

## **Module 1: INTRO TO SC**

**(Page no. are given so don't include first Header page )**

- Definitions - Computing, Hard Computing, Soft Computing - 2
- Difference between Hard and Soft Computing -2
- Goals of Soft Computing -2
- Constituents of Soft Computing -3
- Characteristics of Neuro-Computing and Soft Computing - 3
- Applications of Soft Computing - 4
- Learning and its Types – 4
  - Supervised,
  - Unsupervised, and
  - Reinforcement.

## **Module 2: ANN – 6**

- Intro to ANN - 7
- Neuron (Biological Concept) - 7
- Comparison of Biological vs. Artificial Neuron - 8
- Characteristics of ANN - 9
- Structure of ANN - Weights, Bias, Threshold, Learning Rate, Activation Function. - 9
- Activation Functions – Discrete, Continuous. - 10
- Discrete Activation Functions – 10
  - Identity function.
  - Binary Step function.
  - Bipolar Step function.
- Continuous Activation Functions – 11
  - Binary Sigmoidal function.
  - Bipolar Sigmoidal function.
  - RAMP function.
- Neural Network Architectures – 12
  - Single Layer Feedforward network.
  - Multi-Layer Feedforward network.
  - Recurrent network.
- McCulloch-Pitts Neuron Model. - 14
- Hebbian Learning Rule. - 15
- Winner Takes All. - 15
- Back Propagation Network (BPN) - 16
- Perceptron Network. - 19
- Linear Separability. - 19
- Self-Organizing Maps (SOMs). - 20
- Kohonen Network (KSOMs). - 21
- Linear Vector Quantization (LVQs). - 22

## **Module 3: FUZZY SET THEORY**

- Fuzzy Logic and the Need for Fuzzy Logic. - 43
- Classical and Fuzzy Sets. - 43
  - Properties of Crisp Sets.
  - Operations on Crisp Sets.
  - Degree of Membership.
  - Properties of Fuzzy Sets.
  - Operations on Fuzzy Sets.
- Classical and Fuzzy Relations - 46
  - Crisp Cartesian Product.
  - Crisp Relations.
  - Properties of Crisp Relations.
  - Operations on Crisp Relations.
  - Composition on Crisp Relations (w/ Example).
  - Fuzzy Cartesian Product.
  - Fuzzy Relations.
  - Properties of Fuzzy Relations.
  - Operations on Fuzzy Relations.
  - Composition on Fuzzy Relations (w/ Example).
- Tolerance and Equivalence Relations - 50
  - Crisp Tolerance and Equivalence.
  - Fuzzy Tolerance and Equivalence.
- Membership Functions. - 51
  - Methods for assigning membership values.
  - Features of membership functions.
- Fuzzification. - 53
- De-Fuzzification. - 54
- Lambda  $\lambda$ -cut (alpha-cut). - 58
- Fuzzy Extension Principle. - 59

*Refer hand-written notes for **Types of Membership functions & Fuzzy Controller (MAMDANI) sums.** (index given below at bottom )*

## **Module 4: FUZZY SET THEORY - 60**

- Introduction to Hybrid Systems. - 61
- Neuro-Fuzzy Hybrid Systems. - 62
  - Co-Operative NFS.
  - General NFS.
- Fuzzy Inference System. - 63
- ANFIS. - 65
- Hybrid Learning Rule. - 67

## **Module 5: INTRODUCTION TO OPTIMIZATION TECHNIQUES - 68**

- Introduction to Optimization. - 69
- Derivative Based Optimization. - 69
  - Steepest (Gradient) Descent.
  - Newton Method.
- Derivative Free Optimization. - 72
  - Simulated Annealing.
  - Random Search.
  - Downhill Simplex Search.

## **Module 6: GENETIC ALGORITHMS AND ITS APPLICATIONS - 77**

- Introduction to GA. - 78
- Simple GA (Algorithm). – 79
- Inheritance Operators. - 80
- Bitwise Operators. - 81
- Encoding. - 83
- Selection Techniques. - 85
  - Roulette Wheel, Random, Rank, Tournament, Elitism.*
- Crossover Techniques. - 86
  - Single Point, Two Point, Multi Point, Uniform, Three Parent, Reduced Surrogate, Shuffle, Ordered, Partially Matched (PMX), Precedence Preservative (PPX).*
- Mutation Techniques. - 89
  - Flipping, Interchanging, Reversing.*
- Replacement Techniques. - 90
  - Random, Weak Parent, Both Parents.*
- Convergence of GA. – 90
- Advantages and Disadvantages. - 91
- Applications of GA. - 91

## Extra Notes Index

- MP neuron – 3
- Learning Method – 7
- Unsupervised Learning – 9
- Reinforced Learning – 10
- Linear Separability – 11
- Kohonen's Self Organizing Network – 14
- Linear Vector Quantization – 17
- Fuzzy Set Theory – 20
- Optimization Technique – 26
- Newton's Method – 28
- Mamdani Model Sum - 30