(3 Hours) [Total Marks : 80]

N.B. : (1) Question No.1 is **compulsory**.
    (2) **Attempt** any **three** questions from remaining questions.
    (3) **Assume** suitable data whevevre **necessary**.

1. Attempt any **four** questions :   20
   (a) Compare and contrast the biological neuron and artificial neurons.
   (b) Define fuzzy logic and crisp logic. With suitable examples, explain the operations and properties of fuzzy sets, crisp sets, fuzzy relations and crisp relations.
   (c) What are the various activation functions and learning rules used in neural networks?
   (d) Explain any two types of De-fuzzification methods.
   (e) Draw a McCulloch-Pitts neuron and explain its working.

2. (a) Differentiate between supervised and unsupervised learning methods.   10
   (b) Design a Hopfield network for 4-bit bipolar patterns. The training patterns are :   10

$$S_1 = [1,-1,-1,-1]$$
$$S_2 = [-1,1,1,-1]$$
$$S_3 = [-1,-1,-1,1]$$

   Find weight matrix and energies for three input samples. Determine the pattern to which the sample $S = [-1, 1,-1,-1]$ associates.

3. (a) What are the two types of BAM? Explain. How are the weights determined in a discrete BAM.   10
   (b) Find the weights required to perform the following classification using Perceptron network. The vectors $(1,1,1,1)$ and $(-1,1,-1,-1)$ are belonging to the class and have target value 1 and vectors $(1,1,1-1)$ and $(1,-1,-1,1)$ are not belonging to the class and have a target value -1. Assume learning rate as 1 and initial weights as 0.   10

4. (a) With a neat architecture, explain the training algorithm of Kohonen self-organizing maps.   10
   (b) State the importance of back propagation algorithm and draw its architecture.   10

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5. (a) For the fuzzy sets A, B and C are define on discrete universe X, Y and Z 10 repectively.

$$A = \left\{ \frac{0.1}{x_1} + \frac{0.5}{x_2} + \frac{1.0}{x_3} \right\}, B = \left\{ \frac{0.3}{y_1} + \frac{0.8}{y_2} \right\}, A = \left\{ \frac{0.4}{z_1} + \frac{0.7}{z_2} + \frac{1.0}{z_3} \right\}$$

Find:
   (i) Fuzzy Cartesian product $P = A \times B$;
   (ii) Fuzzy Cartesian product $S = B \times C$;
   (iii) $T = P \text{ O } S$ using min-max and max-product method.

 (b) With a neat architecture, explain the training algorithm and testing algorithm of 10 Adaline network.

6. Write short notes on any **four** : 20
   (a) Simulated annealing,
   (b) LVQ,
   (c) Fuzzy Logic Controller,
   (d) Boltzmann Machine,
   (e) Adaptive Resonance Theory.

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