Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL 2018
SUBJECT: SOFT COMPUTING TECHNIQUES (ECE -4033)

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

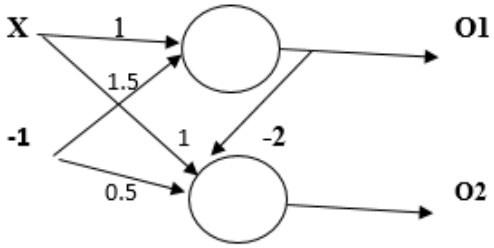
Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Assume that you have a collection of 1000 transistors belonging to 3 different make 1, 2 and 3. Two features about each transistor are known as to whether it is of low/high power and AF/RF type. With the help of a training set given below, predict the type of an "unknown transistor given that it is of low power and RF frequency" using Bayesian classifier design.

Transistor make	Low power	High Power	AF	RF	Total
Type 1	400	100	350	150	500
Type 2	0	300	150	150	300
Type 3	100	100	150	50	200
Total	500	500	650	350	1000

1B. Implement the following Boolean functions using both McCulloch-pitts and unipolar binary perceptron classifier model: $F = (x + y)(x + y')$

1C. Identify the task performed by the following neural network using unipolar discrete perceptrons for X=0, 1, 2, 3. Show the calculation for all steps to justify your answer.



(5+3+2)

2A. Design an auto associative memory to store the following patterns: $S^1 = [1 \quad 1 \quad -1]^t$, $S^2 = [-1 \quad 1 \quad 1]^t$. Perform synchronous and asynchronous update assuming the initial pattern, $S^0 = [-1 \quad -1 \quad -1]^t$. Find the energy at each step. Assume sgn(0)=1.

2B. The initial transposed weight matrix of a Kohenen's feature map is given by:

$$W^t = \begin{bmatrix} 0.1 & 0.5 & 1 \\ 0.01 & 0.5 & 0.03 \\ 0.9 & 0.6 & 0.1 \end{bmatrix}$$

. Perform single step training for the input vector using correlation metric.

The input vector is X = $[0.05 \ 0.5 \ 1]^t$. Assume α=1, R=1. After weight updation, calculate the correlation metric with new weights and same input. Comment on your results.

2C. Find the accuracy, precision and recall of a classifier given that the confusion matrix is:

	PREDICTED CLASS		
ACTUAL CLASS		+	-
	+	150	40
	-	60	250

(5+3+2)

3A. Compute the weight matrix W for a spatio temporal memory network for the following sequence of input vectors:

$S_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$, $S_2 = \begin{bmatrix} -1 \\ 1 \\ 1 \\ -1 \\ -1 \end{bmatrix}$, $S_3 = \begin{bmatrix} -1 \\ 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}$. Perform both forward and backward recall. Is the recall successful?

3B. In a certain pattern classification problem, error back propagation training was used using one input layer consisting of 2 linear neurons and one output layer consisting of one linear neuron. In the forward pass, the hidden layer outputs are 0.1 & -0.5 respectively while the output layer neuron responds with 0.5 with the desired output equal to -1 and the output layer weight vector is $W^t = [1 \quad 3.2 \quad -2]$.The input is $z = [0.5 \quad -1]^t$.Assume η=1.Find new weights in the output layer after single backward pass

3C. Prototype points are given as

$x_1^t = [10 \quad -2]$; $x_2^t = [2 \quad 5]$; $x_3^t = [-5 \quad -5]$

Design a minimum distance linear classifier for the given prototype points if the input bias is +1.

(5+3+2)

4A. With basic fuzzy complement , interpret the following fuzzy IF-THEN rule: 'IF current is very SMALL THEN resistance is very HIGH', where the fuzzy sets SMALL, HIGH are defined on a universe of current and resistance respectively as:

$\text{SMALL} = {}^{1}/_{10} + {}^{0.5}/_{30} + {}^{0.2}/_{50}$ $\quad \text{HIGH} = {}^{0.3}/_{30} + {}^{0.8}/_{50} + {}^{1}/_{70}$ using Godel and Mamadani Product implication.

4B. Consider the following fuzzy relations:

$$Q1 = \begin{pmatrix} 0.02 & 1 & 1 \\ 0.8 & 0.5 & 0.6 \\ 0.7 & 0 & 0.3 \end{pmatrix}, Q2 = \begin{pmatrix} 0.1 & 1 & 0.8 \\ 0.5 & 0.01 & 0.7 \\ 0.9 & 0.4 & 0.2 \end{pmatrix}$$

Perform Q1 o Q2 by max-min composition. Is composition operation commutative? Justify your answer with proof.

4C. Find whether algebraic sum, algebraic product and Sugeno complement form, an associated class or not.

(5+3+2)

5A. Design a 3-rule based fuzzy system to simulate the nonlinear function given by:

$$y = 1 - x, -1 \le x \le 0$$
$$= 1 + x, \quad 0 \le x \le 1$$

Use Mamadani minimum implication for interpreting fuzzy IF-THEN rules, min for t-norm and max for union. Test the output of the system for x=0.25, -0.75 using centre average defuzzification.

5B. Explain with illustration any 2 defuzzification methods

5C. Draw the flowchart for the Genetic Algorithm (GA). Briefly explain the various steps involved

(5+3+2)