Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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SECOND SEMESTER M TECH (OPEN ELECTIVE) DEGREE END SEMESTER EXAMINATION
MAY / JUNE 2016
SUBJECT: NEURAL NETWORKS AND FUZZY LOGIC (ECE -567)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Prototype points are given as

x1 = $[5,1]^t$, x2 =$[7,3]^t$ x3= $[3,2]^t$ x4 =$[5,4]^t$ → class 1
x5 = $[0,0]^t$, x6 =$[-1,-3]^t$ x3= $[-2,3]^t$ x4 =$[-3,0]^t$ → class 2

i. Determine if the two classes of patterns are linearly separable
ii. Determine the canter of gravity for patterns of each class and find decision surface in pattern space.
iii. Design dichotomizer for the given prototype points and determine how it would recognize the following input patterns of unknown class x= $[4,2]^t$?

1B. Consider the fuzzy sets F and G defined in U= [0,1,2,3,4,5] by

$$\mu_F(x) = \frac{x}{x+2} \quad and \quad \mu_G(x) = 2^{-x}$$

Determine

i. $F \cap \overline{G}$ ii) $\overline{F \cup G}$ iii) Bounded Sum

(6+4)

2A. Given two fuzzy sets

$$A = \frac{0.1}{1} + \frac{0.3}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{1}{5} \quad and \quad B = \frac{0.2}{1} + \frac{0.5}{2} + \frac{0.7}{3} + \frac{0.9}{4} + \frac{0}{5}$$

Determine the following:

i. Fuzzy union of A0.4 and slightly B by algebraic sum
ii. Fuzzy intersection by Dubois –Prade class with α =1
iii. Fuzzy AND with p = 1
iv. Sugeno complement of fuzzy set A with λ = 1
v. IF plus A THEN minus B by Godel implication

2B. Design an auto associative memory to store the following patterns $[1,-1,-1]^t$,[-1,1,1] Perform synchronous update and compute the energy for [1,-1,1].

(6+4)

3A. With the help of a flowchart, explain all he computation steps of ART1 algorithm. Draw the network architecture.

3B. Three steps of perceptron learning performed on a bipolar binary neuron resulted in $W^4 = 0$. Determine the initial weight W^1 for the following input and desired outputs.
Assume c= 0.5.

$X1 = [\ 1,\ 1, -0.5, -0.5\ ]^t$ d1 = 1
$X2 = [\ 1, -5,\ 1.5,\ 0\ ]^t$ d2 = -1
$X3 = [\ -2,\ 5\ ,\ 0,\ 1\ ]^t$ d3 = 1

3C. Implement XOR classification using Mc Culloch _Pitts model.

(4+4+2)

4A. Consider a set P= {P1,P2,P3,P4} of four varieties of paddy plans, set D ={D1,D2,D3,D4} of various diseases affecting the plants and S= { S1,S2,S3,S4 } the common symptoms of the diseases. Let R be a relation on P x D and Q be a relation on D x S as

$$R = \begin{array}{c} \\ P1 \\ P2 \\ P3 \\ P4 \end{array} \begin{array}{c} \begin{array}{cccc} D1 & D2 & D3 & D4 \end{array} \\ \begin{bmatrix} 0.6 & 0.6 & 0.9 & 0.8 \\ 0.1 & 0.2 & 0.9 & 0.8 \\ 0.9 & 0.3 & 0.4 & 0.8 \\ 0.9 & 0.8 & 0.1 & 0.2 \end{bmatrix} \end{array} \qquad Q = \begin{array}{c} \\ D1 \\ D2 \\ D3 \\ D4 \end{array} \begin{array}{c} \begin{array}{cccc} S1 & S2 & S3 & S4 \end{array} \\ \begin{bmatrix} 0.1 & 0.2 & 0.7 & 0.9 \\ 1 & 1 & 0.4 & 0.6 \\ 0 & 0 & 0.5 & 0.9 \\ 0.9 & 1 & 0.8 & 0.2 \end{bmatrix} \end{array}$$

Obtain the association of the plants with different symptoms of diseases using Max-Min composition

4B. Explain genetic algorithm with the help of a flowchart.

4C. Show that the Yager's sum, Yager's product and basic fuzzy compliment form associative class

(4+4+2)

5A. Consider a 2-input 1-output fuzzy system constructed from the following two rules:

If x1 is A1 and x2 is A2, Then y is A2
If x1 is A2 and x2 is A1, Then y is A1

Where A1 and A2 are fuzzy sets with membership functions.

$\mu_{A1}(u) = 1 - |u|\ ,\ if\ -1 \le u \le 1$ = 0 otherwise

$\mu_{A2}(u) = 1 - |u-1|\ ,\ if\ \ 0 \le u \le 2$ = 0 otherwise

If the input to the fuzzy system is [x1*, x2*] = [0.5 0.9], use singleton fuzzifier to determine the output of the fuzzy system y* in the following cases:

i) Minimum inference engine and mean of maxima defuzzifier
ii) Product inference engine and center average defuzzifier

5B. Four steps of Hebbian learning of a single neuron network have been implemented starting with $W = [1,1]^t$ for learning constant c= 1 using
$X1= [1,-2]^t$ $X2= [0,1]^t$ $X3= [2,3]^t$ $X1= [1,-1]^t$
Find final weights for bipolar binary activation function

(6+4)

6. Analyse a single feed forward and back propagation step for a two layered feed forward network of, two input two output and bias=-1 in each layer . The transposed weight matrices for both the layers are:

1st layer

$$V = \begin{bmatrix} 1 & -2 & 3 \\ 2 & 0 & -1 \end{bmatrix}$$

2nd layer

$$W = \begin{bmatrix} 1 & 0 & 2 \\ 1 & -2 & 3 \end{bmatrix}$$

Use unipolar continuous neurons. Assume η=1 and λ =1.The input to the network and desired outputs are

$$\begin{bmatrix} x1 \\ x2 \\ -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix} \quad \text{and} \quad \begin{bmatrix} d1 \\ d2 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

(10)