

## EC541 - NEURAL NETWORKS & FUZZY SYSTEMS (Elective I)

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### Course objectives

- To know the models of brain as a neuron
- To obtain the knowledge of learning strategies and learning rules
- To obtain the knowledge of feed forward and feedback network.
- To obtain the knowledge of logical components etc.,

### Course Outcome

- Obtains the knowledge of Neuron model of a brain.
- Understands how different learning strategies and learning rules can be applied to various applications.
- Knows how Fuzzy logic can be useful to solve different problems.

**UNIT – I (9 hours) Introduction to Neural Networks:** Introduction, Organization of the Brain, Biological and Artificial Neuron Models, Integrate-and-Fire Neuron Model, McCulloch-Pitts Model, Characteristics of ANN, 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 (9 hours) Single Layer & Multi-layer 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 (9 hours)

**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 Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

**Neural network applications:** Process identification, control, fault diagnosis and load forecasting.

**UNIT – IV (9 hours) Classical & Fuzzy Sets :** Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

**UNIT – V (9 hours) Fuzzy Logic System Components:** Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**Fuzzy logic applications:** Fuzzy logic control and Fuzzy classification.

### TEXT BOOKS:

1. Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication.
2. S.N.Sivanandam, S.Sumathi, S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0 "TMH, 2006
3. J.M.Zurada, "Artificial Neural Networks".
4. Timothy.J.Ross, "Fuzzy logic Applications".

### REFERENCES:

1. James A Freeman and Davis Skapura, "Neural Networks", Pearson Education, 2002.
2. Simon Hakins, "Neural Networks", Pearson Education
3. C.Eliasmith and CH.Anderson, "Neural Engineering", PHI  
Bart Kosko, "Neural Networks & Fuzzy systems".