References:

1. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak
2. Nonlinear Programming by Dimitri Bertsekas

Practicals:

1. Hands-on practice with optimization algorithms and tools.
2. A small project to apply optimization techniques to various problems.
3. A comprehensive project to formulate and solve a complex optimization problem. 4. Reviewing and analyzing optimization problems in real-world scenarios.

DSE – 20
Soft Computing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Soft Computing	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. *To teach students the fundamentals of soft computing and its applications.*
2. *To give students knowledge of neural networks, fuzzy systems and hybrid systems.*

Learning Outcomes:

1. To Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities.
2. Soft Computing is a consortia of methodologies which collectively provide a body of concepts and techniques for designing intelligent systems.

UNIT-I **(5 Hours)**

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

UNIT-II **(10 Hours)**

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

UNIT-III **(15 Hours)**

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification, Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

UNIT-IV **(15 Hours)**

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems. GA based Weight Determination, K - factor determination in Columns.

References:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
2. Genetic Algorithms: Search and Optimization, E. Goldberg.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Practicals:

1. Train a simple perceptron or multilayer perceptron to learn the XOR logic gate using Python or MATLAB.
2. Use Python (TensorFlow or Keras) to implement a backpropagation neural network to classify simple data like digits or shapes.
3. Write a simple genetic algorithm in Python to find the maximum value of a mathematical function (e.g., `f(x) = x * sin(x)`).
4. Use scikit-fuzzy (Python) or MATLAB to cluster sample data (e.g., customer behavior data) using fuzzy C-means algorithm.
5. Use MATLAB's ANFIS editor to train and test a fuzzy-neural model for function approximation or prediction.