EE455: OPTIMIZATION OF POWER SYSTEMS
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To introduce fundamentals of optimization theory to students with specific focus on applications for power systems.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				
L	T	P	C	Theory		Practical		Total Marks
				ESE	CE	ESE	CE	
3	0	2	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**<u>Introduction to Optimization:</u>** Engineering applications of optimization, Statement of an optimization Problem, Classification of optimization problems, Optimization techniques, Solution of optimization problems using MATLAB, Gurobi, GLPK, OpenSolver etc.	07
2	**<u>Classical Optimization Techniques:</u>** Single-Variable optimization, Multivariable Optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with inequality constraints, Convex programming problem.	07
3	**<u>Linear Programming :</u>** Applications of 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 of the simplex method, Simplex algorithm, Two phases of the simplex method, MATLAB Solution of LP Problems.	07

Unit No.	Topics	Teaching Hours
4	**<u>Economic Load Dispatch of Thermal Generating Units:</u>** Generator operating cost, Economic dispatch problem on a bus-bar, Optimal Generation Scheduling, Economic dispatch using Newton-Raphson method, Classical method to calculate loss coefficients, Loss coefficient calculation using YBUS, Loss coefficient calculation using sensitivity factors, Transmission loss coefficients, Transmission loss formula as a function of generation and loads, economic load dispatch using exact loss formula, economic load dispatch using loss formula as a function of real and reactive power, economic dispatch for active and reactive power balance.	07
5	**<u>Infrastructure Planning:</u>** Nodal placement and sizing, Problem types and greedy algorithms, Power sources, Multiple scenarios, Energy storage, Transmission expansion, Basic approach, Linearized models, Branch flow approximation, Relaxations, Feasibility issues.	07
6	**<u>Power System Economics:</u>** Background, Lagrangian duality, Pricing and the welfare theorems, Game theory, Electricity markets, Nodal pricing, Multi-period and dynamic pricing, Transmission cost allocation, Pricing under non-convexity, Market power, Supply function equilibrium, Complementarity models, Capacitated price competition.	07
	TOTAL	**42**

List of References:

1. Singiresu S. Rao, "*Engineering Optimization: Theory and Practice*", 3rd Edition, New Age International, 2013.
2. D.P.Kothari and J.S.Dhillon, "*Power System Optimization*", 2nd Edition, PHI Learning Private Ltd., 2011.
3. Joshua Adam Taylor, "*Convex Optimization of Power Systems*", Cambridge University Press, 2015.
4. Jizhong Zhu, "*Optimization of Power System Operation*", 2nd Edition, John Wiley and Sons, 2009.

Course Outcomes (COs):

1. Comprehend the engineering applications of optimization.
2. Understand and analyze the classical optimization techniques.
3. Apply optimization theory to power system domain.
4. Formulate and solve optimization problem for economic load dispatch of thermal generating units.
5. Formulate and solve optimization problem for infrastructural planning problems of power system.
6. Formulate and solve optimization problem for power system economics problems.