Seat no:

GANPAT UNIVERSITY
B.TECH. SEM. VI BIOMEDICAL & INSTRUMENTATION ENGINEERING
REGULAR EXAMINATION MAY-JUNE 2012

BME 605 NEURALNETWORKS AND FUZZY LOGIC

TIME -: 3 Hours **TOTAL MARKS -: 70**

Instructions:

1. All the questions are compulsory.
2. Answer of each section must be written in separate answer books.
3. Figure to the right indicate marks.
4. Assume data, if needed.
5. Conventional terms / notations are used.

Section – I

Que.1 **[12]**

a). Discuss the application of neural network in Skin disease diagnosis.

b). Do the perceptron learning rule for AND logic upto 2 cycle.

OR

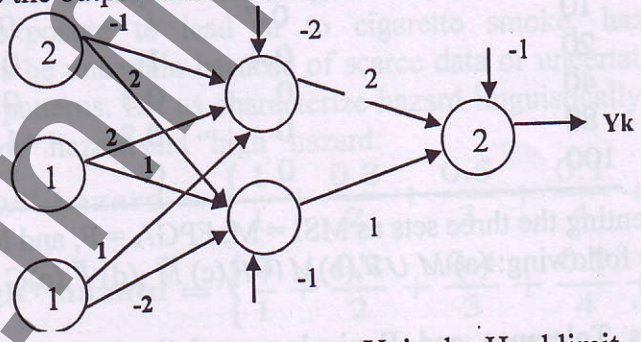
Que.1. **[12]**

a). Define activation function. Explain different types of activation function in brief.

b). Discuss the error correction learning rule giving neat diagram.

Que.2. **[11]**

a). Compute the output of the neuron shown below.



Transfer function of hidden layer : Unipolar Hard limit
Transfer function of output layer : Bipolar Hard limit

Fig. 1

b). Discuss the identification and classification in neural processing.

OR

Que.2 **[11]**

a). Define artificial neural network. What are the benefits of neural network? Describe the useful properties and capabilities of neural network.

b). What do you understand by ADALINE? Describe the application of ADALINE giving example.

Que.3. **Answer any Three:** [12]

a). Enumerate the different application of neural network.

b). Explain the meaning "winner takes al" in competitive learning rule.

c). Explain in detail the architecture of neural network.

d). Draw and explain MC-PITS neuron model.

Section – II

Que.4 [12]

a). You are asked to select an implementation technology for a numerical processor. Computation throughput is directly related to clock speed. Assume that all implementations will be in the same family (e.g., CMOS). You are considering whether the design should be implemented using medium-scale integration (MSI) with discrete parts, field-programmable array (FPGA) parts, or multichip modules (MCM). Define the universe of potential clock frequencies as X ={1, 10, 20, 40, 80, 100}MHz, and define MSI, FPGA, and MCM as fuzzy sets of clock frequencies that should be implemented in each of these technologies, where the following table defines their membership values:

Clock frequency (MHz)	MSI	FPGA	MCM
1	1	0.3	0
10	0.7	1	0
20	0.4	1	0.5
40	0	0.5	0.7
80	0	0.2	1
100	0	0	1

Representing the three sets as MSI = M, FPGA = F, and MCM = C, find the following: (a) $M \cup F$,(b)$M \cap F$,(c) $\overline{M}$,(d) $\overline{F}$,(e)$C \cap \overline{F}$, and (f) $\overline{M \cap C}$.

b). What is Tolerance and Equivalence relation? Explain necessary condition for a fuzzy relation to be in equivalence.

OR

Que.4 **a).** The formation of algal solutions and other biological colonies in surface waters is strongly dependent on such factors as the pH of the water, the temperature, and oxygen content. Relationships among these various factors enable environmental engineers to study issues involving bioremediation using the algae. Suppose we define a set T of water temperatures from a lake on the following discrete universe of temperatures in degrees Fahrenheit: [12]

$$T = \{50, 55, 60\}$$

And suppose we define a universe O of oxygen content values in the

water, as percent by volume:

$$O = \{1, 2, 6\}$$

Suppose a Cartesian product is performed between specific fuzzy sets T and O defined on T and O to produce the following relation:

$$\underset{\sim}{R} = \underset{\sim}{T} \times \underset{\sim}{O} = \begin{array}{c} \\ 50 \\ 55 \\ 60 \end{array} \begin{array}{c} \begin{array}{ccc} 1 & 2 & 6 \end{array} \\ \begin{bmatrix} 0.1 & 0.2 & 0.9 \\ 0.1 & 1 & 0.7 \\ 0.8 & 0.7 & 0.1 \end{bmatrix} \end{array}$$

Now suppose we define another fuzzy set of temperatures, "about 55° F," with the following membership values:

$$\underset{\sim}{I}_T = \left\{ \frac{0.5}{50} + \frac{1}{55} + \frac{0.7}{60} \right\}$$

(a) Using max–min composition, find $S = I_T \circ (T \times O)$.

(b) Using max–product composition, find $S = I_T \circ R$.

b). Draw and explain Types of membership function using suitable equations.

Que.5 **[11]**

a). Briefly explain Mamdani and Sugeno method and also explain advantages of each.

b). In risk assessment, we deal with characterizing uncertainty in assessing the hazard to human health posed by various toxic chemicals. Because the pharmacokinetics of the human body are very difficult to explain for long-term chemical hazards, such as chronic exposure to lead or to cigarette smoke, hazards can sometimes be uncertain because of scarce data or uncertainty in the exposure patterns. Let us characterize hazard linguistically with two terms: "low" hazard and "high" hazard:

$$\text{"Low" hazard} = \left\{ \frac{1}{1} + \frac{0.8}{2} + \frac{0.5}{3} + \frac{0.1}{4} + \frac{0}{5} \right\}$$

$$\text{"High" hazard} = \left\{ \frac{0}{1} + \frac{0.2}{2} + \frac{0.4}{3} + \frac{0.9}{4} + \frac{1}{5} \right\}$$

Find the membership functions for the following linguistic expressions:

(a) Low hazard and not high hazard

(b) Very high hazard and not low hazard

(c) Low hazard or high hazard.

OR

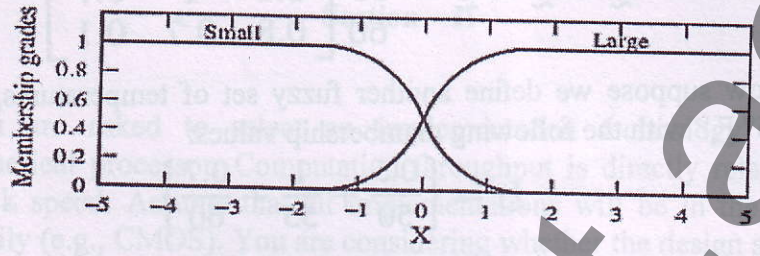
Que.5 **[11]**

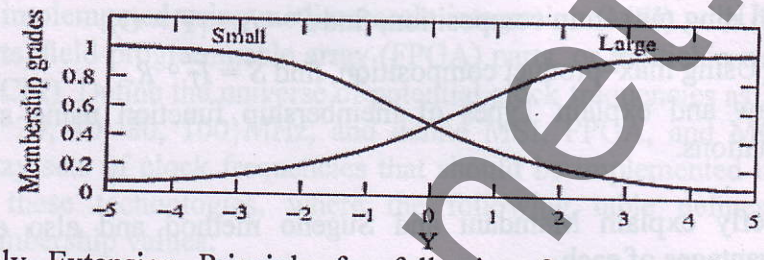
a). Develop Sugeno inference system on given knowledge base and simulate it for X =2 and Y = -1.

Rule base:

1. IF X is small and Y is small, THEN z = −x + y + 1.
2. IF X is small and Y is large, THEN z = −y + 3.
3. IF X is large and Y is small, THEN z = −x + 3.
4. IF X is large and Y is large, THEN z = x + y + 2.

Membership Functions:





b). Apply Extension Principle for following fuzzy set with given equation.

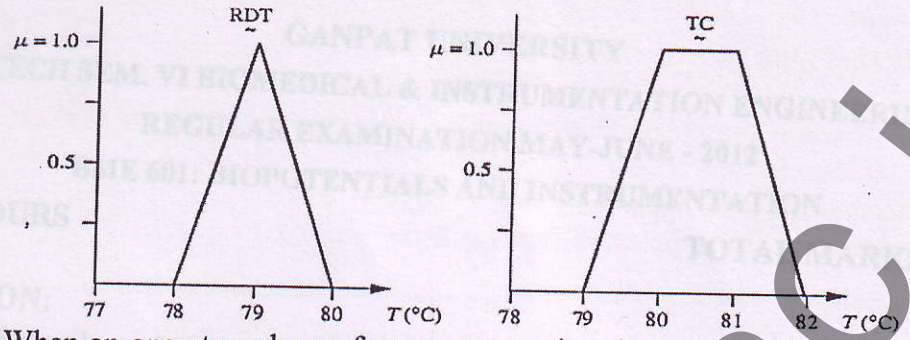
$$A = \{\frac{0.2}{-1} + \frac{0.4}{0} + \frac{0.6}{1} + \frac{1}{2} + \frac{0.3}{3}\}$$

$$f(x) = x^2 - 3$$

Que.6 [12]

a). What is extension principle? Explain its practical consideration briefly.

b). Often, in chemical processing plants, there will be more than one type of instrumentation measuring the same variable at the same instance during the process. Owing to the nature of measurements, they are almost never exact, and hence can be represented as a fuzzy set. Owing to the differences in instrumentation, the measurements will usually not be the same. Take, for example, two types of temperature sensors, namely, a thermocouple (TC) and a resistance temperature detector (RTD) measuring the same stream temperature. The membership function of the two types of temperature sensors may look as in Figure,



When an operator who prefers one measuring device ends his or her shift, and then is replaced by another operator with a different preference in measuring device, there may be a problem in determining the actual value of a variable. To avoid this problem, it was decided to plot the membership functions of the two types of sensors, take their union, and employ defuzzification using 1) Weighted average, 2) Centre of largest area

c). Explain properties of set of rules.

END OF PAPER