No. of Printed Pages : **2**

Sl. No.

C4-R4 : ADVANCED ALGORITHMS

NOTE :

1. Answer question 1 and any FOUR questions from 2 to 7.

2. Parts of the same question should be answered together and in the same sequence.

Total Time : 3 Hours **Total Marks : 100**

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1. (a) Solve following recurrence :

$T(n) = T(n-1) + 1$ if $n > 1$

$= 1$ if $n = 1$

(b) Binary search is a well-known divide and conquer based scheme to search an element in a sorted array. Write the steps of binary search.

(c) In context of Bellman-Ford algorithm, why relaxing edges $N-1$ times, gives us single source shortest Path ?

(d) Briefly discuss the need of dynamically expanding and contracting a table.

(e) An undirected connected graph is given with 5 vertices, A, B, C, D and E, where degrees of these vertices are 2, 4, 2, 4 and 3 respectively. Is there any possibility to have Euler's cycle in this graph ? Justify your answer.

(f) In context of Knuth-Morris-Pratt algorithm for string matching, compute the prefix function, π for following pattern :

ababbabbabbababbabb

(g) Justify the correctness of the statement : Quick sort is better than Merge sort. **(7x4)**

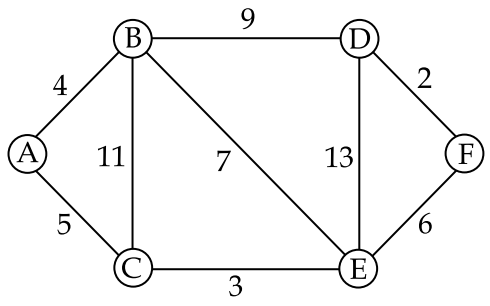
2. (a) Given 10 activities (A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9, and A_{10}) along with their start time and end/finish time respectively as follows :

$S_i = (1, 2, 3, 4, 7, 8, 9, 9, 11, 12)$

$F_i = (3, 5, 4, 7, 10, 9, 11, 13, 12, 14)$

With the constraints that an activity cannot start before its given starting time and must completed in the given end/finish time, compute the maximum number of activities that can be performed by a single person, assuming that a person can only work on a single activity at a time.

(b) Explain the basic concepts used in Dijkstra's Algorithm to identify the shortest paths from the source vertex to all the other vertices of the graph. Apply Dijkstra's Algorithm to identify the shortest paths from source vertex A to all other vertices in the graph given as follows :



(9+9)

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3. (a) Apply Strassen's matrix multiplication algorithm to multiply two matrices X and Y given as follows :

$$X = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \text{ and } Y = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

(b) You have been given a chain of four matrices A, B, C, and D of dimensions (2×4), (4×6), (6×3) and (3×2) respectively. Apply the dynamic programming-based solution of Matrix Chain Multiplication problem to fully parenthesize the product i.e. $A \times B \times C \times D$ in a way that minimizes the number of scalar multiplications. Compute the minimum number of scalar multiplications needed and the applied parenthesis. **(9+9)**

4. (a) Differentiate between Big oh, Big Omega and Big Theta.

(b) In terms of big-theta, analyse the time complexity of the algorithm A1 given as follows :

```
Algorithm A1 (int N)
{
    int K=1;
    while (K≤N)
    {
        K=K×2; // symbol × is multiplication operation.
    }
}
```

(c) In context of complexity analysis of an algorithm, discuss the importance of amortized analysis. Also discuss, Aggregate method for performing Amortized analysis. **(6+6+6)**

5. (a) In context of matchings in graphs, discuss the stable marriage problem using an example.

(b) Boyer-Moore string matching algorithm is best suitable for what type of text and pattern. Briefly discuss. Also write the algorithmic steps of the Boyer-Moore string matching algorithm. **(9+9)**

6. (a) Given an array of 8 elements as follows :
{81, 89, 9, 11, 14, 76, 54, 52}. Show all the intermediate steps to sort the given array using Heap Sort.

(b) Briefly discuss the RSA algorithm in cryptography. Also highlight its advantages and disadvantages. **(9+9)**

7. (a) Briefly discuss the 2-Approximation algorithm for travelling salesman problem (TSP) along with its proof. Also, present an example to explain different steps of the 2-Approximation algorithm for TSP.

(b) Based on the number of instruction and data streams that can be processed simultaneously, computing systems are classified into four major categories. Briefly discuss each of them. **(9+9)**

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