SOFT COMPUTING
(AEIE 4142)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) $\mu_{M\cup N}(x,y); x\in M, y\in N$ in fuzzy set is represented by
(a) complement operator (b) minimum operator
(c) maximum operator (d) disjunctive sum operator.

(ii) The statement $\{x | x\in A : or : x\in B\}$ is equivalent to
(a) $A\subset B$ (b) $A\cup B$ (c) $A\cap B$ (d) $A\supset B$.

(iii) In a fuzzy controller, if error is positive and change of error is negative, the control output should be
(a) positive (b) negative
(c) zero (d) any value.

(iv) The truth values of crisp set theory is _____ and that of fuzzy set is _____
(a) either 0 or 1, between 0 & 1
(b) between 0 & 1, either 0 or 1
(c) between 0 & 1, between 0 & 1
(d) either 0 or 1, either 0 or 1.

(v) If $\tilde{A}=\{(x_1,0.2),(x_2,0.3),(x_3,0.5)\}; \mu_{A^2}(x_2)$ equals to
(a) 1.0 (b) 0.25 (c) 0.04 (d) 0.09.

(vi) What is back propagation?
(a) It is another name given to the curvy function in the perceptron.
(b) It is the transmission of error back through the network to adjust the inputs
(c) It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn.
(d) It is a feedforward technique.

(vii) In summer, weather is hot. The hotness can be represented in fuzzy logic by.
(a) Λ MF (b) Γ MF
(c) Gaussian MF (d) Π MF.

(viii) A = {3, 4, 5, 6}; B = {5, 6, 7, 8, 9}; Then A∪B =
(a) {3, 4, 5, 6, 7, 8, 9} (b) {3, 4, 5, 6}
(c) {5, 6} (d) {7, 8, 9}.

(ix) Room temperature is cold. The cold membership function can be represented by
(a) Π MF (b) Γ MF (c) *L* MF (d) Λ MF.

(x) Which of the following(s) is/are found in Genetic Algorithms?
(i) evolution (ii) selection (iii) reproduction (iv) mutation
(a) (i) & (ii) only (b) (i), (ii) & (iii) only
(c) (ii), (iii) & (iv) only (d) all of the above.

Group – B

2. (a) Explain with example the difference between fuzzy set and crisp set.

(b) Consider two given fuzzy sets A and B are:

$$A=\left\{\frac{1}{2}+\frac{0.3}{4}+\frac{0.5}{6}+\frac{0.2}{8}\right\}$$

$$B=\left\{\frac{0.5}{2}+\frac{0.4}{4}+\frac{0.1}{6}+\frac{1}{8}\right\}$$

Perform union, intersection and complement operations over fuzzy sets A and B.

4 + 8 = 12

3. (a) Write the benefits of fuzzy logic.

(b) Using your own intuition, plot the fuzzy membership functions for the age of people.

(c) From the age set of {0, 100} years, develop suitable fuzzy membership function for young people.

4 + 4 + 4 = 12

Group – C

4. (a) Derive the relation matrix using Zadeh implication for the given fuzzy sets C and D:

$$C = \left\{ \frac{0.2}{x_1} + \frac{0.0}{x_2} + \frac{0.9}{x_3} + \frac{0.4}{x_4} \right\}$$

$$D = \left\{ \frac{0.1}{y_1} + \frac{0.3}{y_2} + \frac{0.7}{y_3} + \frac{1}{y_4} \right\}$$

(b) For the two fuzzy sets:

$\cup_x = [10, 20, 30, 40]$

$V_y = [10, 20, 30, 40]$

(i) Design a relational matrix 'R' with the elements of U and V for notion of "*approximately equal*".

(ii) Obtain the fuzzy sets by taking projection R on X and Y axis.

6 + (3 + 3) = 12

5. (a) Establish that controller output (u) is a function of input variables error(e) and change of error (Δe) : $u = f(e, \Delta e)$

(b) With a net block diagram, state the design steps to develop a fuzzy PD controller with necessary mathematical calculations.

3 + 9 = 12

Group – D

6. (a) Obtain the output of the neuron y for the network shown in fig.1 below using activation functions as (i) binary sigmoidal and (ii) bipolar sigmoidal.
The inputs values (*Xo, X1, X2*) are 0.5, 0.4 and 0.8 respectively and their corresponding synaptic weights (w_o, w_1, w_2) are 0.2, -0.3 and 0.3.

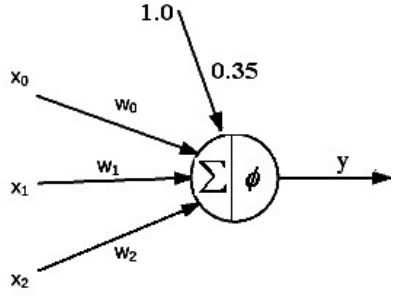

Fig.1

(b) Explain the training algorithms of radial basis function network (RBFN).

6 + 6 = 12

7. (a) How many hidden layers can there be in a neural network?

(b) What is the activation function used in RBFN?

(c) Draw the architecture and list the stages involved in training of back propagation neural network (BPNN).

2 + 2 + 8 = 12

Group – E

8. (a) Write the advantages and limitations of Genetic Algorithm.

(b) With a net flowchart, explain the operation of a simple genetic algorithm.

4 + 8 = 12

9. (a) Explain a general neuro-fuzzy hybrid system with proper block diagram.

(b) State the limitations of neural networks and fuzzy systems when operated individually.

8 + 4 = 12