17ES021 NEURAL NETWORKS & FUZZY SYSTEMS

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P
45	15	-

WA/RA	SSH/HSH	CS	SA	S	BS
15	30	-	5	5	-

Course Objectives:

This course aims at introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.

Course Outcomes:

- Understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
- Understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems

SKILLS:

- Evaluate the learning strategies and learning rules
- Designing of feed forward and feedback network
- Familiarized with different logical components
- Ability to solve different Fuzzy logic based problems
- Knowledge to apply various learning strategies and learning rules

ACTIVITIES:

- Multi-layer feedforward networks: Matlab Implementation
- Applications using matlab
- Design and implement a neural network simulation (with two modes ofoperation: learning and processing) using a high-level language C++.
- A Matlab based simulation study to neuro-fuzzy system.
- Assess the power and usefulness of artificial neural networks in severalapplications including speech synthesis, diagnostic problems, business andfinance, robotic control, signal processing, computer vision and many otherproblems that fall under the category of pattern recognition

Unit – I

Introduction to Neural Networks: Introduction, Organization of the Brain, testing. 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

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

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

Classical & Fuzzy Sets : Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Unit-V

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

REFERENCE BOOKS:

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 Pearson Education, 2002.
4. Bart Kosko, “Neural Networks & Fuzzy systems”. Pearson Education, 2002.
5. Driankov D., Hellendoorn H. & Reinfrank M.,..An Introduction to Fuzzy Control., Narosa Publications,1993.