Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VI SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APR/MAY 2017

SUBJECT: INTELLIGENT CONTROLLERS [MTE 4005]

REVISED CREDIT SYSTEM
(27/04/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Perform single step error-back propagation of a multilayer perceptron network for the given data. Use η=1, λ=1 and both the layers are unipolar continuous. **7**

$$Z = \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix} \quad V^t = \begin{bmatrix} 1 & 0 & 2 \\ 2 & 3 & 1 \end{bmatrix} \quad W^t = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \quad d = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

1B. Describe Artificial Neural Network (ANN)? Explain the applications of ANNs. **3**

2A. Implement McCulloch Pitts model for 2 input logic equation $y = x_1.x_2$ **3**

2B. In computer engineering, different logic families are often compared on the basis of their power-delay product. Consider the fuzzy set F of logic families, the fuzzy set D of delay times (in nanoseconds), and the fuzzy set P of power dissipations (in milliwatts). **3**

F = {NMOS, CMOS, TTL, ECL, JJ}

D = {0.1,1, 10, 100} and P = {0.01, 0.1, 1, 10, 100}

The relation between delay times and logic families (R_1 = D x F) and between logic families and power dissipation (R_2 = F x P) is given below. Find the relation between delay times and P = 0.01 using max-min composition.

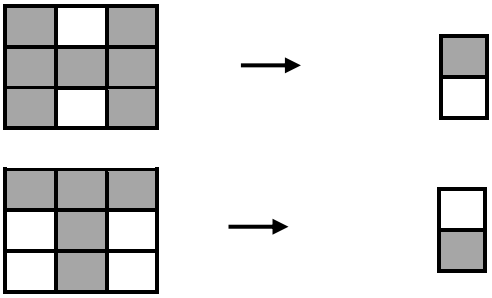
$$R_1 = \begin{array}{c} \\ 0.1 \\ 1 \\ 10 \\ 100 \end{array} \begin{array}{c} \begin{array}{ccccc} N & C & T & E & J \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & .6 & 1 \\ 0 & .1 & .5 & 1 & 0 \\ .4 & 1 & 1 & 0 & 0 \\ 1 & .2 & 0 & 0 & 0 \end{bmatrix} \end{array} \qquad R_2 = \begin{array}{c} \\ N \\ C \\ T \\ E \\ J \end{array} \begin{array}{c} \begin{array}{ccccc} .01 & .1 & 1 & 10 & 100 \end{array} \\ \begin{bmatrix} 0 & .4 & 1 & .3 & 0 \\ .2 & 1 & 0 & 0 & 0 \\ 0 & 0 & .7 & 1 & 0 \\ 0 & 0 & 0 & 1 & .5 \\ 1 & 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

2C. Prototype points for 2-classes are given below: **4**

$$X_1 = \begin{bmatrix} 5 \\ 2.5 \\ -1 \end{bmatrix} \qquad X_2 = \begin{bmatrix} -1.5 \\ 0 \\ -1 \end{bmatrix}$$

Design a R-Category classifier.

3A. Design a bidirectional associative memory to store the following pairs of patterns. **5**



3B. Explain Genetic Algorithm (GA)? Describe the three basic operators used in GA. **3**

3C. Neural Network and Fuzzy Systems are integrated to form Fuzzy-Neural Networks. Explain the significance of integrating Neural networks and Fuzzy systems. **2**

4A. Given two fuzzy sets **2**

$$A = \frac{0.1}{0} + \frac{0.4}{1} + \frac{1}{2} + \frac{0.3}{3} + \frac{.2}{4} \qquad B = \frac{0.2}{0} + \frac{0.5}{1} + \frac{1}{2} + \frac{0.4}{3} + \frac{.1}{4}$$

Determine the following:

i) Fuzzy union of $A_{0.25}$ and B by algebraic sum.

ii) Fuzzy intersection of A and B by drastic product.

4B. Perform perceptron learning rule for the following data set: **4**

$$X_1 = \begin{bmatrix} 2 \\ -3 \\ 0 \\ -1 \end{bmatrix} \quad X_2 = \begin{bmatrix} 1 \\ 4 \\ -3 \\ -1 \end{bmatrix} \quad X_3 = \begin{bmatrix} 1 \\ 1 \\ 2 \\ -1 \end{bmatrix}$$

$$d_1 = -1 \qquad d_2 = 1 \qquad d_3 = 1$$

Initial weight matrix W = $[1\ -2\ 1\ 3]^t$ .Use c= 0.5

4C. Consider the example of classifying airplanes given their masses and speeds as given in the table 2B. Design a minimum distance classifier that can classify airplanes as either bomber or fighter. **4**

Mass	*Speed*	*Class*
1.0	0.1	Bomber
2.0	0.2	Bomber
0.1	0.3	Fighter
2.0	0.3	Bomber
0.2	0.4	Fighter
3.0	0.4	Bomber
0.1	0.5	Fighter
1.5	0.5	Bomber
0.5	0.6	Fighter
1.6	0.7	Fighter

Table 2B

5A. Design a simple rule based fuzzy system to generate y = cos(x) where x = [-180 180] and output is defined in universe y = [-1 1]. **10**

Use Mamadani minimum implication for rule interpretation, minimum for all t-norm operators, maximum for all s-norm operators. Test your system by applying the singleton input x= 90.

Table of S-Norm and T-Norm:

S-Norm	T-Norm
$s_{ds}(a, b) = \begin{cases} a, if\ b = 0 \\ b, if\ a = 0 \\ 1, otherwise \end{cases}$	$t_{dp}(a , b) = \begin{cases} a, if\ b = 1 \\ b, if\ a = 1 \\ 0, otherwise \end{cases}$