

MMTE-002

ASSIGNMENT BOOKLET
(Valid from 1st January, 2025 to 31st December, 2025)

M.Sc. (Mathematics with Applications in Computer Science)
Design and Analysis of Algorithms (MMTE-002)



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(2025)

Dear Student,

Please read the section on assignments in the Programme Guide that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

- 1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO :.....
NAME :.....
ADDRESS :.....
.....
.....

COURSE CODE:
COURSE TITLE :
ASSIGNMENT NO.
STUDY CENTRE: DATE:

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

- 2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
- 3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
- 4) Your answers should be precise.
- 5) While solving problems, clearly indicate which part of which question is being solved.
- 6) This assignment is **valid from 1st Jan, 2025 to 31st Dec, 2025**. If you have failed in this assignment or fail to submit it by Dec, 2025, then you need to get the assignment for the year 2026, and submit it as per the instructions given in the Programme Guide.
- 7) **You cannot fill the examination form for this course** until you have submitted this assignment.

We strongly suggest that you retain a copy of your answer sheets.

We wish you good luck.

Assignment

Course Code: MMTE-002
Assignment Code: MMTE-002/TMA/2025
Maximum Marks: 100

1. a) Define and explain the Big-O, Big - Ω and Big - Θ notations with examples. (6)
- b) Explain the string matching problem with an example. (2)
- c) Explain the Longest Common Subsequence problem with an example. (2)
2. a) Sort the following numbers using the QuickSort algorithm: (5)

2, 9, 7, 6, 4, 3, 8, 5
- b) Construct a Binary Search Tree for the following sequence of numbers: (5)

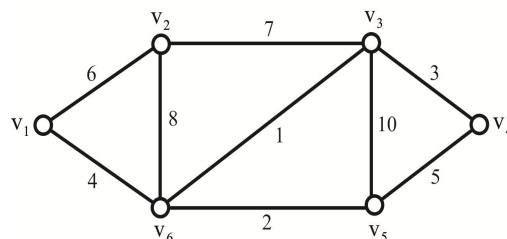
15, 50, 70, 60, 20, 90, 10, 40, 100, 35

with 40 as the value of the key for the root node.
3. a) Show the results of inserting the keys below in order into an empty B-tree of minimum degree 2: (5)

2, 5, 4, 3, 6, 9, 8, 7, 1, 2
- b) Determine the LCS of (1, 1, 1, 1, 1, 0, 0, 1, 1, 1) and (1, 0, 1, 0, 0, 1, 1, 0, 1, 0) using dynamic programming approach, showing all the steps. (5)
4. a) Find an optimal parenthesisation of a matrix chain whose sequence of dimensions is (5, 10, 3, 12, 15). (5)
- b) Let $m \in \mathbb{N} \cup \{0\}$ and $n \in \mathbb{N}$. Let the gcd of $x, y \in \mathbb{Z}$ be denoted by (x, y) . Prove that $(m, n) = (m \pmod n, n)$. (5)
5. a) Construct the Huffman code tree for the set of frequencies in the table below: (5)

Character	Frequency
A	5
B	1
C	6
D	3
E	4

- b) Find an optimal parenthesisation of the matrix chain product whose sequence of dimensions is 10, 25, 10, 5, 17. (5)
6. a) Find a minimal spanning tree for the following graph using the Prim's algorithm, showing all the steps. Take v_1 as the root. (5)



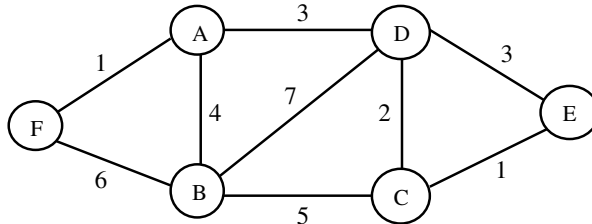
What is the weight of the minimal spanning tree you get? Give reasons for your answer.

- b) Find the Huffman code for the following set of characters: (5)

Character	a	b	c	d	e	f
Frequency	50	30	20	12	5	3

Show all the steps of the algorithm. Also compute the number of bits require to encode the data.

7. a) Find the minimum spanning tree for the following graph using Kruskal's algorithm: (5)

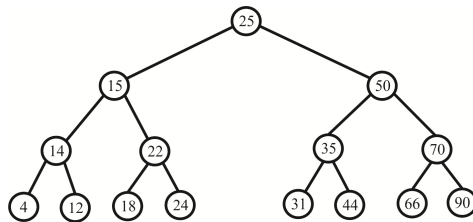


- b) Let $\alpha = 352, b = 671$. Find s and t such that $as + bt = \gcd(a, b)$. Show the steps of the algorithm. (5)

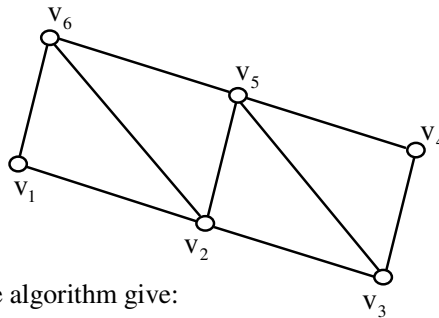
8. a) Illustrate the working of the function PARTITION of the quicksort algorithm using the array and using the last element as PIVOT: (5)

$\langle 35, 22, 11, 45, 26, 71, 82, 37 \rangle$

- b) Write the steps to search the numbers 18 and 45 in the binary search tree: (5)



9. a) Explain the breadth first search algorithm using the graph given below with v_1 as the source vertex: (7)



For each stage of the algorithm give:

- $d(v), \pi(v)$ for each vertex, where $d(v)$ is the distance from the source to the vertex v and is the predecessor of v .
- White and gray vertices
- Vertices in the queue

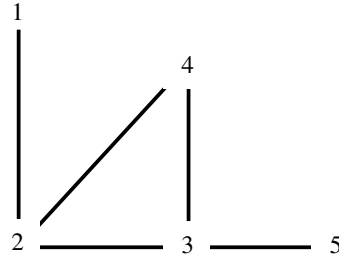
Also, give the breadth search tree.

- b) Check whether the following array represents a max-heap. If not run an algorithm to convert it into a max-heap: (3)

6, 20, 18, 15, 17, 11, 12, 13

10. a) Illustrate, giving all the steps, the operation of the counting sort algorithm on the array $A = \langle 7, 1, 3, 1, 2, 4, 5, 7, 2, 4, 3 \rangle$. (5)

- b) Consider the following undirected graph G with vertices labeled from 1 to 5: (5)



Determine if there exists a clique of size 3 in the graph G . If yes, provide the vertices forming the clique.