(3 Hours) **Total Marks: 80**

N.B : (1) Question **No. 1** is **compulsory**
(2) Attempt **any three** questions out of remaining **five.**

1. (a) Describe the various soft computing characteristics. (05)

   (b) Explain any five defuzzification techniques. (05)

   (c) Explain the different types of activation functions. (05)

   (d) With suitable example explain the concept of linear separability (05)

2. Design a fuzzy logic controller for a train approaching or leaving a station. The inputs are the distance from the station and speed of the train. The output is the amount of brake power used. Use four descriptors for each variable. Derive a set of rules for control action and appropriate defuzzification. The design should be supported by figures. Prove that when the train is nearer to station and speed is medium, the brake power used is high. (20)

3 (a) Explain how learning happens in unsupervised learning. Also write the algorithm of KSOFM. (10)

   (b) Consider *R* and *S* be fuzzy relations defined as follows (4)

$$\tilde{R} = \begin{bmatrix} 0.8 & 0.1 \\ 0.2 & 0.7 \\ 0.6 & 0.3 \end{bmatrix} \quad \tilde{S} = \begin{bmatrix} 0.2 & 0.4 & 0.3 \\ 0.9 & 0.5 & 0.1 \end{bmatrix}$$

   Find the following fuzzy compositions

   1. $\tilde{T} = \tilde{R} \circ \tilde{S}$
   2. $\tilde{U} = \tilde{R} \bullet \tilde{S}$

   (c) A = {0.2/1 + 0.3/2 + 0.1/3 + 0.5/4 + 0.8/5 + 0.4/6 + 0.7/7} (6)

   B = {0.1/1 + 0.8/2 + 0.6/3 + 0.4/4 + 0.7/5 + 0.1/6 + 0.9/7}

   Find the following

   1. $(\bar{A} \cap \bar{B})_{0.5}$
   2. $\bar{B}'_{0.3}$
   3. $(A \cap B)'_{0.7}$
   4. $(A/B)_{0.4}$
   5. $(A \cup B)$
   6. $(\overline{B - A})$

4. (a) Comment on the following: (4)
For a bipolar binary neuron, the weight change formula for a perceptron training rule reduces to

$$\Delta w = \pm 2cx$$

(b) Implement perceptron training rule for a network with the following data (6)
(X_1 = [2 1 -1], d_1 = -1); (X_2 = [0 -1 -1], d_2 = 1),
Initial weights: W_1 = [0 1 0].
Repeat the training sequence (X_1, d_1), (X_2, d_2) until two correct responses in a row are achieved. Assume c=1 and f(net) = sgn(net).

(c) Explain Genetic Algorithm in detail with the help of flowchart. (10)

5. (a) Explain Error Back Propagation Training Algorithm with the help of neat block diagram. (10)

(b) What are hybrid systems? Explain Adaptive Neuro Fuzzy Inference system (ANFIS) with the help of example. (10)

6. (a) Explain the Newton's Methods of optimization in detail. (10)

(b) Explain the Genetic-Neuro Hybrid Systems. Also mention its advantages and disadvantages (10)