Ramakrishna Mission Residential College (Autonomous)
Narendrapur, Kolkata-700103
B.A./B.Sc. End Semester-IV Examinations, 2023
Subject: Computer Honours
Course Contain: Design and Analysis of algorithm
Paper Code: HCOM4CC09L

Time: 2 hours **Full marks: 50**

Section-I is compulsory. Answer any 5 questions from Section-II

Section-I

1. Answer ***any five*** questions: $[5 \times 2 = 10]$
   a) If $A(n) = a_m n^m + \cdots + a_1 n + a_0$ is a polynomial of degree m then prove that $A(n) = O(n^m)$.
   b) Solve $T(n) = 7T\left(\frac{n}{2}\right) + 18n^2$ using Master theorem.
   c) What is the advantage of Strassen's matrix multiplication over normal matrix multiplication?
   d) What is time and space complexity?
   e) What is prefix code? Give example.
   f) What do you mean by Satisfiability problem?
   g) What is a deterministic algorithm?
   h) Differentiate between Divide & Conquer and Dynamic programming paradigm.

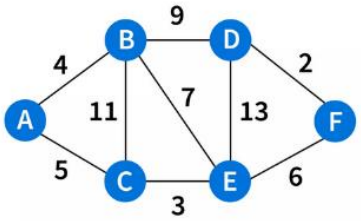
Section-II

2.
   a) Use a recursion tree to determine a good asymptotic upper bound on the recurrence $T(n) = T\left(\frac{n}{2}\right) + n^2$. Use the substitution method to verify your answer.
   b) Show that $5n^2 - 6n = \theta(n^2)$. $[(3 + 3) + 2 = 8]$

3.
   a) A set of different points are given: {(2, 3), (12, 30), (40, 50), (5, 1), (12, 10), (3, 4)}. Find the closest pair from the set of given points using divide and conquer approach.
   b) Show that $S = \left(1 + \frac{1}{n}\right)U - 3$, where S and U represent average number of comparisons in Successful and Unsuccessful search in case of Binary search with n elements. $[4 + 4 = 8]$

4. Write an algorithm to find the K-th smallest element from a set of n elements in linear time. Prove that the time complexity of your algorithm is O(n). $[5 + 3 = 8]$

5. Write a greedy algorithm to find shortest path between a pair of vertices. Apply your algorithm to find shortest path from A to F. $[4 + 4 = 8]$



6.

a) Write an algorithm to solve 0/1 knapsack problem.

b) Solve the 0/1 Knapsack instance for $n = 5$ with benefits $(p_1, p_2, \dots, p_5) = (10, 15, 6, 8, 4)$, weights $(w_1, w_2, \dots, w_5) = (4, 6, 3, 4, 2)$ and capacity $w = 12$.

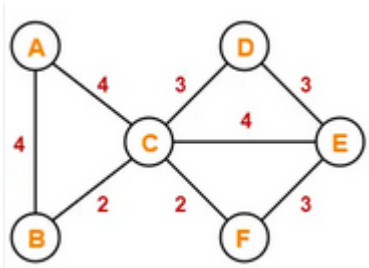
$[3 + 5 = 8]$

7. Solve matrix chain multiplication of five matrices whose dimensions are $4 \times 10, 10 \times 3, 3 \times 12, 12 \times 20, 20 \times 7$. [8]

8.

a) Define Spanning tree and Minimal Spanning Tree (MST) of a weighted graph.

b) Use Prims's algorithm to find the MST of the following graph. $[3 + 5 = 8]$



9. Write Short note (***any two***): $[4 \times 2 = 8]$

A) Huffman Coding

B) Randomized Algorithm

C) Backtracking

D) Longest Common Subseqence (LCS)

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