Soft Computing

Semester III	Subject Code: MS31903	Lectures: 60

Objectives:
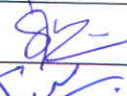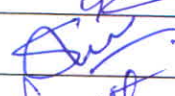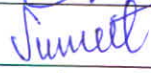
The syllabus aims in equipping students with,
- Fuzzy Logic and applications
- Neural Network and applications
- To understand the concepts of how an intelligent system work and its brief development process.

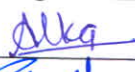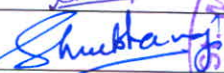| Unit 1: Introduction to Fuzzy Logic	16
Chapter 1.Introduction • The Illusion : Ignoring Uncertainty and accuracy • Uncertainty and information • Fuzzy set and membership • Chance versus Fuzziness	2
Chapter 2. Classical Sets and Fuzzy Sets • Classical Sets • Fuzzy Sets	3
Chapter 3. Classical Relations and Fuzzy Relations • Cartesian Product • Crisp Relations • Fuzzy relations • Tolerance and equivalence Relations • Fuzzy Tolerance and equivalence Relations • Value assignments • Other Forms of the Composition Operations	4

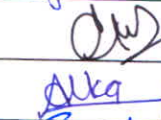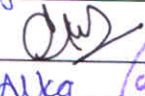| Sr. No.	BOS member		Sign
1	Dr. Razak Sayyed	Subject Expert	
2	Prof. Abhijit Sathe	Subject Expert	
3	Prof. Sonali Deshmukh	Subject Expert	
4	Mr. Sumeet Kakroo	Industry Expert	
5	Ms. Jyoti Sharma	Alumni	
6	Prof. Ashwini Kulkarni	Chairman	
7	Prof. Alka Kalhapure	Internal Faculty	
8	Prof. Shubhangi Jagtap	Internal Faculty	
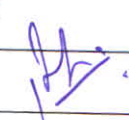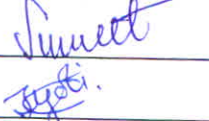
Chapter 4. Properties of Membership Functions, Fuzzification, and Defuzzification • Features of the membership Function • various forms • Fuzzification • Defuzzification to Crisp set • λ-Cuts for fuzzy Relations • Defuzzification to Scalars,	4
Chapter 5. Logic and Fuzzy Systems • Fuzzy Logic- Approximate Reasoning, Others forms of implication operations, Natural Language, Linguistic Hedges • Fuzzy (Ruled-Based) system- Graphical technique of inference, Membership value assignment-Intuition, Inference.	3
Unit 2: Fuzzy System and Classification	12
Chapter 6. Fuzzy System Simulation • Fuzzy Relation, Equations • Nonlinear Simulation Using Fuzzy Systems • Fuzzy Associative Memories.	2
Chapter 7. Fuzzy Classification • Classification by Equivalence Relations • Cluster Analysis • Cluster Validity • c-Means Clustering • Hard c-Means, Fuzzy c-Means • Classification Metric • Hardening the Fuzzy c-Partition • Similarity Relations from Clustering.	5
Chapter 8. Fuzzy Arithmetic and Extension Principle • Extension Principle • Fuzzy Arithmetic • Interval Analysis in Arithmetic	5

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• Approximate Methods of Extension.	

Unit 3: Neural Network	**18**
Chapter 9. Neural Networks and Architectures • Neural networks: Artificial Neural Network- Definition, Advantages of Neural Networks Application Scope of Neural Networks • Fundamental Concept- Artificial Neural Network, Biological Neural Network, Brain vs. Computer-Comparison Between Biological Neuron and Artificial Neuron (Brain vs. Computer) • Artificial Neurons, Neural Networks and Architectures- Neuron Abstraction, Neuron Single Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feedforward and Feedback, Salient Properties of Neural Networks	6
Chapter 10. Geometry of Binary Threshold Neurons and Their Networks • Geometry of Binary Threshold Neurons and Their Networks-Pattern Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are Pattern Dichotomizers, Non-linearly Separable Problems, Capacity of a Simple Threshold Logic Neuron, Revisiting the XOR Problem, Multilayer Networks, How Many Hidden Nodes are Enough?	6
Chapter 11. Supervised Learning:Perspetron and LMS • Learning and Memory: An Anecodatal Introduction • Long Term Memory • The Behavioral Approach to Learning • The Molecular Problem of Memory • Learning Algorithms • Error Correction and Gradient Descent Rules • Learning Objective for TLNs	6

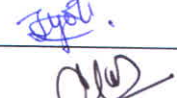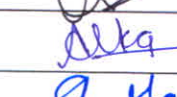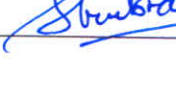| Sr. No.	BOS member		Sign
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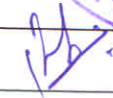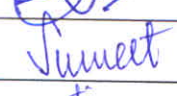
- Pattern Space and Weight Space.
- Linear Seperabilty
- Hebb Network
- Perceptron Network.
- α- Least Mean Square Learning
- MSE Error Surface and Its Geometry
- Steepest Descent Search with Exact Gradient Information
- μ-LMS: Approximate Gradient Descent
- Application of LMS TO Noise Cancelation.

Unit 4: Genetic Algorithms	2

Chapter 12. Genetic Algorithms
- A Gentle Introduction to Genetic Algorithms: What is Genetic Algorithm?
- Robustance of Traditional Optimization and Search Methods
- The Goals of Optimization
- A simple Genetic Algorithm

*Contact hours – 12 hours

Reference Books:

1. Wiley Publication, *Fuzzy Logic With Engineering Applications,* Timothy Ross , 3rd Edition
2. McGraw-Hill, *Neural Networks* , Satish Kumar.
3. Wiley Publication, *Introduction to Soft Computing*, Deepa &Shivanandan.
4. Pearson Education, *Genetic Algorithms in Search, Optimization and Machine Learning* , David   E. Goldberg

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