Duration   3 Hours   **Maximum marks   80**

1)   Question 1 is compulsory.
2)   Solve any three from the remaining five questions.
3)   Assume suitable data if necessary.
4)   Figures to the right indicate full marks.

Q.1.   Attempt any **four** from the following questions.   20
a   Differentiate between feed forward and recurrent artificial neural networks.
b   What is the importance of bias in an artificial neural network?
c   Explain the delta rule of learning with an example.
d   Explain Max-membership principle of defuzzification..
e   State any four learning rules.

Q.2.a   Discuss the learning factors involved in back propagation network.   10
b   Apply Perceptron learning rule to a network   presented with the following training   10
        vectors:
        $X_1 = [1 \ -2 \ 0 \ -1]^t$; $X_2 = [0 \ 1.5 \ -0.5 \ -1]^t$; $X_3 = [-1 \ 1 \ 0.5 \ -1]^t$
        The learning constant, c=0.1 and the desired responses for X_1, X_2 and X_3 are d1= -1, d2=
        -1 and d3=1 respectively. Assume the initial weight vector to be $W_1 = [1 \ -1 \ 0 \ 0.5]^t$ and
        obtain the updated weight vector after one epoch.

Q.3.a   Construct an autoassociative network to store the vectors X1=[1 1 1 1 1],   X2=[1   10
        -1 -1 1 -1], X3=[-1 1 -1 -1 -1]. Find the weight matrix with no self connection and
        calculate the energy of the stored patterns. Using discrete Hopfield network test the
        pattern S=[1 1 1 -1 1].
b.   Explain in detail Adaptive Resonance Theory networks.   10

Q.4.a   With a neat architecture, explain the training algorithm of Kohonen self-organizing   10
        feature maps.
b.   With a neat architecture, explain the training algorithm of Adaline network.   10

Q.5 a   Two fuzzy sets are defined as: 10

$$\underset{\sim}{A} = \left\{ \frac{0.4}{1} + \frac{0.5}{2} + \frac{0.45}{3} + \frac{0.6}{4} + \frac{0.8}{5} \right\}$$

$$\underset{\sim}{B} = \left\{ \frac{0.5}{1} + \frac{0.5}{2} + \frac{0.2}{3} + \frac{0.5}{4} + \frac{0.75}{5} \right\}$$

Perform union, intersection, difference and complement over these fuzzy sets.

    b   With the help of a block diagram, explain the working of a fuzzy logic controller.   10

Q.6   Write short notes on any **four**:   20
        a) McCulloch-Pitts Neuron
        b) Perceptron convergence theorem
        c) Simulated annealing neural network
        d) Radial Basis Function Networks
        e) Bidirectional Associative Memory

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