

MMTE-007

ASSIGNMENT BOOKLET
(Valid from 1st July, 2021 to 30th June, 2022)

M.Sc. (Mathematics with Applications in Computer Science)
SOFT COMPUTING AND ITS APPLICATIONS (MMTE-007)



School of Sciences
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Maidan Garhi, New Delhi-110068

2021-22

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:

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 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 June, 2022. 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 June, 2022, then you need to get the assignment for the session 2022-23 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/2021-22
Maximum Marks: 100

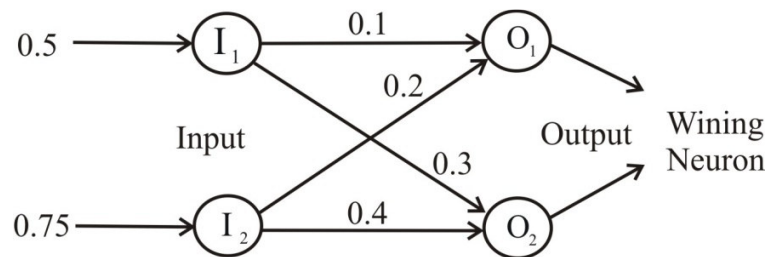
1. State whether the following statements are True or False. Give short proof or a counter example in support of your answer. (10)

- a) Self-organizing system is a special class of artificial neural network based on competitive learning.
- b) The length of chromosomes to determine the maximum value of the set (S)
 $S = \{X \mid 0 \leq x \leq 4096\}$ is 12.
- c) If $\alpha_1 > \alpha_2$, then the subset relation is $A\alpha_1 \supseteq A\alpha_2$.
- d) Only linearly separable data can be classified by multilayer perceptron.
- e) If $w(k_0) = w(k_0 + 1) = w(k_0 + 2)$, then perceptron is non-linear separable.

2. a) Check whether the Fuzzy relation

$$R = \begin{bmatrix} 1 & 0.6 & 0 & 0.2 \\ 0.6 & 1 & 0.4 & 0 \\ 0 & 0.4 & 1 & 0 \\ 0.2 & 0 & 0 & 1 \end{bmatrix} \text{ is an equivalence relation.} \quad (5)$$

b) Write the algorithm for training a Kohonen network. Calculate the output of each neuron, for the Kohonen network shown below. (5)



3. a) Illustrate the steps involved in genetic algorithm to minimize $f(x) = x \sin x + 1$, such that x takes the values between $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ for one generation. The value of crossover probability and mutation probability are 0.4 and 0.2 respectively, and the population size is 6. (5)

b) Find the children solution of the following travelling salesperson problem using order crossover #2 and position crossover: (5)

Parent 1:	1	2	3	4	5	6	7	8	9
Parent 2:	2	3	6	8	5	1	4	7	9

4. a) Consider the Fuzzy sets A and B defined on the interval $X = [0,5]$ by the membership grade functions

$$\mu_A(x) = \frac{x}{x+1} \text{ and } \mu_B(x) = 2^{-x}$$

Determine the mathematical formulae and graphs of the membership function of each of the following sets: $A^c, B^c, A \cup B, A \cap B, (A \cup B)^c$. (6)

- b) In a neural network, if input, weight and bias to a single-input neuron are 2.0, 2.3 and -3 respectively, then, (4)

- i) Determine the net input to the transfer function.
 ii) Determine the neuron output for the following transfer functions:
 I. Hard Limit
 II. Linear
 III. Log-sigmoid

5. a) Maximize $f(x) = \frac{-x^2}{10} + 3x$, where $0 \leq x \leq 31$ using genetic algorithm. (4)

- b) Consider a single layer perceptron having 2 inputs and 1 output. Let threshold be 0.5, learning rate be 0.6, bias be -2 and weight values $w_1 = 0.3$ and $w_2 = 0.7$. If the input patterns are given in the following table, then find the value of output and training using perceptron learning rule for one epoch. (6)

Input Pattern		
x_1	x_2	D
1	1	1
1	0	1
0	1	-1
0	0	1

6. a) A Hopfield network has the following standard binary pattern:

$$S = [111; 101; 100]$$

Find the weight matrix. (8)

- b) Write the expression for triangular membership function. (2)

7. a) Write the schema for the gene sequence (1000111) and (0001100). Also, write six chromosome sets identified by the schemas written by you. (4)

b) Consider the data:

	x_1	x_2	x_3	x_4
f_1	1	2	3	4
f_2	10	8	6	5

Apply fuzzy c-mean algorithm to find the new cluster centre after one iteration.

[Use $c = m = 1$ and $v_1 = (4,4), v_2 = (8,8)$]. (6)

8. (a) What is α -cut of a Fuzzy set? Establish the relation between the set generated by α -cutting and the value of α . Why do we need to determine the α -cut of a fuzzy set? (5)
- b) Determine between the following: (5)
- i) Clustering and classification techniques
 - ii) Mays Learning Rule and Widrow-Hoff (LMS) Learning rule.
9. a) Define the McCulloch-Pitts model. What are the rules for evaluating the input to a McCulloch-Pitts unit? Implement AND function using McCulloch-Pitts neuron (Take binary data). (6)
- b) Find the Length and Order of the following schemas: (4)
- i) $S_1 = 1 ** 00 * 1 **$
 - ii) $S_2 = * 00 * 1 **$
 - iii) $S_3 = **** 0 ****$
 - iv) $S_4 = * 1 * 0 1 *$
10. a) Show that single layer linear network is equivalent to multiplayer network with Linear transfer function. (5)
- b) What are Radial Basis Function Networks (RBFN)? How RBFN is used for polynomial fitting? Give suitable example. (5)