**Elective III: Soft Computing Techniques**

**Unit I:** Introduction to Neuro: Fuzzy and Soft Computing: Soft Computing Constituents and Conventional AI; Neuro-Fuzzy and Soft Computing Characteristics. Fuzzy Sets: Introduction Set Theoretic Operations, MF Formulation and Parameterization, Fuzzy Union, Intersection and Complement. Fuzzy Rules and Fuzzy Reasoning: Extension Principles and Fuzzy Relations, Fuzzy If-Then Rules; Fuzzy Reasoning.

**Unit II:** Fuzzy Inference Systems: Mamdani Fuzzy Models; Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations. Derivative-Free Optimization: Introduction, Genetic Algorithms; Simulated Annealing; Random Search, Downhill Simplex Search.

**Unit III:** Adaptive Networks: Introduction, Architecture; Feed-forward Network; Extended Back-propagation for Recurrent Networks; Hybrid Learning Rule. Supervised Learning Neural Networks, Perceptrons, Back-propagation Multi-layer Perceptrons, Radial Basis Function Networks.

**Unit IV:** Unsupervised Learning and Other Neural Networks: Competitive Learning Networks, Kohonen Self-Organizing Networks; Learning Vector Quantization; Hebbian Learning, Principal Component Networks, Hopfield Networks.

**Unit V:** Adaptive Neuro-Fuzzy Inference System: ANFIS Architecture, Hybrid Learning Algorithm, ANFIS as Universal Approximator. Data Clustering Algorithms: K-Means Clustering; Fuzzy C-Means Clustering, Mountain Clustering Method; Subtractive Clustering.

**Unit VI:** Rulebase Structure Identification: Input Selection, Input Space partitioning, Rulebase Organization, Focus Set-based Rule Combination. 32 Applications: Printer Character Recognition, Hand-written Numeral Recognition, GA-based Fuzzy Filters.

**Text Books:** 1. Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence; Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani; Prentice Hall, 2004.

2. Artifical Intelligence and Soft Computing, Anindita Das, Shroff Publication.

**Reference Books:** 1. Fuzzy Logic with Engineering Applications; Timothy J. Ross; McGraw-Hill; 1997.

2. Genetic Algorithms: Search, Optimization and Machine Learning; Davis E. Goldberg; Addison Wesley; 1989.

3. Neural Networks, Fuzzy Logic and Genetic Algorithms; S. Rajasekaran and G. A. V. Pai; Prentice Hall of India; 2003.