No. of Printed Pages : 5 **MMTE–002**

M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) [M. SC. (MACS)]

Term-End Examination

June, 2025

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 Hours *Maximum Marks : 50*

Note: *Attempt any* ***four*** *questions from question nos.* ***1*** *to* ***6****. Question No.* ***7*** *is compulsory.*

1. (a) Sort the following numbers using the merge sort algorithm, showing all the steps you use in the process : 5

15, 32, 88, 70, 60, 23, 78, 25, 42, 37

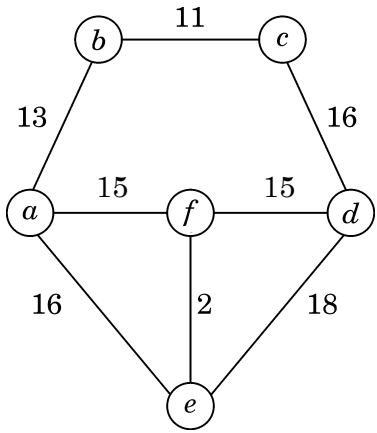
(b) Construct a (2, 4) B-tree by inserting the following numbers in the order given. Show all the steps you have used in the process : 5

4, 1, 3, 2, 8, 7, 9, 6, 5, 11

2. (a) Construct a Huffman code for the following data, showing all the steps : 5

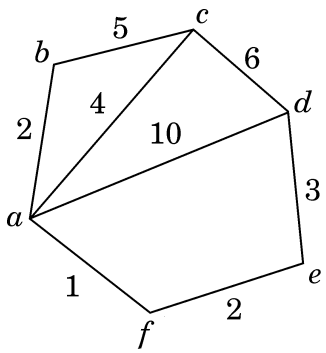
Character	A	B	C	D	E
Probability	0.4	0.1	0.2	0.15	0.15

(b) Find the minimum spanning tree of the following graph using Prim's algorithm, explaining all the steps : 5



3. (a) Find the longest common subsequence of the sequences X = < B, C, D, C, E, B, C > and Y = < C, E, D, B, C, B > using dynamic programming, showing all the steps. 5

   (b) Using Dijkstra's algorithm, find the distances of all the vertices from '*a*', in the weighted graph given below : 5



4. (a) Show the steps in the dynamic programming algorithm to find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is as follows : 5

Matrix	Dimension
A_1	5×10
A_2	10×3
A_3	3×12
A_4	12×5

(b) Give examples of the following : 2.5×2=5

(i) A problem for which the dynamic programming technique out-performs Greedy approach.

(ii) A problem for which Greedy approach outperforms dynamic programming technique.

5. (a) Write the pseudo code for Bubble sort. Derive its running time. 5

(b) Write an algorithm to delete an internal node from a binary search tree. 5

6. (a) Find a general solution to the recurrence $a_n = 3a_{n-1} - 4a_{n-3}$, $n \geq 1$. Find the solution, given the initial conditions $a_1 = 1$, $a_2 = 1$, $a_3 = 1$. 6

(b) Consider the given orders of a binary tree :

Postorder : D, H, E, B, F, G, C, A

Preorder : A, B, D, E, H, C, F, G

Construct the equivalent binary tree. Demonstrate all the steps involved. 4

7. Which of the following statements are true and which are false ? Justify your answer with a short proof or a counter-example :

5×2=10

(a) The worst case running time for the quick sort algorithm is $O(n \log n)$.

(b) The min-heap is a binary search tree.

(c) The minimum spanning tree of any graph is unique.

(d) $n ! = O(n^n)$

(e) Every NP-complete problem is also a NP-hard problem.

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