NEURAL & FUZZY SYSTEMS
(ELECTIVE-II)

Course Code:13EE2216 **L P C**
4 0 3

Pre requisites: Optimization & Set Theory

Course Educational Objectives: To impart the knowledge of Neural Networks and Fuzzy Logic Control and use these for controlling real time systems.

Course Outcomes: At the end of the course, the student

1. achieves an understanding of the technical potential and the advantages and limitations of the learning and self organizing systems of today
2. can apply the methods and produce applications in their working life
3. gets exposure with the new and exciting applications of "vague" knowledge processing and experience the impact on popular dynamical systems

UNIT-I Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT-II FEED FORWARD NEURAL NETWORKS

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the

Perceptron Model, Applications. Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT-III ASSOCIATIVE MEMORIES

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT-IV
SELF ORGANIZING MAPS AND ADAPTIVE RESONANCE THEORY

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications.

NEURAL NETWORK APPLICATIONS: Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

UNIT-V CLASSICAL & FUZZY SETS

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

TEXT BOOKS:

1. Jacek M. Zuarda, "*Introduction to Artificial Neural Systems*", Jaico Publishing House, 1997.

2. Timothy.J.Ross," *Fuzzy logic with Engineering Applications*", International Editions 1997, TMH Publishers**.**

REFERENCES:

1. N. Yadaiah and S. Bapi Raju "*Neural and Fuzzy Systems Foundation, Architectures and Applications*", Pearson Education.

2. James A Freeman and Davis Skapura, "*Neural Networks* ", Pearson, 2002.

3. Simon Hykins "*Neural Networks*", Pearson Education.

4. C. Eliasmith and CH. Anderson, "*Neural Engineering*", PHI.

5. Bork Kosko "*Neural Networks and Fuzzy Logic System*", PHI Publications.

6. Rajasekharan and Rai "*Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications*" PHI Publication. Ion