

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH(EIE)/SEM-8/CS-801C/2012**

**2012**

**SOFT COMPUTING TECHNIQUES**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

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

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) A fuzzy data with membership value 0.5 is called

- |                    |            |
|--------------------|------------|
| a) crossover point | b) core    |
| c) support         | d) centre. |

ii) A sigmoidal membership function is

- |              |                |
|--------------|----------------|
| a) open left | b) open right  |
| c) closed    | d) (a) or (b). |



- iii) Binary fuzzy relation is represented by a
- a) one-dimensional MF      b) two-dimensional MF
  - c) three-dimensional MF    d) none of these.
- iv) A T-norm function satisfies the condition of
- a) monotonicity
  - b) commutativity
  - c) associativity
  - d) all of these mentioned properities.
- v) An S-norm fuction is used to specify in general
- a) fuzzy intersection      b) fuzzy union
  - c) fuzzy complement      d) all of these.
- vi) Extension principle is used to extend
- a) crisp domain to fuzzy domain
  - b) fuzzy domain to crisp domain
  - c) fuzzy data to fuzy domain
  - d) none of these.
- vii) In a general fuzzy inference system, the input can be
- a) only fuzzy                      b) only crisp
  - c) (a) or (b)                      d) none of these.



- viii) ANN is generally used for
- a) learning and adaptation
  - b) decision making
  - c) optimizing
  - d) searching.
- ix) In a recurrent ANN there is/are
- a) at least one feedback path
  - b) more than one feedback paths
  - c) no feedback path
  - d) (a) or (c).
- x) Activation functions are used in
- a) fuzzy systems
  - b) ANN systems
  - c) Genetic algorithm systems
  - d) none of these.
- xi) ANFIS is a
- a) fuzzy system
  - b) ANN system
  - c) Neuro-fuzzy system
  - d) GA system.
- xii) Genetic algorithm is used for
- a) optimization
  - b) searching
  - c) adaptation
  - d) both (a) and (b).



**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.

3 × 5 = 15

2. What is fuzzy extension principle ? A fuzzy set A is given by

$A = 0.1 / -2 + 0.4 / -1 + 0.6 / 0 + 0.8 / 2$  and a function is given by  $f(x) = x^2 - 4$ . Find the fuzzy set  $B = f(A)$  by using the fuzzy extension principle.

2 + 3

3. Consider the following universes of discourse  $X = \{x_1, x_2, x_3\}$  and  $Y = \{y_1, y_2, y_3, y_4\}$ .

- a) The fuzzy set A is given by

$A = 0.6/x_1 + 0.3/x_2 + 0.1/x_3$ . Find the cylindrical extension of A to  $X \times Y$  plane.

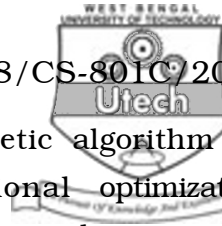
- b) In  $X \times Y$  plane a fuzzy relation is given by the following relational matrix :

R =

0.4	0.3	0.5	0.7
0.3	0.9	0.2	0.1
0.5	1.0	0.5	0.8

Find the extension of this fuzzy relation on X plane.

2 + 3



4. What are the advantages of using genetic algorithm for optimization problems over conventional optimization techniques ? Why is fitness function used in genetic algorithm ? 3 + 2
5. What is a multilayer perceptron network ? Why is a neuro-fuzzy control system more suitable for application than a fuzzy control system ? 3 + 2
6. Prove that the min operator is a T-norm operator. Is Cartesian product a T-norm operator ? Justify. 3 + 2

### GROUP – C

#### ( Long Answer Type Questions )

Answer any *three* of the following. 3 × 15 = 45

7. a) What is membership function ? What are different types of membership functions ? What are the advantages and disadvantages of triangular and trapezoidal membership functions ? What is the advantage of a sigmoidal membership function ?

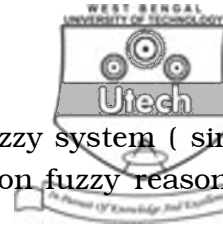
2 + 1 + 2 + 2

- b) A triangular membership function is given by

$$\text{triangle} ( x, 10, 15, 20 ) = \begin{cases} 0 & \text{if } x \leq 10 \\ \frac{x - 10}{15 - 10} & \text{if } 10 \leq x \leq 15 \\ \frac{20 - x}{20 - 15} & \text{if } 15 \leq x \leq 20 \\ 0 & \text{if } x \geq 20 \end{cases}$$

Obtain the fuzzy set for the discrete universe of discourse  $X = \{ 3, 5, 8, 12, 18 \}$ . 4

- c) What is a composite membership function ? What is a two-dimensional membership function ? 2 + 2



8. a) How is the output obtained from a fuzzy system ( single rule with single antecedent ), based on fuzzy reasoning using min-max composition ? 5
- b) Consider the following rules and facts for a fuzzy rule based system :
- rule 1 : if  $x$  is  $A_1$  and  $y$  is  $B_1$  then  $x$  is  $C_1$
- rule 2 : if  $x$  is  $A_2$  and  $y$  is  $B_2$  then  $z$  is  $C_2$
- fact :  $x$  is  $A'$  and  $y$  is  $B'$
- where  $A'$  is close to  $A$  and  $B'$  is close to  $B$ .  $A, A' \in X$ ,  $B, B' \in Y$  and  $C \in Z$ .
- Using fuzzy reasoning and proper diagrams, obtain the fuzzy output. Use min as T-norm operator and max as S-norm operator. 5
- c) Define degree of compatibility and degree of fulfillment in the context of fuzzy reasoning. 2
- d) What is the difference between Mamdani's and Sugeno's fuzzy models ? What are the different defuzzification techniques ? 3
9. a) What is training of an artificial neural network ( ANN ) ? 2
- b) Explain the difference between feed forward and recurrent ANN with suitable layered representations. 2
- c) What are back propagation in ANN and back propagation learning rule ? Write the basic back propagation algorithm. 3
- d) What is Hopfield network ? What is basis of attraction in a Hopfield network ? 2
- e) Draw the layered configuration of a multilayered perceptron ( MLP ), showing the input-output mapping. How is the output of the hidden node calculated in a back propagation MLP ? 6



10. a) What are the parameters used in a classical form of GA ? 4
- b) What are the different selection strategies used in GA dynamics ? Elaborate any one. 4 + 4
- c) What happens if
- i) crossover rate is increased ?
  - ii) mutation rate is increased ?
  - iii) population size is increased ? 3 × 1
11. Write short notes on any *three* of the following : 3 × 5
- a) Compositional rule of inference
  - b) Fuzzy inference system
  - c) Learning vector quantization method of data classification
  - d) Fuzzy backpropagation architecture
  - e) Crossover in genetic algorithm.

=====