

(b) Consider  $\tilde{A}(x)$  and  $\tilde{B}(x)$  are two fuzzy set define bellow:

$$\tilde{A}(x) = \{(x_1, 0.5), (x_2, 0.6), (x_3, 0.4), (x_4, 0.7)\}$$

$$\tilde{B}(x) = \{(x_1, 0.8), (x_2, 0.7), (x_3, 0.6), (x_4, 0.9)\}$$

Find out the value of following fuzzy set

(i)  $(\tilde{A} \cap \tilde{B})(x)$ , (ii)  $\tilde{A}(x) + \tilde{B}(x)$  and (iii)  $\tilde{A}(x) \ominus \tilde{B}(x)$ .

**6 + (3 × 2) = 12**

7. (a) Explain different types of fuzzy propositions with a suitable example.

(b) Consider the following GMP Inferencing process

P: If x is $\tilde{A}$ then y is $\tilde{B}$
Q: x is $\tilde{A}$
Therefore y is $\tilde{B}'$

Let two set of variables x and y be  $x = \{x_1, x_2, x_3\}$  and  $y = \{y_1, y_2\}$ . Also consider two fuzzy set  $\tilde{A}$  and  $\tilde{B}$  are  $\tilde{A} = \{(x_1, 0.5), (x_2, 1), (x_3, 0.6)\}$  and  $\tilde{B} = \{(y_1, 1), (y_2, 0.4)\}$ . Now Apply the above Inferencing rule to find  $\tilde{B}'$  when  $\tilde{A}' = \{(x_1, 0.6), (x_2, 0.9), (x_3, 0.7)\}$ .

**6 + 6 = 12**

**Group - E**

8. Consider the decision system presented below represents data related to the scholarship information of a number of students. Find the reducts of the decision system as well as the minimal reducts from the set of reducts obtained. Also, extract the rules on the basis of one of the minimal reducts

#	Degree	CGPA	Backlog	Recommendation	Decision
1	B.Tech	Average	No	High	Granted
2	B.Tech	Fresher	No	None	Not Granted
3	BSc	Low	No	Moderate	Not Granted
	MCA	High	No	None	Granted
5	MCA	Average	No	None	Not Granted
6	MCA	High	No	High	Granted
7	B.Tech	High	Yes	Moderate	Granted
8	BSc	Low	Yes	High	Not Granted

**8 + 1 + 3 = 12**

9. (a) Consider similarity ( $\approx$ ) relation of triangles i.e., two triangles are similar if they have the same set of angles. Prove that similarity relation of triangles is an equivalence relation.

(b) Describe the applications of Particle Swarm Optimization.

(c) Explain the algorithm of Ant Colony Optimization.

**3 + 4 + 5 = 12**

**SOFT COMPUTING  
(MCAP 3171)**

**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)**

- Choose the correct alternative for the following: **10 × 1 = 10**
  - Ranking is a technique used for
    - deleting undesirable members of the population
    - obtaining the selection probabilities for reproduction
    - copying the fittest member of each population into the mating pool
    - preventing too many similar individuals from surviving to the next generation.
  - Let  $X = (10, 20)$ ,  $Y = (5, 15)$ ,  $Z = (15, 15)$  be three solution points in the objective space of a 2-objective minimization problem. Which of the following statements is true?
    - X and Z are mutually non-dominating
    - Y dominates X and Z
    - Both (a) and (b)
    - None of (a), (b) and (c).
  - In order to apply Simulated Annealing (SA), an optimization problem should be formulated as
    - Maximization problem
    - Minimization problem
    - Decision problem
    - Min-Max problem.
  - Fuzzy Computing
    - mimics human behavior
    - doesn't deal with two valued logic
    - deals with information which is vague, imprecise, uncertain, ambiguous, inexact, or probabilistic
    - all of (a), (b) and (c).
  - Which of the following is not true about McCulloch-Pitts neurons?
    - The interconnections are unidirectional
    - All excitatory interconnections have the same weight
    - All inhibitory interconnections have the same weight
    - The activation is bipolar.

- (vi) The effect of the synaptic gap in a biological neuron is modelled in artificial neuron model as
  - (a) the weights of the interconnections
  - (b) the activation function
  - (c) the net input to the processing element
  - (c) none of these.
- (vii) Which of the following ANN learning methods use Euclidean distance between the weight vector and the input vector to compute the output?
  - (a) Perceptron learning
  - (b) Widrow-Hoff learning
  - (c) Winner-takes-all learning
  - (d) Delta learning.
- (viii) Which of the following is not a recurrent network?
  - (a) Bidirectional associative memory
  - (b) Hopfield network
  - (c) Auto associative memory
  - (d) Both (a) and (b).
- (ix) Let  $(x, y)$  and  $(z, w)$  be the pre-images of an element  $p$  under a function  $f$ . The fuzzy membership values of  $x, y, z,$  and  $w$  in a fuzzy set are 0.5, 0.4, 0.7 and 0.2 respectively. What is the fuzzy membership of  $p$  when  $f$  is extended to its fuzzy domain?
  - (a) 0.5
  - (b) 0.4
  - (b) 0.7
  - (c) 0.2.
- (x) Let  $I = (U, A)$  be an information system and  $B \subset A$  and  $X \subset U$ . Then which of the following is defined as the  $B$ -outside region of  $X$ ?
  - (a)  $U - \underline{B}(X)$
  - (b)  $U - \overline{B}(X)$
  - (c)  $\overline{B}(X) - \underline{B}(X)$
  - (d) None of these.

**Group - B**

- 2. (a) Explain the implications of soft computing, also define different applications of soft computing.
- (b) Consider the following table with individuals and their fitness values

Individual :	1	2	3	4	5	6	7	8
Fitness Value :	1.01	2.11	3.11	4.01	4.66	1.91	1.93	4.51

Explain the selection process using Roulette-Wheel selection scheme.

- (c) Consider the following two parents in binary-coded GA. Find out the offspring(s) using two-point crossover technique (crossover points may be selected randomly).

Parent 1:	0	1	1	0	0	0	1	0
Parent 2:	1	0	1	0	1	1	0	0

**(2 + 3) + 4 + 3 = 12**

- 3. (a) Explain the Shuffle crossover technique in connection with binary-coded GA, with an appropriate example.

- (b) Explain with example the following mutation operation in Order GA (Permutation Coded GA) (i) Swap Mutation and (ii) Insertion mutation.
- (c) Obtain the off spring chromosome(s), it will produce from the reproduction of parent chromosomes  $P_1, P_2$  and the following mask, using uniform crossover with crossover mask technique.

P1:	1	1	0	0	0	1	0	1
P2:	0	1	1	0	0	1	1	1
Mask:	1	0	0	1	1	1	0	1

**4 + 4 + 4 = 12**

**Group - C**

- 4. (a) Is sigmoid function in differentiable? Explain.
- (b) Consider a set of six patterns  $S = \{a (-1, 1), b (-1, 2), c (1, 0), d (1, 2), e (2, -1), f(2, 2)\}$  on a two dimensional Euclidean plane. Intuitively, the six points belongs in three clusters  $\{a, b\}, \{d, f\},$  and  $\{c, e\}$ . Explain, the learning process of these clusters by a neural net applying the *winner-takes-all* as its learning strategy.

**3 + 9 = 12**

- 5. (a) Construct and rest an associative discrete Hopfield network with input vector  $[1, -1, 1, 1]$ . Test the network with missing entries in first and fourth components of the stored vector.
- (b) Implement ADALINE training for the AND-NOT function for bipolar inputs and targets.
- (c) Derive the generalized delta learning rule.

**5 + 4 + 3 = 12**

**Group - D**

- 6. (a) Consider  $R = "x \text{ is considerable larger than } y"$  and  $S = "x \text{ is very close to } y"$  are two fuzzy relations given below.

$$R = \begin{pmatrix} & y_1 & y_2 & y_3 & y_4 \\ x_1 & 0.8 & 0.1 & 0.1 & 0.7 \\ x_2 & 0.0 & 0.8 & 0.3 & 0.6 \\ x_3 & 0.9 & 1.0 & 0.7 & 0.8 \end{pmatrix} \quad S = \begin{pmatrix} & y_1 & y_2 & y_3 & y_4 \\ x_1 & 0.4 & 0.0 & 0.9 & 0.6 \\ x_2 & 0.9 & 0.4 & 0.5 & 0.7 \\ x_3 & 0.3 & 0.0 & 0.8 & 0.5 \end{pmatrix}$$

Find out the following fuzzy relations

- (i) "x is considerable larger than y and x is very close to y"
- (ii) "x is considerable larger than y or x is very close to y".