18CS42
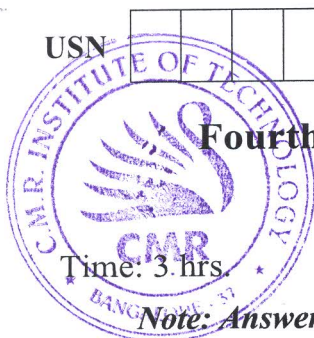
USN

Fourth Semester B.E. Degree Examination, June/July 2023
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. Define Algorithm. Summarize the properties which make the algorithm best. **(08 Marks)**
   b. Write an algorithm to find the sum of first and last digit of a given number. **(04 Marks)**
   c. Define program basic operation. Write an algorithm to find the sum of n numbers, also find the program step count for the above algorithm using step count method. **(08 Marks)**

OR

2 a. Write the Recursive algorithm for Tower of Hanoi. Prove that the time complexity is exponential. **(08 Marks)**
   b. What are Asymptotic Notations? How these are related to time complexity. Give example for each. **(06 Marks)**
   c. Discuss the important problem types, with one example for each. **(06 Marks)**

Module-2

3 a. Discuss the General Method of Divide and Conquer along with control abstraction.
      (06 Marks)
   b. Write an algorithm for MergeSort. Also demonstrate the applicability of Master's theorem to compute the time complexity of MergeSort. **(06 Marks)**
   c. Sort the below given array of elements using QuickSort. Mention Time Complexity.

2	6	4	3	9	1	7

      (08 Marks)

OR

4 a. What are the disadvantages of Divide and Conquer approach? **(04 Marks)**
   b. Discuss decrease and conquer algorithmic technique. Explain its variations. **(06 Marks)**
   c. Write an algorithm for the below given problems in divide and conquer approach:
      (i)   Strasson's matrix multiplication
      (ii) Finding maximum and minimum element in an array. **(10 Marks)**

Module-3

5 a. Apply Greedy technique to solve the following instance of knapsack problem:
$$n = 3, M = 20, \begin{matrix} W_1 W_2 W_3 = (18,15,10) \\ V_1 V_2 V_3 = (30,21,18) \end{matrix}$$
      (08 Marks)
   b. Differentiate between Prim's and Kruskal's algorithm. **(04 Marks)**
   c. Solve the below instance of Prim's algorithm to compute minimum cost spanning tree. Mention Time Complexity. **(08 Marks)**
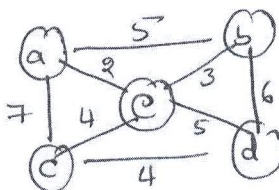

Fig. Q5 (c)

OR

6 a. Find the shortest path for the given input using Dijikstra's algorithm. Consider source node as 'g'. **(08 Marks)**
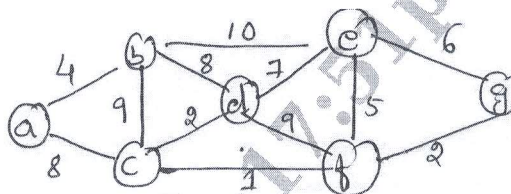

Fig. Q6 (a)

   b. Define Heap. Write Bottom-up Heap construction algorithm. **(06 Marks)**
   c. Write job sequencing with deadline algorithm. Also obtain an optimal schedule for the following jobs with n = 5. Profits = [10, 3, 3, 11, 40] and deadlines = [3, 1, 1, 2, 2] respectively. **(06 Marks)**

Module-4

7 a. Compare dynamic programming and greedy techniques. **(04 Marks)**
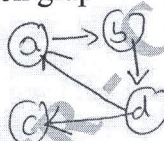   b. With an Algorithm, solve the below given graph to compute transitive closure. **(06 Marks)**

Fig. Q7 (b)

   c. Solve the below Travelling salesperson problem using Dynamic Programming Technique. Also write on algorithm and mention the time complexity.

Fig. Q7 (c)
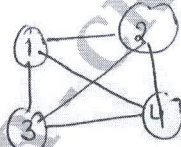
$$\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$$

(10 Marks)

OR

8 a. Construct an optimal Binary search, tree for the following four-key set:

A₁	A₂	A₃	A₄
1	4	2	1

(06 Marks)

   b. Write an algorithm for (Floyd's) computing all-pairs shortest path. Derive its time complexity. **(06 Marks)**
   c. Write a note on : (i) Reliability design   (ii) Multi-stage graphs. **(08 Marks)**

Module-5

9 a. Give the control abstraction of Back tracking. Apply Back tracking technique to solve the sum of subset problem for the given instance. S = {5, 10, 12, 13, 15, 18} and d = 30. Illustrate with possible state space tree. **(08 Marks)**
   b. Write an algorithm to generate the possible Hamiltonian cycles using Back Hacking method and solve the below instance to generate possible Hamiltonian cycles. **(08 Marks)**
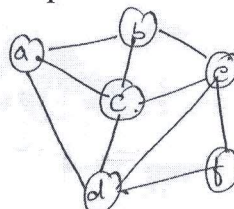
Fig. Q9 (b)

   c. Compare Branch and Bound and Back Hacking algorithm design techniques. **(04 Marks)**

OR

10 a. Solve the below instance of Job Assignment problem using Branch and Bound.

$$
\begin{array}{cccc}
\text{Job1} & \text{Job2} & \text{Job3} & \text{Job4} \\
\begin{pmatrix}
10 & 2 & 7 & 8 \\
6 & 4 & 3 & 7 \\
5 & 8 & 1 & 8 \\
7 & 6 & 10 & 4
\end{pmatrix} &
\begin{array}{l}
\text{Person a} \\
\text{Person b} \\
\text{Person c} \\
\text{Person d}
\end{array}
\end{array}
$$

(08 Marks)

b. Solve the below given instance of 0/1 knapsack problem using Branch and Bound technique.

Item	Weight	Value
1	4	$40
2	7	$42
3	5	$25
4	3	$12

(08 Marks)

c. Write a note on NP-Hard and NP complete problems.

(04 Marks)

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