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MMTE-007

**M.SC. (MATHEMATICS WITH
APPLICATIONS IN COMPUTER
SCIENCE)**

[M.SC. (MACS)]

Term-End Examination

June, 2026

**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 non-programable scientific
calculator is allowed.

1. (a) Write the differences between soft partition and hard partition with suitable examples. 2
- (b) Perform union, intersection, difference and complement operations over fuzzy sets :

$$A = \left\{ \frac{.2}{3}, \frac{1}{4}, \frac{.5}{7}, \frac{.1}{8} \right\}$$

$$B = \left\{ \frac{.7}{3}, \frac{.5}{4}, \frac{.6}{7}, \frac{.3}{8} \right\}$$

Also, find A^c and B^c . 4

- (c) Consider a Hopfield network with weight matrix (W) :

$$W = \frac{1}{3} \begin{bmatrix} 0 & -2 & 2 \\ -2 & 0 & -2 \\ 0 & -2 & 0 \end{bmatrix}$$

and two test input vectors

$$P_1 = [1 \quad -1 \quad 1], P_2 = [-1 \quad 1 \quad -1].$$

Verify that the output state vector satisfies the alignment condition. 4

2. (a) Write advantages and disadvantages of unsupervised pattern recognition techniques in comparison to supervised pattern recognition technique. 4
- (b) A single-layer neural network has four inputs and two outputs. The outputs are to be limited to and continuous over $[0, 1]$.

Answer the following : 6

- (i) How many neurons are required ?
- (ii) What are the dimensions of the weight matrix ?
- (iii) Which transfer function can be used ?
- (iv) Is a bias required ? If yes, why ?

3. (a) What are the *two* major limitations of Hopfield network ? Under what conditions, a Hopfield model of 'N' nodes can achieve 100% correct retrieval on '*p*' patterns ? 5
- (b) Minimize :

$$f(x) = \frac{-x^2}{10} + 3x,$$

where $0 \leq x \leq 31$ using genetic algorithm. 5

4. (a) State the Schema theorem. 2
- (b) Design a Hopfield Network 3-bit bipolar patterns. The training patterns are

$$S_1 = [2 \ 2 \ 2]$$

$$S_2 = [-1 \ -1 \ 1]$$

Find the weight matrix and energy for the two input samples. Determine

the pattern to which the sample $S = [-1 \ 1 \ -1]$ associates. 5

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

5. (a) How does ADALINE differ from MADALINE ? Discuss the MADALINE architecture with a suitable diagram. 5

(b) Write short notes on the following giving suitable example for each : 5

(i) Perception Learning Rule

(ii) Widrow-Hoff (LMS) Learning Rule

6. (a) Write the Schema for Gene Sequence (1000110) (0001100). 2

(b) Write at least *four* chromosome sets, which are identified by Schema $S = (10^*0^*)$. 2

- (c) Consider the QA technique for the following travelling salesman problem involving 9 cities with parent chromosomes as below : 6

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

Determine the children solution using order crossover $\neq 2$ assuming 3rd, 5th and 7th positions as key positions.

7. State whether the following statements are true or false. Justify your answer. $5 \times 2 = 10$
- (a) Classical set is a particular case of Fuzzy set.
- (b) The output of a neuron does not depend on its activation function in general.
- (c) In cross validation methods, many networks of different complexity are trained and then tested on an independent validation set.

- (d) Genetic algorithm cannot optimize discontinuous objective functions.
- (e) The offsprings of parents with a high fitness value, have a high fitness value, for any fitness function.

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