7. (a) Consider a four input single node perceptron with bipolar sigmoid function.

$$A(net) = \frac{2}{1+exp^{-\lambda net}} - 1,$$

where λ is set to 1.

The set of input and desired output training patterns are as follows:
{ $X^{(1)}$ = (1, -2, 0 , -1)^T, $d^{(1)}$ = - 1}, { $X^{(2)}$ = (0 , -1.5, -0.5, -1)^T, $d^{(2)}$ = - 1},
{ $X^{(3)}$ = (-1, 1, 0.5, -1)^T, $d^{(3)}$ = 1}.

The initial weight vector is chosen as W = [1, -1, 0, 0.5] ^{T}, and the learning constant η = 0.1.

Apply delta-learning rule and find out W with those inputs.

(b) Implement a Neural Network (without using RBF) such that it can cluster the outputs of XOR.

7 + 5 = 12

Group - E

8. (a) What is ANFIS? What are the two options available for FIS training using ANFIS parameter optimization method?

(b) When to do we use Neuro-Adaptive Learning?

(4 + 2) + 6 = 12

9. (a) How is Chaos related to non-linear dynamic systems? What makes a Chaos System?

(b) Give Lorenz's solution with the initial condition s = 10.0, b = 8/3, r = 28.0, and a non-dimensional time step of 0.0005. When do you get convection and chaotic motions?

3 + (3 + 6) = 12

ADVANCED SOFT COMPUTING
(CSEN 5223)

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 of the following functions is differentiable?
(a) Bipolar sigmoid function   (b) Unit step function
(c) Threshold function   (d) Hard limit function.

(ii) Which of the following artificial neural networks uses competitive learning?
(a) The Hopfield network
(b) Bi-directional Associative Memory
(c) Self-organizing feature map
(d) Multi-layer feed forward network.

(iii) A 4-input neuron has weights 1, 2, 3 and 4. The transfer function is linear with the constant of proportionality being equal to 1. The inputs are 8, 10, 5 and 20 respectively. The output will be:
(a) 123   (b) 76   (c) 119   (d) 125.

(iv) Which activation function is applicable in "Delta" learning rule?
(a) Unipolar and bipolar sigmoid function
(b) Unit step function
(c) Signum function
(d) Ramp function.

(v) Which of the following kinds of classification problems can be solved by a perceptron?
(a) Linearly seperable   (b) Non-linearly seperable
(c) Both (a) and (b)   (d) None of the above.

(vi)   Operation that is not applicable over fuzzy subsets A and B of X are.
        $A = \{1/a, 0.3/b, 0.8/c \; 0.6/d, 0.2/e\}$, $B = \{0.9/a, 0.9/b, 0.7/c, 0.3/d, 0.2/e\}$
        (a) a-cut $A_{0.3}$, $A_{0.2}$ (b) $A \cup B$
        (c) card(A)   (d) strong a-cut (A).

(vii)   Which of the following neural networks uses supervised learning?
        (a) Bi-directional Associative Memory
        (b) Self-organizing feature map
        (c) Hopfield network
        (d) Back propagation for Multi layer feed forward network.

(viii) Defuzzification is necessary, since controllers of physical systems require
        (a) composite signals   (b) discrete signals
        (c) analog signals   (d) none of these.

(ix)   In rough set theory $\underline{B}(T) = \{X | [X]_B \subseteq T\}$ represents
        (a) lower approximation   (b) upper approximation
        (c) boral set   (d) boundary region of T.

(x)   Which of the following algorithms is not a Heuristic technique?
        (a) Gravitational Search Algorithm   (b) Ant Colony Optimization
        (c) Genetic algorithm   (d) Frog leap algorithm.

Group – B

2.(a)   Explain Fuzzy Logic Rule Base with an Example

(b)   A = {0.5/a, 0.8/b, 1/c, 0.9/d, 0.2/e}
        B = {0.8/a, 0.2/b, 0.7/c, 0.6/d, 0.1/e}

        Find for *A* and *B* independently:
            (i) Support   (ii) Core   (iii) Cardinality.
                                    6 + (2 + 2 + 2) = 12

3.(a)   What are the Defuzzification processes?

(b)   Explain any one of Centroid method or Weighted-Average Method.
                                    6 + 6 = 12

Group - C

4.(a)   Suppose you have a function f(X) = $5X^3 + 5X^2 - 2X$. Now, you have to find the minimum value of f(X) using Genetic Algorithm for $0 \leq X \leq 255$. Encode the problem and explain the cross over operation.

(b)   Compare "Rank selection" and ordinary "Roulette wheel Selection".

(c)   Find a suitable fitness function for Homogeneous Bin packing Problem, where 3, 4, 6, 7, 4, 6, 4, 3, 6, 5, 4, 4, 3, 4, 1 are the weights of individual objects. Assume bin capacity as 10 units.
                                    (4 + 2) + 6 = 12

5.(a)   Define soft computing in terms of intractability and Big data.

(b)   Briefly describe "schemata" concept in the light of convergence of Genetic algorithm.

(c)   You are asked to solve the Travelling Salesman problem for a complete graph consisting of 8 nodes (numbered 1, 2, ... 8) using Genetic Algorithm. How can you represent the solutions in the chromosomal form.

(d)   Explain the method of calculating fitness value of such chromosomes and crossover operation with examples.

(e)   What is the computational complexity of Exhaustive search for TSP problem?
                                    2 + 2 + 2 + (2 + 2) + 2 = 12

Group - D

6.(a)   What is associative memory?

(b)   Differentiate between linear associative memory and hetero associative memory.

(c)   Consider a BAM memory. **X** and **Y** are Input and Output vectors respectively.
        $X_1 = \{1, 1, 1, -1\}$, $X_2 = \{1, 1, -1, -1\}$, $X_3 = \{-1, 1, -1, -1\}$
        $Y_1 = \{1, 1, -1\}$, $Y_2 = \{1, -1, -1\}$, $Y_3 = \{1, -1, -1\}$
        Create weight matrix **W**.
                                    2 + 4 + 6 = 12