Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 10840

M.C.A. DEGREE EXAMINATIONS, APRIL/MAY 2023.

First Semester

MC 4101 – ADVANCED DATA STRUCTURES AND ALGORITHMS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define algorithm and mention the properties of algorithm.

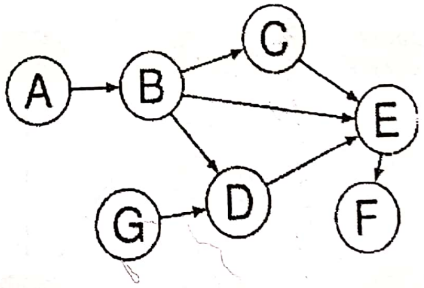
2. Identify the space needed during execution of the algorithm which computes the product of the elements in an array recursively.

3. Consider the following set of elements in max heap represented in the form of an array. What is the content of this array after sorting two elements using heap sort? [25, 23, 19, 21, 20, 7, 15, 12]

4. Write down the properties of Red Black trees.

5. List out the steps in Floyd-Warshall algorithm.

6. Write down the vertices in the following graph in topological ordering.



7. Differentiate greedy and dynamic programming techniques.

8. Specify longest common subsequences of the following sets.

$S1 = \{B, C, D, A, A, C, D\}$

$S2 = \{A, C, D, B, A, C\}$

9. Draw a diagram showing the relationship between *P*, *NP*, *NP* hard and *NP* complete problems?

10. When can we say an algorithm takes polynomial time?

PART B — (5 × 13 = 65 marks)

11. (a) List out the asymptotic notations and explain each in detail with necessary examples.

Or

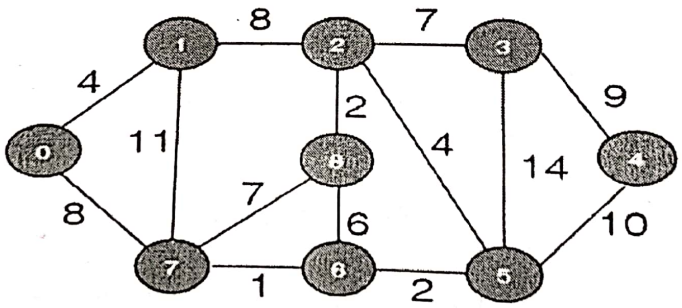
(b) Write an iterative algorithm for finding Frobenius norm of matrix and determine polynomial equation representing time complexity of the algorithm by finding the frequency of each statement. The Frobenius norm is defined as the square root (use sqrt function in the algorithm) of the sum of the squares of all elements in the matrix. For matrix A with r rows and c columns, the Frobenius norm is given as, $\| A \|_F = \sqrt{\sum_{i=1}^{r} \sum_{j=1}^{c} A_{ij}^2}$.

12. (a) Explain various cases of deletion in binary search trees with an example for each.

Or

(b) Write about left rotation and right rotation in red black trees and also write algorithms for the same.

13. (a) List out the steps in Kruskal's algorithm and apply on the following graph to construct minimum cost spanning tree. Show step by step construction of the tree.



Or

(b) Write depth first search algorithm and apply it on the following graph represented as an adjacency matrix $\begin{vmatrix} 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 \end{vmatrix}$.

14. (a) Suppose A, B, C, D, E, F, G and H are 8 data items and are assigned with frequencies as follows:

A	B	C	D	E	F	G	H
22	5	11	19	2	13	25	6

Generate Huffman code for all the data items by showing the construction of the tree at each step.

Or

(b) Write greedy algorithm for activity selection problem and apply it on the following set of activities. Each activity is associated with start time and end time.

S = (A1 A2 A3 A4 A5 A6 A7 A8 A9 A10)

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

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

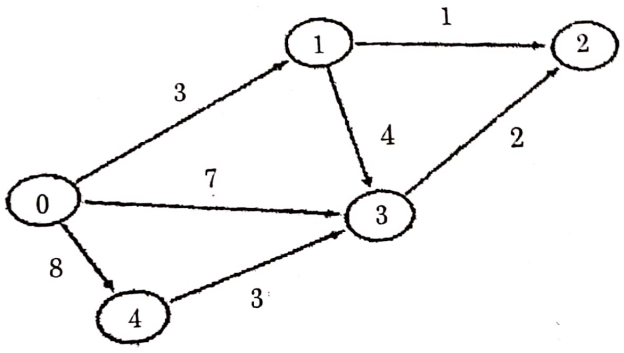
15. (a) Explain reducibility with an example.

Or

(b) Prove that clique decision problem is NP-Complete.

PART C — (1 × 15 = 15 marks)

16. (a) Apply Dijikstra's algorithm on the following graph and show the shortest from vertex 0 to all other vertices in the graph. Show the content of all the arrays at each step.



Or

(b) Consider that you are given a sequence {4, 10, 3, 12, 20}. The matrices have sizes 4 × 10, 10 × 3, 3 × 12 and 12 × 20. Compute minimum of multiplication operations $M[i, j]$ where $1 \leq i, j \leq 4$.

10840