SOFT COMPUTING TECHNIQUES

Course Code: 13EE2113 **L P C**
4 0 3

Pre requisites: Basic knowledge of optimization.

Course Educational Objectives:

1. To get introduced to the soft computing concepts and techniques such as Artificial Neural Networks (ANN) , Fuzzy Logic (FL), Genetic Algorithms (GA), Particle Swarm Optimization (PSO) which form an alternate paradigm to classical optimization techniques.
2. To recognize the feasibility of applying a soft computing technique to a particular optimization problem
3. To apply soft computing techniques to hard real life optimization problems which cannot be solved with classic techniques.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply neural networks to power engineering optimization problems
2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3. Apply genetic algorithms to combinatorial optimization problems
4. Apply particle swarm optimization technique to optimization problems

UNIT-I

ARTIFICIAL NEURAL NETWORKS (ANN) - I : (Fundamentals, Feed forward/Feedback Networks) Introduction, ANN Basic Building Blocks and Terminologies, ANN Models, Learning Rules, Perceptron Networks (Single layer / Multi layer), Feed Forward Networks- Back Propagation Networks (BPN), Feedback Networks - Hopfield Net, Applications.

UNIT-II

ARTIFICIAL NEURAL NETWORKS (ANN) - II: (Associative Memory Networks, SOM and ART)

Associative Memory Networks – Algorithms for pattern association, Hetero Associative Memory Neural Networks, Auto Associative Memory Networks, Bidirectional Associative Memory (BAM) Network,

Relation between BAM and Hopfield Nets. Self-Organizing Feature Maps (SOM) – Kohonen SOM, Learning Vector Quantization (LVQ). Adaptive Resonance Theory (ART) – Fundamentals, ART1, ART2.

UNIT-III FUZZY LOGIC :

Fuzzy Set Theory- Fuzzy versus Crisp, Crisp Sets, Fuzzy Sets – Membership Function, Crisp Relations, Fuzzy Relations, Fuzzy Systems-Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Applications.

UNIT-IV

GENETIC ALGORITHMS (GA) :

GA Fundamentals-Basic concepts, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Genetic Modeling – Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators, Bit-wise Operators used in GA, Generational Cycle, Convergence of GA, Applications, Multi-level Optimization, Differences and Similarities between GA and other traditional methods, Advances in GA.

UNIT-V

PARTICLE SWARM OPTIMIZATION (PSO) :

Basic concepts, Swarm intelligence, population, velocity updation, particle- best (pbest), global-best (gbest), velocity initialization, solution, Applications.

Text Books:

1) S. N. Sivanandam, S. Sumathi, S. N. Deepa, "*Introduction to Neural Networks using MATLAB 6.0*", TMH, 2006 (Unit-I,II)
2) S. Rajasekharan and G.A. Vijayalakshmi Pai, "*Neural Networks, Fuzzy Logic, Genetic Algorithms - Synthesis and Applications*", First Edition, PHI Publication, 2012 (Unit III,IV)
3) Clerc, M. "*Particle Swarm Optimization*". First Edition, Wiley-ISTE, 2006 (Unit-V)

Reference Books:

1) J. S. R. Jang, C.T. Sun and E. Mizutani, "*Neuro-Fuzzy and Soft Computing*", Pearson Education, 2004.

2) N. Yadaiah and S. Bapi Raju, "*Neural and Fuzzy Systems*": Foundation, Architectures and Applications,Pearson Education, 2010.
3) Timothy J.Ross, "*Fuzzy Logic with Engineering Applications*", John Wiley & Sons, 2009.
4) Jacek M. Zurada, "*Introduction to Artificial Neural Systems*", 1st Edition, Jaico Publishing House, 2007.
5) F. Karray and C. De Silva, "*Soft Computing and Intelligent Systems Design, Theory, Tools and Applications*", Prentice Hall, 2004.