(10 Marks)**

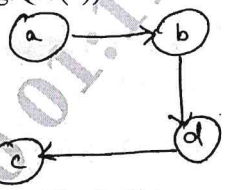

Fig.Q.6(a)

b. Apply dynamic programming to solve the given knapsack problem with capacity M = 5

Item	Weight	Value
1	2	12
2	1	10
3	3	20
4	4	15

(10 Marks)

7 a. Write an algorithm to find a solution for single source shortest path problem using Dijkstra's method. Also analyse the time complexity of the algorithm. **(10 Marks)**

b. Find the minimum spanning tree of the given graph in Fig.Q.7(b), using Kruskal's method. Trace the algorithm and show the steps in detail. **(10 Marks)**

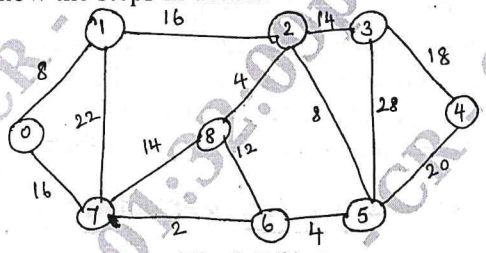

Fig.Q.7(b)

8 a. Construct a state space tree for sum of subset problem given: W = {3, 5, 6, 7} and m = 15. **(05 Marks)**

b. Define: i) Pclass and ii) NP-class problem. **(05 Marks)**

c. Apply branch and bound algorithm to solve the travelling salesman problem. (Refer Fig.Q.8(c)). **(10 Marks)**

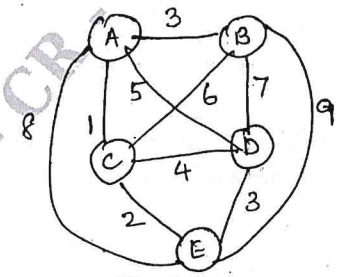

Fig.Q.8(c)

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