No. of Printed Pages : 4

MCS-031

MASTER OF COMPUTER APPLICATION (MCA) (REVISED)

Term-End Examination

June, 2022

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours *Maximum Marks : 100*

Note : *Question* ***No. 1*** *is compulsory. Attempt any* ***three*** *questions from the remaining questions.*

1. (a) Write an algorithm that finds the real roots, if any, of a quadratic equation : 5

$$ax^2 + bx + c = 0$$

where a, b and c are real numbers.

(b) Write and explain recursive algorithm to find the factorial of any given number $n \geq 0$. 5

(c) Prove that $f(x) = 2n^3 + 3n + 5$ is $O(n^3)$, where O indicates "Big-oh" notation. 5

P. T. O.

(d) Show that Strassen's matrix multiplication method takes O $\left(n^{2.81}\right)$ to multiply two matrices A and B of order ($n \times n$). 5

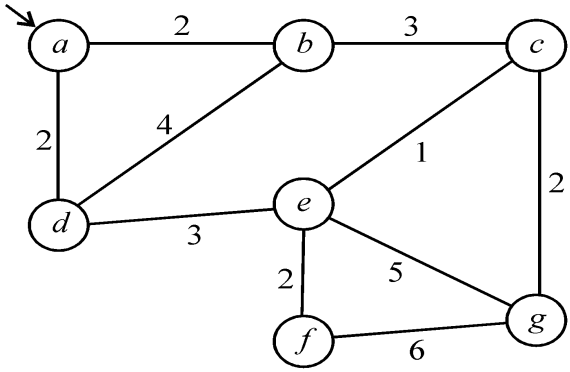
(e) Differentiate between Divide and Conquer, and dynamics programming technique for solving problems. 5

(f) Write binary search algorithm and find its time complexity in the worst case. 5

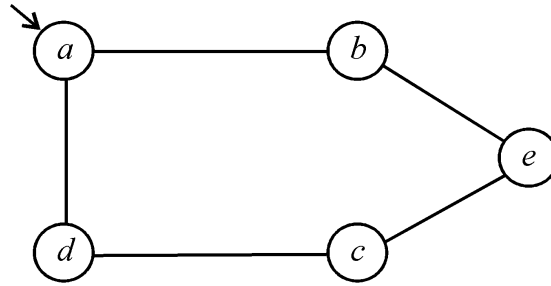
(g) What is Push Down Automata ? How is it different from Finite Automata ? 5

(h) Write a regular expression and design a finite automata to generate all strings of odd lengths over the alphabet $\Sigma = \{a, b\}$. 5

2. (a) Write Prim's algorithm for finding minimum cost spanning tree (MST). Obtain the minimum cost spanning tree (MST) for the following graph using Prim's algorithm ('a' is starting vertex) : 10



(b) Define a Breadth-First Search (BFS). Give the breadth first traversal for the undirected graph given below starting from vertex '*a*'., 5



(c) Multiply 2345 × 1263 using Karatsuba's method. 5

3. (a) Sort the following elements using Heap sort : 10

10, 28, 46, 39, 15, 12, 18, 9, 56, 2

Show each step involved in creation and processing of heap.

(b) Explain how dynamic progamming can be used to solve matrix chain multiplication. Apply the algorithm to multiply the following : 10

4 matrices < M_1, M_2, M_3, M_4 > with dimensions < (15, 3) (3, 10), (10, 2), (2, 5) >.

4. (a) Write the Context-Free Grammar (CFG) for the following : 10

(i) $L = \{a^n b^m c^m : n, m \geq 1\}$

(ii) $L = \{a^n b^n c^m d^m : m, n \geq 0\}$

(b) What is NP-complete problem ? Is it necessary that every NP-complete problem must also be a NP-hard problem ? Justify. 5

(c) Explain Chomsky's classification of grammars. 5

5. (a) Explain the term 'polynomial time reduction'. Explain how the CLIQUE problem can be transformed to the vertex cover problem (VCP). 10

(b) Design a Turing Machine (TM) for the language :

$$L\{\omega \subset w^R : \omega \in \{a, b\}^*\}$$

where ω^R is the reverse of ω. 5

(c) What is undecidability ? Give an example for an undecidable problem. 5