

N.B : 1. Question No. 1 is **compulsory**.

2. Attempt any **four** out of remaining **six** questions.

- 1.(a) Define with examples the following terms: 12
 (i) Convex and non-convex fuzzy set
 (ii) Nucleus and height of fuzzy set
 (iii) Cardinality, Fuzzy Cardinality, Relative Cardinality
- (b) Explain Outstar learning rule and Delta learning rule. 08
2. Design a fuzzy controller to determine the wash time of a domestic washing Machine. Assume that the inputs are dirt and grease on clothes. Use three Descriptors for each input variable and five descriptors for the output variable. Device 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 larger degree the wash time required will be more. 20
3. A single-neuron network using $f(\text{net}) = \text{sgn}(\text{net})$ has been trained using the pairs of x_i, d_i as shown below : 20
 $(x_1 = [1 \ -2 \ 3 \ -1], d_1 = -1), (x_2 = [0 \ -1 \ 2 \ -1], d_2 = 1) \ x_3 = [-2 \ 0 \ -3 \ -1], d_3 = -1)$
 The final weights obtained using the perceptron rule are:
 $w^4 = [3 \ 2 \ 6 \ 1]$
 Knowing that correction has been performed in each step for $c=1$, determine the following weights :
 (a) w^3, w^2, w^1 by back tracking the training
 (b) w^5, w^6, w^7 obtained for steps 4,5 and 6 of training by reusing the sequence $(x_1, d_1), (x_2, d_2), (x_3, d_3)$.
- 4.(a) Explain with suitable diagram error back propagation training algorithm. 10
 (b) Explain with suitable examples linearly and non- linearly separable pattern classification. 10
- 5.(a) Explain the following membership function : 10
 (i) Triangular (ii) Trapezoidal (iii) Gaussian (iv) π membership function.
 (b) If the network does not get trained, what are the possible reasons? Explain what you will do to get it trained. 10
- 6.(a) Explain the architecture of Bidirectional associative memory. How is storage And retrieval performed in BAM? 10
 (b) Explain RBF network and give the comparison between RBF and MLP. 10
7. Write notes on the following (Any Two): 20
 (a) LMS Algorithm
 (b) Boltzmann Machine
 (c) Energy minimization in Hopfield Network.