

- N.B. (1) Question No. 1 is compulsory.  
(2) Attempt any four questions out of the remaining.

1. (a) Define the following terms with examples- (10)

(i) Intersection of fuzzy set.

(ii) Union of fuzzy set.

(iii) Convex and non convex fuzzy set

(iv) Cardinality and Relative cardinality of fuzzy set

(b) Explain different models of Artificial Neural network in detail. (10)

2. Design a fuzzy controller to determine the wash time of a domestic washing machine. Assume that the inputs are dirt and grease on cloths. Use three descriptors for each input variables and five descriptors for the output variables. Derive a set of rules for control action and defuzzification. The design should be supported by figures wherever possible. Clearly indicate that if the clothes are soiled to a large degree the wash time required will be more. (20)

3. Solve the following classification problem with the perceptron learning rule. Apply each input vector in order, for as many repetitions as it takes to ensure that the problem is solved.

$$X_1 = [2, 2], t_1 = 0$$

$$X_2 = [1, -2], t_2 = 1$$

$$X_3 = [-2, 2], t_3 = 0$$

$$X_4 = [-1, 1], t_4 = 1$$

Use the initial weights and bias  $W(0) = [0, 0], b(0) = 0$  (20)

4. (a) Prove the following identities:

i) For unipolar continuous activation function

$$f'(net) = O(1-O)$$

ii) For bipolar continuous activation function

$$f'(net) = (1-O^2) / 2$$

Where O is out. (10)

(b) Discuss in detail Hopfield network. (10)

5. What do you mean by learning? List different learning rules and explain any three with suitable diagrams. (20)

6. (a) Explain concept of linearly separable and nonlinearly separable patterns. (10)

(b) Define RBF networks. Compare the RBF networks with the multilayer perceptron. (10)

7. Write notes on the following: (20)

1) Boltzmann Machine

2) Bidirectional Associative Memory