NEURAL & FUZZY SYSTEMS
(ELECTIVE-II)

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

Pre requisites: Optimization & Set Theory.

Course Outcomes: At the end of the course, the student will be able to

CO1: Identify the difference between Biological and Artificial neuron models and their learning strategies

CO2: Solve problems related to feed forward neural networks

CO3: Apply the knowledge of Associative memory architecture and Hopfield network to solve Problems.

CO4: Apply the knowledge of Self Organizing Maps and Adaptive Resonance Theory in solving problems.

CO5: Measure the fuzziness involved in various systems and applies fuzzy set theory knowledge in solving problems.

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