MMTE-007

ASSIGNMENT BOOKLET

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

M.Sc. (Mathematics with Applications in Computer Science)

SOFT COMPUTING AND ITS APPLICATIONS (MMTE-007)

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
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 :……

……

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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, 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
(To be done after studying all the blocks)

Course Code: MMTE-007
Assignment Code: MMTE-007/TMA/2025
Maximum Marks: 100

1. a) List the elements of the following sets described by rule method: (6)

   i) $A = \{n \in N : n \text{ is odd prime less than } 200\}$

   ii) $B = \{x \in R : x^2 - 9x + 18 = 0\}$

   iii) $C = \{\max\{a,b\} : a, b \text{ are twin primes } \leq 200\}$

   b) Consider a subset of natural numbers from 1 to 30, as the universe of discourse, U. Define the fuzzy sets "small" and "medium" by enumeration. (4)

2. Let A and B are two fuzzy sets and $x \in U$, if $\mu_A(x) = 0.4$ and $\mu_\beta(x) = 0.8$ then find out the following membership values: (10)

   i) $\mu_{A \cup B}(x)$, ii) $\mu_{A \cap B}(x)$, iii) $\mu_{\overline{A} \cup \overline{B}}(x)$,

   iv) $\mu_{\overline{A} \cap \overline{B}}(x)$, v) $\mu_{\overline{A \cup B}}(x)$, vi) $\mu_{\overline{A \cap B}}(x)$,

3. a) Define Error Correction Learning with examples. (5)

   b) Write the types of Neural Memory Models. Also, give one example of each. (5)

4. a) Construct the $\alpha-$cut at $\alpha = 0.4$ for the fuzzy sets defined in Q. 1(b). (5)

   b) Apply the "very" hedge on the fuzzy sets defined in Q. 1(b) to get the new modified fuzzy sets. Show the modified fuzzy sets through numeration. (5)

5. Consider a dataset of six points given in the following table, each of which has two features f_1 and f_2. Assuming the values of the parameters c and m as 2 and the initial cluster centers $v_1 = (5,5)$ and $v_2 = (10,10)$, apply FCm algorithm to find the new cluster center after one iteration. (10)

	f_1	f_2
x_1	3	11
x_2	3	10
x_3	8	12
x_4	10	6
x_5	13	6
x_6	13	5

6. a) Define Kohonen networks with examples. (5)

b) Describe the Function Approximation in MLP. Also, explain Generalization of MLP. (5)

7. Consider the set of pattern vectors P. Obtain the connectivity matrix (CM) for the patterns in P (four patterns). (10)

$$p = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

8. a) State the Schema theorem. (2)

b) Improve the solution of the following problem using the genetic algorithm:

Maximize $f(x) = \sqrt{x}$, subject to $1 \le x \le 25$ by considering the length of the string 4. Show only one iteration. (5)

c) Give an example of Radial Basis Function Network and draw its network diagram. (3)

9. a) Design a Hopfield Network for 4-bit bipolar patterns. The training patterns are (7)

$$S_1 = [1 \quad 1 \quad -1 \quad -1]$$
$$S_2 = [-1 \quad 1 \quad -1 \quad 1]$$
$$S_3 = [-1 \quad -1 \quad -1 \quad 1]$$

Find the weight matrix and energy for the three input samples. Determine the pattern to which the sample $S = [-1 \quad 1 \quad -1 \quad -1]$ associates.

b) Using max-min composition, find the relation between R and S: (3)

$$R = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array} \begin{array}{c} \begin{array}{ccc} y_1 & y_2 & y_3 \end{array} \\ \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \end{array} \quad \text{and} \quad S = \begin{array}{c} \\ y_1 \\ y_2 \\ y_3 \end{array} \begin{array}{c} \begin{array}{cc} z_1 & z_2 \end{array} \\ \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \end{array}$$

10. a) Consider a Kohonen self-organizing net (given below) with two cluster units and five input units. The weight vectors for the cluster units are given by (7)

$$w_1 = \{1.0, 0.9, 0.7, 0.5, 0.3\}$$
$$w_2 = \{0.3, 0.5, 0.7, 0.9, 1.0\}$$

Use the square of the Euclidean distance to find the winning cluster unit for the input pattern (x)

$$x = [0.0 \quad 0.5 \quad 1.0 \quad 0.5 \quad 0.0].$$

Using learning rate of 0.25, find the new weights for the winning unit.

b) Differentiate between the effects of operator crossover and mutation in the genetic algorithm with suitable example. (3)