IV B. Tech – I Semester
(20EE7331) POWER SYSTEM OPTIMIZATION & TECHNOLOGY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisite: Power Systems, Mathematics

Course Objectives
1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
2. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
3. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
4. To introduce evolutionary programming techniques.
5. To introduce basic principles of Genetic Algorithms and Partial Swarm Optimization methods.

Syllabus

Unit – 1: Introduction and Classical Optimization Techniques
Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

Unit – 2: Linear Programming
Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

Unit – 3: Nonlinear Programming
Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method.
Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

Unit – 4: Introduction to Evolutionary Methods
Evolutionary programming methods - Introduction to Genetic Algorithms (GA)– Control parameters –Number of generations, population size, selection, reproduction, crossover and mutation – Operator selection criteria – Simple mapping of objective function to fitness function – constraints – Genetic algorithm steps – Stopping criteria –Simple examples.

Unit – 5: Introduction to Swarm Intelligence Systems

Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

Course Outcomes

S. No	Course Outcomes	BTL
1.	State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem and apply different classical optimization problems.	L5
2.	Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.	L5
3.	Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.	L3
4.	Able to apply Genetic algorithms for simple electrical problems.	L3
5.	Able to solve practical problems using PSO.	L3

Correlation of COs with POs& PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	3	3	2	2	3				1		1		2	
CO 2	3	3	2	2	3				1		1		2	
CO 3	3	3	2	2	3				1		1		2	
CO 4	3	3	2	2	3				1		1		2	
CO 5	3	3	2	2	3				1		1		2	

1 – Weak, 2 – Moderate and 3 - Strong

Text Books:
1. "Engineering optimization: Theory and practice"-by S. S. Rao, New Age International (P) Limited, 3rd edition, 1998.Signals and Systems – A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, Second Edition, 1997.
2. Soft Computing with Matlab Programming by N. P. Padhy & S. P. Simson, Oxford University Press – 2015

Reference Books:
1. "Optimization methods in operations Research and Systems Analysis" by K. V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by David
3. E. Goldberg, ISBN:978-81-7758-829-3, Pearson by Dorling Kindersley (India) Pvt. Ltd.
4. "Operations Research: An Introduction" by H. A. Taha, PHI pvt. Ltd., 6th edition. Linear Programming by G. Hadley.