MASTER OF COMPUTER APPLICATIONS
(MCA–NEW)
Term-End Examination
June, 2025

MCS–211 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours   *Maximum Marks : 100*

Weightage : 70%

Note : *Question No. **1** is compulsory and carries 40 marks. Attempt any **three** questions from the rest.*

1. (a) Define algorithm. State any *four* important characteristics of an algorithm. 5

     (b) Write linear search algorithm and do analysis of this algorithm for best case and worst case. 5

(c) Solve the following recurrence equation : 5

$$T(n) = T\left(\frac{n}{2}\right) + n \quad \text{for } n > 1$$

$$T(n) = 1 \qquad \text{for } n = 1$$

(d) What is NP class of problem ? Explain with the help of an example problem. 5

(e) What is Adjacency matrix ? Write adjacency matrix for the following graph : 5
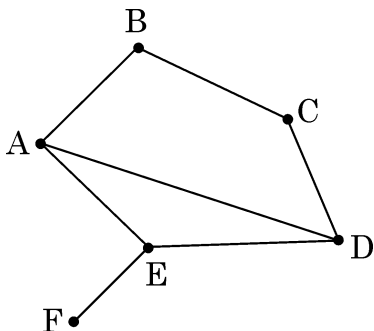
(f) Define the big theta notation. Show that : 5

$$n^2 + 3\log n = \theta(n^2)$$

(g) Consider the following four matrices and their dimensions :   5

$$A(2; 4) \quad B(4,5) \quad C(5,3) \quad D(3,5)$$

Find the optimal parenthesization of matrix-chain multiplication $A \times B \times C \times D$.

(h) Explain the working principle of Floyd-Warshall's algorithm.   5

2. (a) Explain Strassen's Matrix Multiplication Algorithm and apply the same to multiply the following two matrices :   10

$$A = \begin{bmatrix} 5 & 6 \\ -4 & 3 \end{bmatrix}, B = \begin{bmatrix} -7 & 6 \\ 5 & 9 \end{bmatrix}$$

(b) Write an algorithm for quick sort. Sort the following sequence of numbers using quick sort :

15, 10, 13, 9, 12, 7

Analyze the time complexity of quick sort in best and worst case.   10

3. (a) Write an algorithm for merge sort and analyse its best and worst case run time complexity.   10

(b) Write and explain Prim's algorithm and use it to find a minimal spanning tree for the graph given below :   10
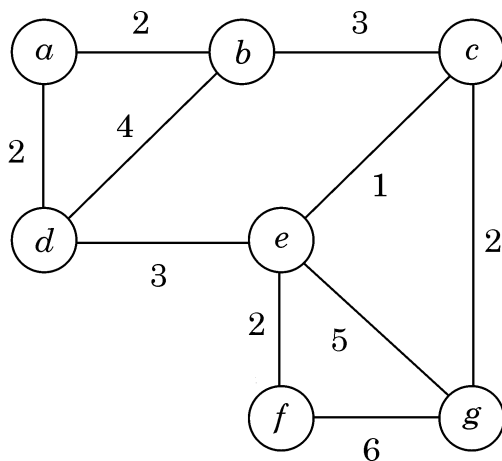
4. (a) Write an algorithm for solving fractional Knapsack problem. Using this algorithm, solve the following fractional Knapsack problem :   10
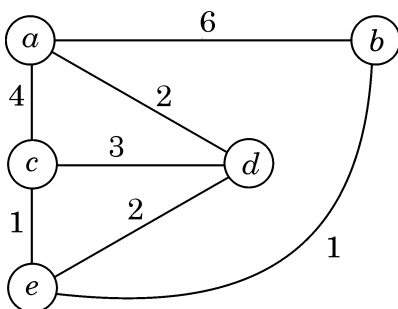
Capacity of Knapsack : 5 kg

Number of items : 5

Objects	Weight (kg)	Profit
1	2	10
2	3	5
3	5	15
4	7	7
5	1	6

(b) Write Dijkstra's algorithm and use it to find the minimum distance of all the nodes from node 'b' which is taken as the source node, for the following graph : 10

5. (a) Differentiate between NP-complete and NP-hard problem. State CLIQUE problem and vertex-cover problem.   10

   (b) Explain the use of master method. Write and interpret all the three cases of the master method to solve recurrence relation problem.   10

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