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No. of Printed Page : 5 MCS-031

MCA (REVISED)

Term-End Examination, 2019

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours] [Maximum Marks : 100

Note : Question number **1** is **compulsory**. Attempt **any three** questions from the rest.

1. (a) Multiply the following two matrices using Strassen's algorithm : [5]

$$\begin{bmatrix} 5 & 6 \\ -4 & 3 \end{bmatrix} \text{ and } \begin{bmatrix} -7 & 6 \\ 5 & 9 \end{bmatrix}$$

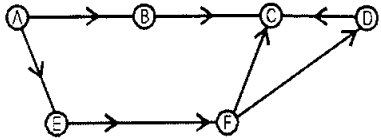
(b) Explain Quick sort algorithm using suitable example. [5]

(c) Prove that running time of $T(n) = n^3 + 20n + 1$ is $O(n^3)$. [5]

(d) Explain Push Down Automata (PDA) with suitable examples. [5]

(e) Define fractional Knap sack problem and give a greedy algorithm to solve this problem efficiently. [5]

(f) Find the topological ordering of the following graph : [5]



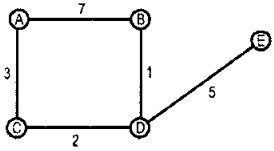
(g) Consider the following Context Free Grammar (CFG) :

$$\begin{pmatrix} S \leftarrow SS \mid XaXaX \mid \wedge \\ X \rightarrow bX \mid \wedge \end{pmatrix}$$

Explain the language generated by CFG. [5]

(h) What is an algorithm ? Explain characteristics of an algorithm with the help of an example. [5]

2. (a) What is Minimum Spanning tree ? Write Prim's algorithm for finding minimum spanning tree and find its time complexity. Also find MST of the following graph using Prim's algorithm : [10]



(b) Define Halting Problem of Turing Machine with an example. [5]

(c) Show that there does not exist algorithm for deciding whether or not $L(G_A) \bigcap L(G_B) = \phi$ for arbitrary context free grammars G_A and G_B. [5]

3. (a) Prove that running time of binary search algorithm in worst case is $O(\log_2 n)$. [5]

(b) Explain how 0|1 Knapsack problem can be solved using Dynamic Programming. [5]

(c) What is "Principle of optimality" in Dynamic programming ? Explain how dynamic programming can be used to solve a chain of Matrix Multiplication. Apply Dynamic Programming to multiply the following fair Matrices: [10]

$\langle M_1, M_2, M_3, M_4 \rangle$ with dimensions

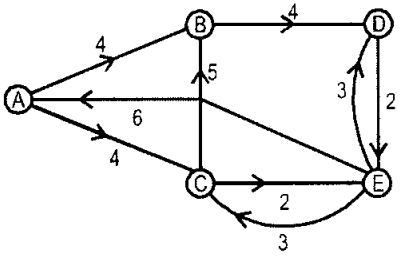
$\langle (15,3), (3,8), (8,9), (9,7) \rangle$

4. (a) Differentiate between class P, NP and NP-complete problems. [6]

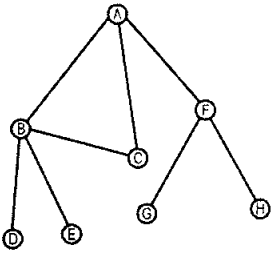
(b) Show a polynomial time reduction from the clique problem to the vertex cover problem by giving an example. [9]

(c) Write Euclid's algorithm for finding Greatest Common Divisor (GCD) of two natural numbers M and N. [5]

5. (a) Represent the following graph using (i) Array; and (ii) Adjacency list [6]



(b) Trace how Depth First Search Traverses the following Graph when starting at node A : [9]



(c) If L_1 and L_2 are Context Free Language (CFL), Prove that $L_1 \cup L_2$ is also Context Free. [5]

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