M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) [M. SC. (MACS)]

Term-End Examination

June, 2025

MMTE-007 : SOFT COMPUTING AND ITS APPLICATIONS

Time : 2 Hours   *Maximum Marks : 50*

Weightage : 50%

Note : *(i)*   *Question No. **7** is compulsory.*

     (ii)   *Attempt any **four** questions from question nos. **1** to **6**.*

     (iii)   *Use of scientific (non-programmable) calculator is allowed.*

     (iv)   *All symbols have their usual meanings.*

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1. (a) Find the α-cut at 0.7 and 0.2 for the fuzzy set (A) given below :   3

$$A = \left\{ \frac{0}{10}, \frac{0}{20}, \frac{0.2}{30}, \frac{0.8}{40}, \frac{1.0}{50}, \right.$$

$$\left. \frac{1.0}{60}, \frac{0.6}{70}, \frac{0.2}{80}, \frac{0}{90}, \frac{0}{100} \right\}$$

Compare the results of the α-cut of the set A for values 0.7 and 0.2. Give comments for the status of α-value variation.

(b) Describe McCulloch-Pitts neuron, and implement NAND function using McCullah-Pitts neuron for the binary data given below :   7

Input	
x_1	x_2
0	0
0	1
1	0
1	1

2. (a) Write Fuzzy C-mean algorithm. Apply it and perform *one* iteration to find the new cluster centre for the data given below : 7

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

Assume the values of parameters c and m as 2 and the initial cluster centres V_1 as (3, 3) and V_2 as (5, 5).

(b) List all the schemas for the 5-bit chromosome '100**'. Also, find length and order of the schema. 3

3. (a) Use Genetic algorithm to maximize $f(x) = \dfrac{-x^2}{10} + 3x$, where $0 \le x \le 31$. 6

(b) Describe Hopfield network. Give *two* major limitations of Hopfield network. Under what conditions, a Hopfield model of 'N' nodes can achieve 100% correct retrieval of 'P' patterns ? 4

4. (a) Write Roulette-wheel criterion and use it to generate the population in the next iteration, for the data given below :   6

k	F_k
1	3.5
2	4.6
3	5
4	2.8
5	1.8

(b) Consider the Travelling Salesman problem (involving 10 cities) given below :

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

Find the children solution using : 4

(i) Order crossover #1 with key positions 3 and 6.

(ii) Order crossover #2 with key positions 2, 4, 7, 8.

5. (a) Given the input, weight and bias to a single-input neuron as 2.0, 2.3 and – 3, respectively, then determine the following : 4

(i) The net input to the transfer function

(ii) The neuron output for the following transfer functions :

(I) Log-sigmoid

(II) Hard limit

(III) Linear

(b) Explain the MADALINE architecture with a suitable diagram. Also, compare MADALINE with ADALINE. 6

6. Write short notes on the following :

$2.5 \times 4 = 10$

(i) Kohonen Self-Organizing feature map

(ii) Hedges

(iii) Multivalued Recognition Systems

(iv) XOR Problem

7. State whether the following statements are True *or* False. Give reasons for your answers :   10

(a) Every original pattern of a discrete Hopfield network with a synchronous update provides a global minimum.

(b) If R is a fuzzy relation between the fuzzy sets A and B, then membership function of $R(\mu_R)$ is :

$$\mu_R(x, y) = \max(\mu_A(x), \mu_B(y))$$

(c) Self-Organizing Map (SOM) is an unsupervised learning technique.

(d) The offsprings of parents with a high fitness value, have a high fitness value for any fitness function.

(e) If $\omega(k_0) = \omega(k_0 + 1) = \omega(k_0 + 2)$, then perceptron is non-linearly separable.

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