SOFT COMPUTING
(CSEN 5202)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Let A and B are two fuzzy sets with membership function mx(A), mx(B). Then mx(A ∩ B) is equal to
(a) mx(A)+mx(B) (b) max(mx(A),mx(B))
(c) mx(A)-mx(B) (d) min(mx(A),mx(B))

(ii) **Statement 1:** The membership values of a crisp set can be either 0 or 1
Statement 2: The membership values of a fuzzy set can be between 0 & 1
Statement 3: The membership values of a crisp set can be between 0 & 1
Statement 4: The membership values of a fuzzy set can be either 0 or 1
(a) Both Statement 1 and Statement 2 are false
(b) Both Statement 1 and Statement 2 are true
(c) Both Statement 3 and Statement 4 are true
(d) Statement 2 is false and Statement 3 is true.

(iii) Radial basis function can be used to classify
(a) non-linearly separable classes (b) linearly separable classes
(c) neither (a) nor (b) (d) both (a) and (b)

(iv) A self-organizing feature map (SOFM) has 10 input units, and 100 output units arranged in a two dimensional grid. How many weights does this network have?
(a) 100 (b) 800 (c) 1000 (d) 1500

(v) A neuron with input [x1, x2, x3] = [0 · 3, 0 · 5, 0 · 6] and weights [w1, w2, w3] = [0 · 2, 0 ·1, − 0 · 3], the output of linear transformation in this neuron having bias=0.08 will be
(a) 0.07 (b) -0.07 (c) 0.01 (d) -0.01

(vi) In order to apply GA, an optimization problem should be formulated as
(a) Maximization problem (b) Minimization problem
(c) Decision problem (d) Sorting problem

(vii) For the Travelling Salesman problem in GA encoding which can be adopted is
(a) permutation encoding (b) sequence encoding
(c) value encoding (d) tree encoding

(viii) Which of the following GA operators do not help in exploring the various parts of the search space?
(a) Selection (b) Crossover
(c) Mutation (d) None of the above

(ix) The pareto-front of a population in multi-objective GA consists of
(a) a set of non-dominated solutions
(b) a set of dominated solutions
(c) a set of semi-dominated solutions
(d) a set of partially-dominated solutions

(x) What is Deep Learning?
(a) A type of unsupervised learning
(b) A type of reinforcement learning
(c) A type of machine learning that uses neural networks with multiple layers
(d) A type of semi-supervised learning.

Fill in the blanks with the correct word

(xi) A fuzzy relation is a _____ of Cartesian product.

(xii) Kohonen's Self-Organizing Map (SOM) employ _____ learning.

(xiii) In GA, crossover probability is _____ mutation probability.

(xiv) The _____ selection technique never selects the worst-fit chromosome of a population.

(xv) Deep learning uses _____ multi-layer artificial neural network.

Group - B

2. (a) Consider $A(x)$and $B(x)$are two fuzzy set define below:
$A\ (x) = \{(x1,0.3)\ ,\ \{x2,0.4\}\ ,\ \{x3,0.1\},\ ,\ (x4,0.5)\}$
$B(x) = \{(x1,0.2)\ ,\ (x2,0.8)\ ,(\ x3,0.7)\ ,\ (x4,0.3)\}$.
Find out following fuzzy sets. (i) A(x) ∪ $B(x)$ (ii) $A(x) \cap B(x)$ (iii) A(x) XB(x)
[(CO2)(Remember/LOCQ)]

(b) Consider a set P = {P1, P2, P3, P4} of four varieties of paddy plants, set D = {D1, D2, D3, D4} of the various diseases affecting the plants and S = {S1, S2, S3, S4} be the common symptoms of the diseases. Let R be a relation on P x D and Q be a relation on D x S.

R

	D1	D2	D3	D4
P1	0.0	0.5	0.2	0.8
P2	0.3	0.1	0.3	0.2
P3	0.5	0.0	0.4	0.4
P4	0.8	0.9	0.5	1.0

Q

	S1	S2	S3	S4
D1	1.0	0.9	0.3	0.5
D2	0.9	0.8	1.0	0.8
D3	0.2	0.1	0.5	1.0
D4	0.8	1.0	0.6	1.0

Obtain the association of the plants with the different symptoms of the diseases using max-min composition. *[(CO2)(Apply/HOCQ)]*

(2 × 3) + 6 = 12

3. (a) Two wheelers bikes of a vehicle company can be represented by the following fuzzy sets:
"Powerful Bike" = {0.9/BikeA +0.4/BikeB + 0.8/BikeC + 0.2/BikeD}
"Fast Pickup Bike"={0.5/BikeA+0.8/BikeB+0.6/Bike+0.9/BikeD }.
Find out whether both versions of De Morgan's law is valid for the two fuzzy sets. *[(CO2)(Apply/LOCQ)]*

(b) Two fuzzy relations R and S are as following:

Relation S	Z1	Z2	Z3
Y1	0.9	0.5	0.3
Y2	0.8	0.4	0.7

Relation R	Y1	Y2
X1	0.6	0.3
X2	0.2	0.9

Find the Max-min Composition between R and S. *[(CO2)(Apply/IOCQ)]*

(c) Explain with an example what is Fuzzy truth value. *[(CO2)(Understand/LOCQ)]*

(3 + 3) + 4 + 2 = 12

Group - C

4. (a) Explain training mechanism in a single layered artificial neural network (perceptron) for multi-class data sets using back propagation technique. *[(CO5)(Understand/LOCQ)]*

(b) Explain the main reasons why a Back-Propagation training algorithm might not find a set of weights which minimizes the training error for a given feed-forward neural network. *[(CO5)(Analyze/HOCQ)]*

(c) Explain the purpose of the momentum term that is often included in the Back-Propagation learning algorithm. *[(CO5)(Understand/IOCQ)]*

6 + 3 + 3 = 12

5. (a) Consider the following 2-dimensional points together with their class labels:

x1	**x2**	**Class**
0	0	+1
0	1	+1
1	0	+1
1	1	-1

Find the weight vector after four iterations using single perceptron model. Assume learning rate η = 1, initial weight vector w = [0.5, 0.5]Tand bias = 1. *[(CO5)(Analyse/HOCQ)]*

(b) Describe Radial Basis Network as a classifier. *[(CO5)(Remember/HOCQ)]*

6 + 6 = 12

Group - D

6. (a) Consider a TSP problem with fully connected Graph G(V,E), where |V|=8 and W_{ij} is the weight associated with the edge city v_i and v_j. As per your choice, assign weight of each edge of the graph G and define Chromosomes, fitness function, cross over and mutation in solving the TSP problem instance using genetic algorithm. *[(CO3)(CO4)(Apply/HOCQ)]*

   (b) Discuss the importance of mutation operation in genetic algorithm. *[(CO3)(Remember/LOCQ)]*

8 + 4 = 12

7. Suppose we have the problem of "0-1 knapsack" and maximum weight that the knapsack can hold is 50**.** Now, consider 7 objects with the following (weight, value) pairs (10, 50), (12, 30), (30, 25), (16, 15), (28, 40), (40, 35), (37, 40). The objective is to fill-up the knapsack with the objects such that (i) the total weight of the objects placed inside the knapsack does not exceed 50 and (ii) sum of the values of such objects in the knapsack is maximum.
   Define Chromosomes, fitness function, cross over and mutation in solving this problem using genetic algorithms. *[(CO3)(CO4)(Understand/IOCQ)]*

(4 × 3) = 12

Group - E

8. (a) Discuss concept of dominance in the context of multi-objective optimization problem. *[(CO4)(Analyse/HOCQ)]*

   (b) Let's consider the example of a car manufacturer who wishes to simultaneously reduce the cost of the car and the number of accidents involving the specific model. In the available data set given below, find out which models dominate other models. *[(CO6)(Apply/LOCQ)]*

Model	(Cost, Accidents)
A	(3, 3)
B	(8,10
C	(2, 5)
D	(4, 6)
E	(5, 7)
F	(7, 2)

6 + 6 = 12

9. (a) Explain in details how Neural network be applied in Deep learning. *[(CO5)(Remember/LOCQ)]*

   (b) What type of neural network is more suitable for Deep learning in image processing? Discuss your answer. *[(CO5)(Analyse/HOCQ)]*

7 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	38.54	19.79	41.66