MMTE-002

ASSIGNMENT BOOKLET
(Valid from 1ˢᵗ January, 2026 to 31ˢᵗ December, 2026)

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

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THE PEOPLE'S
UNIVERSITY

School of Sciences
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Maidan Garhi, New Delhi-110068
(2026)

Dear Student,

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

Instructions for Formating 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 :…………………………………………

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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., 2026 to 31st Dec., 2026**. If you have failed in this assignment or fail to submit it by Dec., 2026, then you need to get the assignment for the year 2027 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 assignments

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

We wish you good luck.

Assignment (MMTE-002)

1. a) Write an algorithm to find the first two largest numbers in an in array of integers. For example, given the input $\langle 2, 3, 7, -4, 5, 1 \rangle$, the algorithm should output $7, 5$. State precisely a loop invariant for you algorithm. Prove that your loop invariant holds and hence conclude that your algorithm works. (5)

    b) Analyse the algorithm to find the upper bound for run time of the above algorithm. (5)

2. a) With the help of an example, explain the following:

    i)   Algorithm,
    ii)   Input and output for an algorithm
    iii) Running time of an algorithm (5)

    b) Illustrate the operations of partition in quick sort on the array

    $A = \{4, 11, 9, 6, 13, 10, 7, 14, 5, 3, 8\}$. (5)

3. a) Show step by step how you will construct a binary search tree by inserting keys in the order $12, 6, 4, 7, 8, 10, 7, 5, 13, 16, 11,$ starting from an empty binary tree. Explain step by step how you will delete the node with the key 13 from the binary tree. (5)

    b) Illustrate the operations of performing counter sort on the array $A = \{3, 3, 2, 3, 1, 6\}$. (5)

4. a) Show the results of inserting the keys

    $C, R, A, U, J, S, F, T, O, P, M, L, N, W, Q$

    in order into an empty B-tree with minimum degree 2. Only draw the configurations of the tree just before some node must split, and also draw the final configuration. (5)

   b) Using bipartite checking algorithm find out whether the graph given below is bipartite or not. (5)
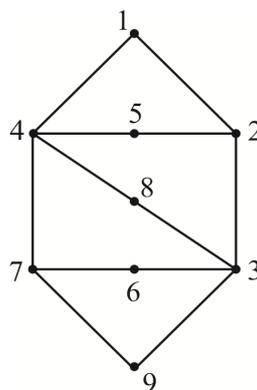
5. a) Show step by step how the merge procedure of merge sort will merge the arrays $1, 3, 4, 7, 9, 11, 13, 14$ and $2, 5, 6, 8, 10, 12$. (3)

    b) For the following set of points, describe how the CLOSET-PAIR algorithm finds a closest pair of points:

$$(1, 2), (2, -1), (3, -3), (3, 2), (-3, 4), (-1, 2), (2, 3), (1,1), (-5, -2).$$ (3)

    c)   Find an optimal parenthesisation of a matrix chain product whose sequence of dimensions is (4, 8, 7, 2, 3). (4)

6. a)   Taking v_1 as the root, find a spanning tree of the following graph using the breadth first search (BFS) algorithm. (5)
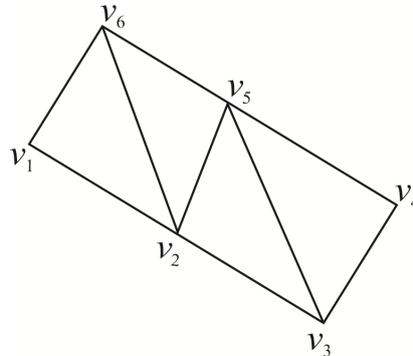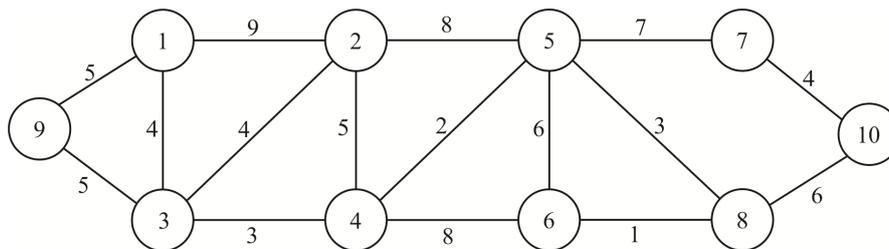

    b)   Determine an LCS of (1, 1, 1, 1, 0, 1,1, 0, 1, 0) and (1, 1, 1, 0, 0, 1, 1, 0, 1, 0). (4)
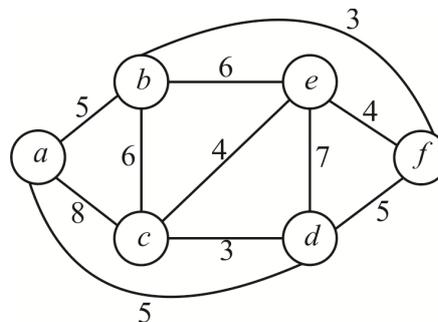
7. a)   Apply DFS algorithm to find a spanning tree of the following graph. Also find all the fundamental cycles of the spanning tree. (7)
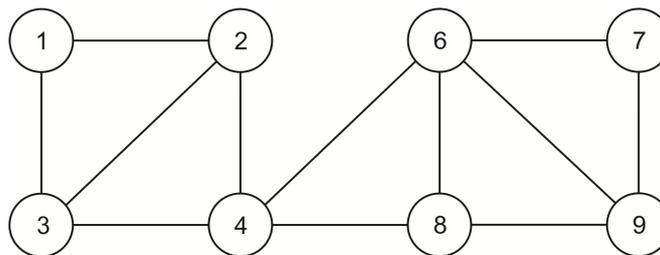
    b)   Use Kruskal's algorithm to find a minimal spanning tree in the graph given below (7)

    c)   Use Dijkstra's algorithm to find the shortest paths in the graph given below with a as the source vertex. (6)

8. a)   Construct a MAXHEAP tree on the following list of numbers
        15, 22, 7, 10, 43, 52, 13, 16. (5)

b) Construct a binary search tree with the following keys, inserting them in the given order:
110, 8, 19, 6, 9, 12, 32.   (5)

9. 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) Show the minimum heap after each of the following operations   (5)
  i)   Create with values 13, 46, 68, 15, 87, 4, 33, 21, 1, 79.
  ii) Insertion of value 9.
  iii) Update of value 1 by 71.