

SOFT COMPUTING
(MCAP 1203)

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) The soft computing technique to deal with vagueness in information systems is
(a) Artificial neural nets (b) Rough set theory
(c) Genetic algorithms (d) None of the above.
 - (ii) The probability of performing mutation in genetic algorithm is considered to be very low because
(a) mutation helps to maintain the diversity in the population
(b) high mutation rate affects the convergence of the algorithm
(c) mutation does not generate new solution
(d) none of these.
 - (iii) Which of the following genetic operators is based on the Darwinian principle of Survival of the fittest?
(a) Selection (b) Crossover (c) Mutation (d) None of the above.
 - (iv) If p_c and p_μ be the crossover probability and the mutation probability of a GA then which of the following relations is true?
(a) $p_c < p_\mu$ (b) $p_c > p_\mu$ (c) $p_c = p_\mu$ (d) None of the above.
 - (v) In which of the following cases Hebb learning does not guarantee that the net will learn the classification task even if it was possible for a Hebb net to learn the task under suitable conditions?
(a) The training set is bipolar (b) The training set is binary
(c) Both (a) and (b) (d) None of the above.
 - (vi) Consider a fuzzy set old as defined below:
Old = {(20,0),(30,0.2),(40,0.4),(50,0.6),(60,0.8),(70,1),(80,1)}. Then the alpha-cut for $\alpha = 0.4$ for the set old will be
(a) {(40, 0.3)} (b) {50, 60, 70, 80}
(c) {(20, 0.1),(30, 0.2)} (d) {(20, 0),(30, 0),(40, 1),(50, 1),(60, 1),(70, 1),(80, 1)}

- (vii) Which of the following is associated with artificial neural nets?
 (a) Vagueness (b) Learning (c) Optimization (d) None of the above.
- (viii) Which of the following selection techniques never selects the worst-fit chromosome of a population?
 (a) Roulette wheel (b) Tournament selection
 (c) Both (a) and (b) (d) None of the above.
- (ix) For standard fuzzy intersection, which of the following hold?
 (a) $\mu_{A \cap B}(x) = \min(\mu_A(x), \mu_B(x))$ (b) $\mu_{A \cap B}(x) = \mu_A(x) \cdot \mu_B(x)$
 (c) $\mu_{A \cap B}(x) = \mu_A(x) - \mu_B(x)$ (d) None of the above
- (x) Consider a fuzzy set $A^{\sim}(x) = \{(a, 0.4), (b, 0.6), (c, 1), (d, 1), (e, 0.8)\}$. The Support of $A^{\sim}(x)$ i.e. $\text{Sup}(A^{\sim})$ is
 (a) $\{b, c, d, e\}$ (b) $\{a, b, e\}$ (c) $\{c, d\}$ (d) None of these.

Group – B

2. (a) Outline the premises of soft computing. [(CO1)(Analyze/IOCQ)]
 (b) Compare between soft and hard computing. [(CO1)(Understand/LOCQ)]
 (c) Explain with suitable examples the Uniform crossover with crossover mask technique. [(CO2)(Understand/LOCQ)]

3 + 4 + 5 = 12

3. (a) Implement “Three parent crossover” technique to obtain the offspring chromosomes from the given parent chromosomes P_1 , P_2 and P_3 .

P_1 :	1	1	0	1	0	0	0	1
P_2 :	0	1	1	0	1	0	0	1
P_3 :	0	0	1	1	0	1	1	0

[(CO2)(Apply/IOCQ)]

- (b) Explain the terms ‘population diversity’ and ‘selection pressure’ in context with the selection phase of Genetic Algorithm? [(CO2)(Understand/LOCQ)]
 (c) Consider the Child chromosome in ordered GA given below

Child Chromosome: 2 5 1 7 6 8 4 3

Apply the following techniques to find out the Mutated chromosome:

- (i) Scramble Mutation, (ii) Inversion Mutation. [(CO2)(Apply/IOCQ)]

4 + 4 + 4 = 12

Group - C

4. (a) Determine the weight after one iteration for Hebbian learning of single neuron network starting with initial weight $w = [1, -1]$, input as $X_1 = [1, -2]$, $X_2 = [2, 3]$, $X_3 = [1, -1]$ and $c = 1$. [use binary activation function] [(CO3)(Apply/IOCQ)]
 (b) What are limitations of single layer perceptron model? How it can be overcome. [(CO3)(Remember/LOCQ)]
 (c) What does the learning rate do in Back-Propagation training? [(CO3)(Remember/LOCQ)]

6 + 4 + 2 = 12

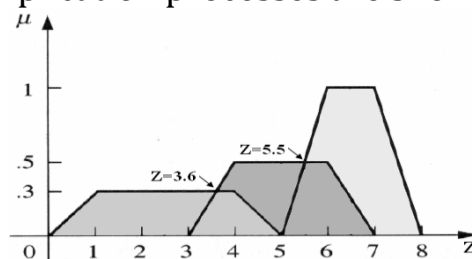
5. (a) For the given training pattern and their respective target,
 $X_1 = [-1, 1, -1]$ $t_1 = -1$
 $X_2 = [1, 1, -1]$ $t_2 = +1$
 Find the weight with a learning rate given as 0.4 and weight initialize as $[0, 0, 0]$,
 Apply ADALINE network for two epochs. [(C03)(Analyze/IOCQ)]
- (b) What is 'delta learning rule'? [(C03)(Understand/LOCQ)]
- (c) Outline the architecture of Hopfield network with suitable example. [(C03)(Analyze/IOCQ)]
- 5 + 2 + 5 = 12**

Group - D

6. (a) Consider $\tilde{A}(x)$ and $\tilde{B}(x)$ are two fuzzy set define bellow:
 $\tilde{A}(x) = \{(x_1, 0.1), (x_2, 0.2), (x_3, 0.3), (x_4, 0.4)\}$
 $\tilde{B}(x) = \{(x_1, 0.1), (x_2, 0.5), (x_3, 0.3), (x_4, 0.6)\}$
 Find out the value of following fuzzy set
 (i) $\tilde{A}(x) - \tilde{B}(x)$ (ii) $\tilde{A}(x) \ominus \tilde{B}(x)$. [(C04)(Understand/LOCQ)]
- (b) Consider R and S be fuzzy relations given below:
 Find max-min and max prod composition. [(C04)(Apply/IOCQ)]
- $$R = \begin{pmatrix} x_1 & y_1 & y_2 & y_3 & y_4 \\ 0.8 & 0.1 & 0.1 & 0.7 \end{pmatrix} \quad S = \begin{pmatrix} z_1 & z_2 & z_3 \\ 0.4 & 0.9 & 0.3 \\ 0.3 & 0.4 & 0.1 \\ 0.9 & 0.5 & 0.8 \\ 0.6 & 0.7 & 0.5 \end{pmatrix}$$
- 4 + 8 = 12**

7. (a) Plot the following membership function for fuzzy set and find singleton, core, cross-over points and support for the same. Why this fuzzy set is said to be normal?
- $$\mu_{\tilde{A}}(x) = \begin{cases} = 0 & \text{if } x \leq a \\ = (x - a) / (b - a) & \text{if } a \leq x \leq b \\ = (c - x) / (c - b) & \text{if } b \leq x \leq c \\ = 0 & \text{if } c \leq x \end{cases}$$
- Where $a = 2$, $b = 4$ and $c = 6$. [(C04)(Apply/IOCQ)]

- (b) The results of three implication processes are shown below:



Find the defuzzyfied output using the following methods:

- (i) Center of Sum (COS), (ii) Center of Gravity (COG). [(C04)(Apply/IOCQ)]

(4 + 2) + 6 = 12

Group - E

8. (a) What do you mean by reducts in rough set theory? Explain the same in brief. [(C05)(Remember/LOCQ)]

(b) Consider the following information system:

	a1	a2	a3
X1	2	1	3
X2	3	2	1
X3	2	1	3
X4	2	2	3
X5	1	1	4
X6	1	1	2
X7	3	2	1
X8	1	1	4
X9	2	1	3
X10	3	2	1

If attribute $B = \{a1, a2, a3\}$ is selected, find out the equivalence classes. Detect the lower approximation, upper approximation, and boundary region of this set.

[(C05)(Evaluate/HOCQ)]

4 + 8 = 12

9. (a) Discuss the behaviour of real ants and compare it with artificial ants.
[(C06)(Remember/LOCQ)]
- (b) 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.
[(C02)(Analyze/IOCQ)]
- (c) Summarize the advantages and disadvantages of PSO.

[(C02)(Understand/IOCQ)]

3 + 5 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33	58.33	8.34

Course Outcomes (CO):

After successfully completing this course, the students will be able to:

1. Understand soft computing concepts, technologies and their role in problem solving.
2. Analyze the genetic algorithms and their applications to solve single-objective and multi-objective optimization problems.
3. Understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.
4. Understand the knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.
5. Understand the need for approximate analysis and computation methods and use the tenets of rough set theory in developing applications.
6. Effectively use of evolutionary algorithms.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question