USN | | | | | | | | | |
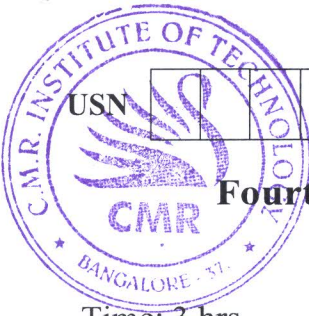
**21CS42**

## Fourth Semester B.E. Degree Examination, June/July 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.   Define algorithm. Explain the following asymptotic notations:
         i) Big On        ii) Big Omega        iii) Big Theta                    **(08 Marks)**
    b.   Design a non-recursive algorithm to find maximum element in an array of n elements. Give
         the Mathematical Analysis.                                              **(08 Marks)**
    c.   Define time and space complexity.                                       **(04 Marks)**

### OR

2   a.   Design an algorithm for performing sequential search and compute Best, Worst and Average
         case efficiency.                                                        **(08 Marks)**
    b.   Write an algorithm to find the uniqueness of element an array and give mathematical
         analysis of this non recursive algorithm with steps.                    **(08 Marks)**
    c.   List and explain basic asymptotic efficiency classes.                   **(04 Marks)**

### Module-2

3   a.   Illustrate the tracing of the Quick Sort algorithm for the following set of numbers
         5, 3, 1, 9, 8, 2, 4, 7                                                  **(10 Marks)**
    b.   Apply the topological sorting algorithm for the following graph shown in Fig.Q3(b). Find
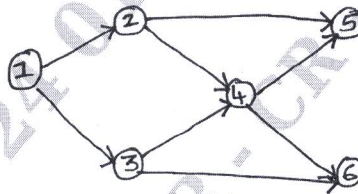         the topological sequence.



Fig.Q3(b)                                                                       **(10 Marks)**

### OR

4   a.   Write a C++/JAVA program for Merge Sort. Analyze its efficiency and apply the same to
         sort the following numbers : 4, 9, 0, –1, 6, 8, 9, 2, 3, 12.            **(10 Marks)**
    b.   Write a recursive algorithm for Binary Search and also bring out its efficiency.    **(10 Marks)**

### Module-3

5   a.   Apply greedy method to obtain an optimal solution to the knapsack problem given M = 60.
         W = {5, 10, 20, 30, 40}
         P = {30, 20, 100, 90, 160}
         Find total profit earned.                                              **(10 Marks)**

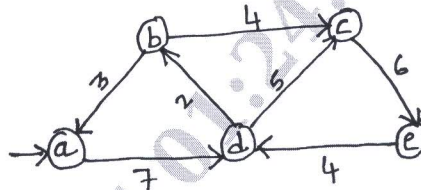b. Apply single source shortest path algorithm to the following graph Fig.Q5(b). Assume vertex 'a' as source.



Fig.Q5(b)                                                      (10 Marks)

**OR**

6  a. A message consisting of the character given in the table below has to be transmitted network in a secured manner.

| Character | A | M | R | - |
|-----------|-----|-----|-----|-----|
| Probability | 0.4 | 0.2 | 0.3 | 0.1 |

   i) Construct Huffman tree
   ii) Device Huffman codes for the given characters
   iii) Encode the text : RAMA_RAMAR
   iv) Decode the text : 1000101                               (10 Marks)

   b. Find the optimal solution using greedy for the job sequencing with dead line problem with following values:

| Job | $J_1$ | $J_2$ | $J_3$ | $J_4$ | $J_5$ |
|-----|-----|-----|-----|-----|-----|
| Profit | 10 | 3 | 33 | 11 | 40 |
| Dead line | 3 | 1 | 1 | 2 | 2 |

(10 Marks)

## Module-4

7  a. Define a Multistage Graph. Give an example. Explain the technique of finding the minimum cost path in a multistage graph.                       (10 Marks)

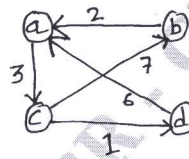   b. Write Floyd's Algorithm and find all pair Shortest path for the given graph. [Refer Fig.Q7(b)]



Fig.Q7(b)                       (10 Marks)

**OR**

8  a. Apply the Dynamic Programming to solve travelling sales person problem for the following graph shown in Fig.Q8(a).
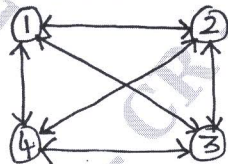


| C | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 0 | 10 | 15 | 20 |
| 2 | 5 | 0 | 9 | 10 |
| 3 | 6 | 13 | 0 | 12 |
| 4 | 8 | 8 | 9 | 0 |

Fig.Q8(a)                                                      (10 Marks)

   b. Write Horspool Algorithm for string matching. Trace the algorithm to find the pattern "ELECTION" in the text.
   "EDUCATION ONLY HELPS IN SELECTION."                         (10 Marks)

## Module-5

9  a. Construct the state-space tree for sum of subset problem given the following data:
      W = {3, 5, 6, 7}  and m = 15.                                          (10 Marks)
   b. Write C++ / JAVA program to find all Hamiltonian cycles in a connected undirected Graph
      G of n vertices using backtracking principle.                          (10 Marks)

### OR

10 a. Explain Branch and Bound concept. Apply Branch and Bound to the following instance of
      assignment problem.

|          | Job1 | Job2 | Job3 | Job4 |
|----------|------|------|------|------|
| Person A | 9    | 2    | 7    | 8    |
| Person B | 6    | 4    | 3    | 7    |
| Person C | 5    | 8    | 1    | 8    |
| Person D | 7    | 6    | 9    | 4    |

                                                                             (10 Marks)

   b. Explain the following concepts :
      i)   Graph coloring problem with an example
      ii)  NP Complete Problem
      iii) NP-Hard Class Problem                                             (10 Marks)

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