SOFT COMPUTING
(CSEN 5202)

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)   Which one of the following is more likely to be adopted as a mutation probability in genetic algorithm?
   (a) 100%   (b) 80-85%   (c) 50%   (d) 1-2%.

   (ii)   Genetic Algorithm are a part of
   (a) evolutionary computing   (b) static programming
   (c) non evolutionary computing   (d) none of the above.

   (iii)   Supervised learning is
   (a) learning with the help of examples
   (b) learning without teacher
   (c) learning with the help of teacher
   (d) learning with computers as supervisor

   (iv)   Adopting very small population size of GA makes it
   (a) robust   (b) inefficient exploration of search space
   (c) efficient   (d) none of these.

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

   (vi)   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.

   (vii) A 4-input neuron has weights 1, 2, 3 and 4. The transfer function is linear with the constant of proportionality being equal to 2. The inputs are 4, 10, 5 and 20 respectively. What will be the output?
   (a) 238   (b) 76   (c) 119   (d) 123.

(viii) **Statement 1:** Fuzzy logic is same as probabilistic logic.
Statement 2: In artificial neural network number, of hidden layers and number of nodes in each layer before its construction is same.
(a) Both Statement 1 and Statement 2 are false
(b) Both Statement 1 and Statement 2 are true
(c) Only Statement 1 is true
(d) Only Statement 2 is true.

(ix) Higher learning rate in back propagation algorithm makes
(a) rapid learning   (b) slower learning
(c) slow convergence   (d) lower oscillation of weights.

(x) What is perceptron?
(a) A single layer feed-forward neural network with pre-processing
(b) An auto-associative neural network
(c) A double layer auto-associative neural network
(d) A neural network that contains feedback.

Group- B

2. (a) What is soft computing technique? Suppose we are going to solve TSP with 'n' number of cities, then what is the time complexity to get all possible solutions.
[(CO1)(Remember/LOCQ)]

(b) A = {1/a, 0.3/b, 0.2/c 0.8/d, 0/e},
B = {0.6/a, 0.9/b, 0.1/c, 0.3/d, 0.2/e}
Find for A and B independently:
(i) Support
(ii) Core
(iii) Cardinality.   [(CO2)(Understand/LOCQ)]
(3 + 3) + 6 = 12

3. (a) Write the benefits of fuzzy set theory over classical set.
[(CO2)(Remember/LOCQ)]
(b) The mobile characteristics are defined as speed and cost. The fuzzy set for 'High speed' sand 'Costly' linguistic variable are given as
High Speed= { 1/1 + 0.8/2+0.5/3 +0.3/4 + 0.1/5)
Costly = { 0/1+ 0.2/2+ 0.4/3 + 0.7/4 + 0.9/5), respectively .
Determine the linguistic variable 'Slightly Costly', 'Very high speed' and 'Not very high speed' and 'Not Costly'.   [(CO2)(Understand/IOCQ)]
2 + (2.5 × 4) = 12

Group - C

4. (a) What are the different ANN architectures? Explain with figures.
[(CO5)(Remember/HOCQ)]
(b) Describe radial basis function network as classifier.   [(CO4)(Analyze/LOCQ)]
6 + 6 = 12

5. (a) Suppose input features space has four dimensions and we have a classification problem with four classes. Now it is also given that all the data sets are linearly separable. Suggest neural network architecture to classify this input dataset.

    [(CO5)(Understand/IOCQ)]

    (b) Describe the architecture of Kohonen self-organizing feature maps.

    [(CO6)(Understand/LOCQ)]

    6 + 6 = 12

Group - D

6. (a) Discuss different types of crossover methods in genetic algorithm.

    [(CO3)(Remember/IOCQ)]

    (b) Explain the roulette wheel algorithm.   [(CO3)(Understand/LOCQ)]

    (c) What is the impact of population size of Genetic Algorithm?

    [(CO3)(Remember/IOCQ)]

    5 + 5 + 2 = 12

7. Suppose we have the problem of "Bin Packing "and maximum capacity of each bin is **10.** Now, consider 10 objects with the following weights
    5, 2, 7, 3, 5, 6, 8, 4, 4, 7.
    Define Chromosomes, fitness function, cross over and mutation in solving this problem using genetic algorithms.   [(CO5)(Understand/IOCQ)]

    (4 × 3) = 12

Group - E

8. (a) Define multi objective optimization problem. Discuss with example, the role of Pareto front in solving the problem.   [(CO5)(Analyse/HOCQ)]

    (b) What is non-dominated solution in a Multi Objective Optimization problem?

    [(CO5)(Remember/IOCQ)]

    7 + 5 = 12

9. Briefly discuss any three of the followings:
    (i) Gradient Descent Algorithm
    (ii) Hebbian Learning Model
    (iii) Deep Learning Neural Network
    (iv) Competitive Learning Model.   [(CO5)(Understand/HOCQ)]

    (4 × 3) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.3	41.67	25.03

Course Outcome (CO):

After completion of course, students would be able to:
CO1. Learn (remember) and understand soft computing techniques and their roles in building intelligent machines.
CO2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
CO3. Design (create) methodology to solve optimization problems using genetic algorithms
CO4. Analyze and evaluate solutions by various soft computing approaches for a given problem.
CO5. Understand various models of artificial neural networks and their applications in solving pattern recognition and machine learning problems.
CO6. Develop intelligent systems leveraging the paradigm of soft computing techniques.

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