MMTE-007

# ASSIGNMENT BOOKLET

(Valid from 1st January, 2024 to 31st December, 2024)

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

2024

Dear Student,

Please read the section on assignments and evaluation in the Programme Guide for Elective courses that we sent you after your enrolment. A weightage of 20 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 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:

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ROLL NO :……………………………………………

NAME :……………………………………………

ADDRESS :……………………………………………

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COURSE CODE: …………………………….

COURSE TITLE : …………………………….

ASSIGNMENT NO. ………………………….…

STUDY CENTRE: ………………………..….. DATE:

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**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 to be submitted to the Programme Centre as per the schedule made by the programme centre. Answer sheets received after the due date shall not be accepted.
We strongly suggest that you retain a copy of your answer sheets.

7) This assignment is valid only upto December, 2024. For submission schedule please read the section on assignments in the programme guide. If you have failed in this assignment or fail to submit it by December, 2024, then you need to get the assignment for the session 2025 and submit it as per the instructions given in the programme guide.

We wish you good luck.

# Assignment (MMTE-007)

**Course Code: MMTE-007**
**Assignment Code: MMTE-007/TMA/2024**
**Maximum Marks: 100**

1. a) Two sensors based upon their detection levels and gain settings are compared. The following of gain setting and sensor detection levels with a standard item being monitored provides typical membership values to represent the detection levels for each of the sensors. (6)

| Gain Setting | Sensor 1 detection levels | Sensor 2 detection levels |
|---|---|---|
| 0 | 0 | 0 |
| 20 | 0.5 | 0.35 |
| 40 | 0.65 | 0.5 |
| 60 | 0.85 | 0.75 |
| 80 | 1 | 0.90 |
| 100 | 1 | 1 |

The universe of discourse is $x = \{0, 20, 40, 60, 80, 100\}$. Find the membership function for the two sensors. Also, verify De-morgon's laws for these membership functions.

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. 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)

3. 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) $\mu_{\overline{A\cap B}}(x)$,

4. 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 |

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

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

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

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

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

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

8. a) Find the length and order of the following schema: (6)

   i) $S_1 = (1 ** 0\ 0 * 1 * *)$

   ii) $S_2 = (* 0\ 0 * 1 * *)$

   iii) $S_3 = (** * 1 * * *)$

   b) Let an activation function be defined as (4)

$$\phi(v) = \frac{1}{1+e^{-av}}, a > 0$$

   Show that $\frac{d\phi}{dv} = a\phi(v)[1-\phi(v)]$. What is the value of $\phi(v)$ at the origin? Also, find the value of $\phi(v)$ as $v$ approaches $+\infty$ and $-\infty$.

9. a) Consider the following travelling salesman problem involving 9 cities. (4)

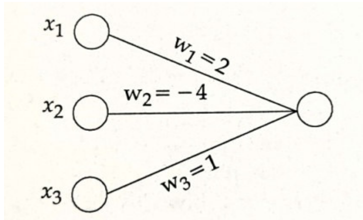
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parent 1 | G | J | H | F | E | D | B | I | C |
| Parent 2 | D | C | H | J | I | G | E | F | B |

   Determine the children solution using.

   i) Order crossover #1, assuming $4^{th}$ and $7^{th}$ sites as the crossover sites.

   ii) Order crossover #2, assuming $3^{rd}$, $5^{th}$ and $7^{th}$ as the key positions.

b) Consider the following single layer perception as shown in the following figure. (6)




and the activation function of each unit is defined as $\Phi(v) = \begin{cases} 1, \text{ if } & v \geq 0 \\ 0, \text{ otherwise.} \end{cases}$

Calculate the output y of the unit for each of the following input patterns:

| Patterns | $P_1$ | $P_2$ | $P_3$ | $P_4$ |
|---|---|---|---|---|
| $x_1$ | 1 | 0 | 1 | 1 |
| $x_2$ | 0 | 1 | 0 | 1 |
| $x_3$ | 0 | 1 | 1 | 1 |

Also, find the modified weights after one iteration.

10. Which of the following statements are true or false? Give a short proof or a counter example in support of your answers. (10)

a) There is chance of occurrence of the premature convergence in Roulett-wheel selection shceme used in GA.

b) Gradient based optimization methods are used when the objective function is not smooth and one needs efficient local optimization.

c) The $\alpha-$cut of a fuzzy set A in $\bigcup$ is defined as $A\alpha_0 = \{x \in \bigcup | \mu_A(x) \leq \alpha_0\}$

d) A single perception with preprocessing is neither an auto associative network nor a multiple layer neural network.

e) If $W(k_0) = W(k_0 + 1) = W(k_0 + 2)$, then perception is non-linear separable.