

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E

Communication Engineering

Subject Name: **Soft Computing Technique and its Application in Engineering**

Sr.No	Course content
1	Introduction to Soft Computing: Introduction, Importance of Soft Computing, Main Components of Soft Computing, Fuzzy Logic, Artificial Neural Networks, Introduction to Evolutionary Algorithms, Hybrid Intelligent Systems
2	Artificial Neural Network and Supervised Learning: Introduction, Comparison of Neural Techniques and Artificial Intelligence, Artificial Neuron Structure, Adaline Model, ANN Learning, Back-Propagation Learning, Properties of Neural Networks, Limitations in the Use of Neural Networks.
3	Factors Affecting the Performance of Artificial Neural Network Models Network Complexity, Neuron Complexity, Number of Layers, Number of Neurons in Each Layer, Type and Number of Interconnecting Weights, Problem Complexity, Range of Normalization of Training Data, Type of Functional Mapping, Sequence of Presentation of Training Data, Repetition of Data in the Training Set, Permissible Noise in Data, Learning Complexity, Training Algorithms of ANN
4	Development of Generalized Neuron and Its Validation Existing Neuron Model, Development of a Generalized Neuron (GN) Model, Advantages of GN, Learning Algorithm of a Summation Type Generalized Neuron, Benchmark Testing of Generalized Neuron Model, Ex-OR Problem, The Mackey-Glass Time Series, Character Recognition Problem
5	Applications of Generalized Neuron Models
6	Application of GN Models to Electrical Machine, Electrical Load Forecasting Problem, Load Frequency Control Problem, Power System Stabilizer Problem, Aircraft Landing Control System Using GN Model
7	Introduction to Fuzzy Set Theoretic Approach Introduction, Uncertainty and Information, Types of Uncertainty, Introduction of Fuzzy Logic, Historical Development of Fuzzy Logic, Difference Between Precision and Significance, Fuzzy Set, Operations on Fuzzy Sets, Fuzzy Intersection, Fuzzy Union, Fuzzy Complement, Fuzzy Concentration, Fuzzy Dilation, Fuzzy Intensification, α -Cuts, Fuzzy Quantifier/Modifier/Hedges, Characteristics of Fuzzy Sets, Fuzzy Singleton, Height, Cardinality,
8	Properties of Fuzzy Sets: Commutative, Associative, Distributive Property, Idem Potency, Identity Involution, Excluded Middle Law, Law of Contradiction, Demorgan's Law, Transitive, Fuzzy Cartesian Product, Various Shapes of Fuzzy Membership Functions, Methods of Defining of Membership Functions, Fuzzy Compositional Operators, Fuzzy Relation, Operation of Fuzzy Relation, Projection and Cylindrical Extension, Approximate Reasoning, Defuzzification Methods, Fuzzy Rule Based System

9	Applications of Fuzzy Rule Based System Introduction, System's Modeling and Simulation Using Fuzzy Logic Approach, Selection of Variables, their Normalization Range and the Number of Linguistic Values, Selection of Shape of Membership Functions for Each Linguistic Value, Determination of Overlapping of Fuzzy Sets, Selection of Fuzzy Intersection Operators, Fuzzy Union Operators, Implication Methods, Compositional Rule, Defuzzification Method,
10	Control Applications: Adaptive Control, PID Control System, Fuzzy Control System, Power System Stabilizer Using Fuzzy Logic
11	Genetic Algorithms Introduction, History of Genetics, Genetic Algorithms, Crossover, Mutation, Survival of Fittest, Population Size, Evaluation of Fitness Function, Effect of Crossover Probability on GA Performance, Effect of Mutation Probability on GA Performance, Main Components of GA, Variants, Applications of Genetic Algorithms
12	Applications of Genetic Algorithms to Load Forecasting Problem
13	Integration of Neural Networks and Fuzzy Systems Introduction, Adaptive Neuro-Fuzzy Inference Systems, Constraints of ANFIS, HIV/AIDS Population Model Using Neuro-Fuzzy Approach
14	ANN – GA-Fuzzy Synergism and Its Applications Introduction, Training of ANN, Advantages of GA, ANN Learning Using GA, Validation and Verification of ANN-GA Model.

Reference Books:

1. Soft Computing Techniques and its Applications in Electrical Engineering
2. Devendra K. Chaturvedi, Springer
3. Fuzzy Logic with Engineering Applications
4. Timothy J Ross, John Wiley & Sons.
5. Neuro-Fuzzy and Soft Computing Lee Jng, Chuentsaisun, E G Maizutani, PE India.