Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.TECH (EE)/SEM-1/CIM-103(b)/2010-11
2010-11
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.

Answer Question No. 1 which is compulsory and any *four* from the rest.

1. State whether the following statements are *True* or *False*. Justify your answer : $7 \infty 2 = 14$

   a) Crisp set is a restricted case of fuzzy set.

   b) Normalization of a normal fuzzy set is the set itself.

   c) Fuzzy relations are fuzzy sets that capture the strength of association among elements of two or more sets and not just whether an association exists or not.

   d) Extension principle is used to extend crisp domain to fuzzy domain.

   e) Permutation encoding is most suitable for representing a multiperiod job scheduling problem using simple genetic algorithm.

40196   [Turn over
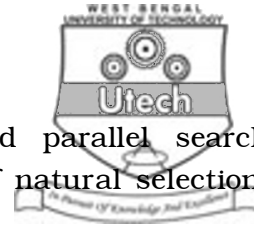
f) Genetic algorithm is a randomised parallel search algorithm based on the principles of natural selection, the process of evolution.

g) Genetic algorithms are used for solving optimization problems and modelling evolutionary phenomena in the natural world.

2. a) What is 'data normalization' ? Why is it important to normalize the input and output data in ANN ?

   b) What do you understand by

   i) linearly separable and

   ii) non-linearly separable patterns ?

   Give examples for both.

   c) Can you use single layer perceptron network to solve 'XOR problem' ? Justify your answer.   3 + 5 + 6

3. a) What is the 'method of steepest descent' ? Explain in brief, how this method is utilized to achieve 'minimum error' in back propagation learning.

   b) In a 3-layer Perceptron Network with 2-input layer neurons, 2-hidden layer neurons and a single output layer neuron, the following training set is used :

Training Sample No.	Input Data		Target Output (O)
	I_1	I_2	
1	0·4	– 0·7	0·1
2	0·3	– 0·5	0·05
3	0·6	0·1	0·3
4	0·2	0·4	0·25
5	0·1	– 0·2	0·12

Assuming the weight vectors are initialized to the following random values show

i) one back propagation training iteration

ii) modified weight matrices

iii) error, before and after one training iteration.

Initial weight matrices

i) between input and hidden layer :

$$[V]^0 = \begin{bmatrix} 0 \cdot 1 & 0 \cdot 4 \\ -0 \cdot 2 & 0 \cdot 2 \end{bmatrix}$$

ii) between hidden and output layer :

$$[W]^0 = \begin{bmatrix} 0 \cdot 2 \\ -0 \cdot 5 \end{bmatrix}.$$

5 + (3 + 3 + 3)

4. a) What do you understand by the term 'competitive learning' ? Describe with the help of suitable diagram, a scheme for update of weight vectors associated with the winner neuron in a competitive learning network.

b) What is 'Self-organizing Map (SOM) ? What are the similarities between SOM and Biological maps ?

c) What is 'neighbourhood function' ? How can 'Mexican Hat' type function be used to modify the lateral connection weights in Kohonen's SOM ?

(2 + 2) + (2 + 3) + (2 + 3)

5. a) Describe the Rosenblatt's Perceptron Model and explain the functions of each of its components.

b) Define the terms (i) Threshold, (ii) Bias, (iii) Activation functions and also explain their functions in an artifical neural network.

c) What is the difference between Mamdani's and Sugeno's fuzzy models ? 5 + 5 + 4
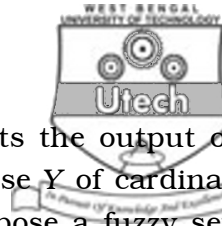
6. a) Suppose that a fuzzy set A represents the output of a process and that it belongs to universe Y of cardinality (number of elements) 5. Again suppose a fuzzy set B represents the control input to the process and it belongs to universe z of cardinality 4. It is given that

$$A = \frac{0 \cdot 2}{y_2} + \frac{1}{y_3} + \frac{0 \cdot 8}{y_4} + \frac{0 \cdot 1}{y_5}$$

$$B = \frac{0 \cdot 1}{z_1} + \frac{0 \cdot 7}{z_2} + \frac{1}{z_3} + \frac{0 \cdot 4}{z_4}$$

Now suppose that a process measurement y_0 is male and that the measurement is closest to the element y_4 in Y. If the crisp set is represented by A_0 having membership function

$$\mu_{A0}(y_i) = [\, 0 \quad 0 \quad 0 \quad 0 \cdot 8 \quad 0 \,]$$

find $\mu_{B'}(z_i)$ using compositional rule of inference.

b) What do you mean by compositional rule of inference ?

$$10 + 4$$

7. a) Illustrate with suitable diagram the operation of a fuzzy logic controller.

b) Discuss defuzzification strategies used in fuzzy logic control. $8 + 6$

8. a) Describe the various components of simple genetic algorithm.

b) Explain how such an algorithm can be used to maximize a function with an example. 15