

16352(D)

M. Tech 3rd Semester Examination

Neural Networks and Fuzzy Logics

EC-311

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Attempt any five questions.

(ii) All questions carry equal marks.

1. (a) Depict the flow of information in a nervous system. (10)
- (b) Derive Delta learning rule and explain it through schematic diagram. (10)
2. (a) Through schematic diagram explain following kinds of neural learning
  - (i) Unsupervised learning
  - (ii) Supervised learning
  - (iii) Reinforced learningAlso list the ANN models employing above kinds of learning or their combination. (10)

- (b) By making use of continuous activation function apply Hebbian learning rule to update weight vector  $W^1$  while it is fed by three input vector one after the other

$$W^1 = \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0.5 \end{bmatrix}, X_1 = \begin{bmatrix} 1 \\ -2 \\ 1.5 \\ 0 \end{bmatrix}, X_2 = \begin{bmatrix} 1 \\ -0.5 \\ -2 \\ -1.5 \end{bmatrix}, X_3 = \begin{bmatrix} 0 \\ 1 \\ -1 \\ 1.5 \end{bmatrix}$$

Take learning constant  $c=1$  and slope constant  $\lambda=1$ . (10)

3. Draw the architecture of Kohonen self-organizing feature map (SOFM) and explain information processing with the help of flow chart. (20)
4. Draw architecture of Hopfield network. How does information processing takes place in continuous mode? Prove that for continuous output mode energy decreases for any transition in network state. (20)

5. (a) A fuzzy set F for the speed of a train, S (km/hour) with the membership function is given below:

$$F(S) = \begin{cases} 0.04S & \text{if } 0 \leq S < 25 \\ 1 & \text{if } 25 \leq S \leq 75 \\ -0.04(S - 100) & \text{if } 75 < S \leq 100 \\ 0 & \text{otherwise} \end{cases}$$

Draw the graph of this membership function and comment on its type. Also give linguistic value to this fuzzy set based on sense conveyed by the membership function. (10)

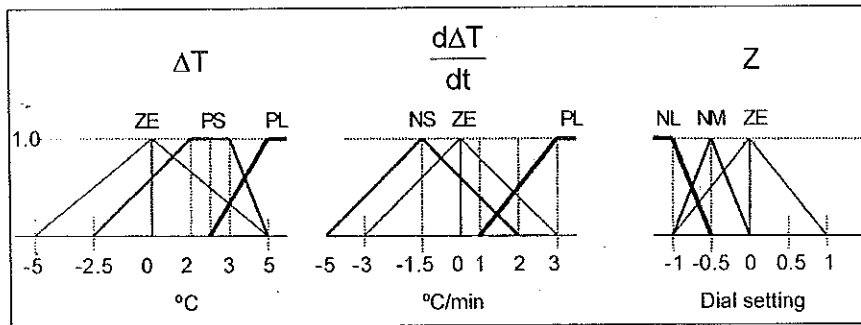
- (b) Describe the following operations on fuzzy sets:
  - (i) Union
  - (ii) Intersection
  - (iii) Complement
  - (iv) bounded sum
  - (v) Dilation.(10)
6. (a) With the help of suitable block diagram explain Mamdani fuzzy inference system for single input-single output (SISO) system. (10)
- (b) Draw block diagram for typical fuzzy system and also explain the function of each block. (10)

7. It is required to keep the temperature of room at  $T_0$  °C (set point) through the dial control of air conditioner. When dial is turned positive, warm/hot air is supplied from the air conditioner and if it is turned negative cool/cold air is supplied. If set to zero no

air is supplied. A person now notices the difference in temperature ( $\Delta T$  °C) between the room temperature ( $T$  °C) as measured by the thermometer and the desired temperature ( $T_0$  °C) at which the room is desired to be kept. The problem now is to determine to what extent the dial should be turned so that appropriate supply of air (hot/warm/cool/cold) will nullify the change in temperature.

Fuzzy rule base for the air conditioner control.

1. If  $\Delta T$  is ZE and  $\frac{d\Delta T}{dt}$  is PL then dial should be NL.
2. If  $\Delta T$  is PL and  $\frac{d\Delta T}{dt}$  is ZE then dial should be NM.
3. If  $\Delta T$  is PS and  $\frac{d\Delta T}{dt}$  is NS then dial should be ZE.



Find output,  $Z$  if inputs are:  $\Delta T = 2.5^{\circ}\text{C}$  and  $\frac{d\Delta T}{dt} = -1^{\circ}\text{C}/\text{min}$ .

(20)

8. Write short note on any TWO of the followings:
  - (i) VLSI implementations of neural networks.
  - (ii) ART networks.
  - (iii) Industrial applications of Fuzzy Control System.

(10×2=20)