Power System Operation, Control and Optimisation

Code	CreditHours
EEE-800	3-0

CourseDescription

This advanced course delves into the comprehensive study of power system operation, control, and optimization, integrating technical, economic, and practical perspectives. The curriculum encompasses power and energy interchange, power pools, production cost models, and the intricacies of generation control, including automatic generation control. It also addresses power system security, contingency analysis, and optimization techniques for enhancing system performance. Through a blend of lectures, practical sessions, and hands-on projects, students will gain the skills needed to tackle contemporary challenges in power system operations, with a strong emphasis on optimization strategies for efficient and reliable power delivery.

Textbook

1. Power generation, operation & Control, Allen Wood & B. Wollenberg (Latest edition)
2. Optimization—Theory and Practice by Wilhelm Forst , Dieter Hoffmann (2010 Edition) Published by Springer.

ReferenceBook

1. Power Systems Analysis, Arthur R. Bergen, Prentice-Hall (2^{nd} Edition)
2. Power System Analysis, John, J. Grainger & W. D. Stevenson, McGraw-Hill (Latest edition)

Prerequisites

1. Steady-state analysis of single-phase and three-phase circuits
2. Elements of transient analysis and basics electromagnetic field theory
3. Principles of electric machines, transformers, and transmission lines
4. Per-unit system and representations
5. Please also review Linear Systems for definition of a vector, a matrix, matrix sum and products, determinants, matrix inverse

ASSESSMENTSYSTEMFORTHEORY

Quizzes	10-15%
Assignments	5-10%
MidTerms	25-30%
Project	5-10%
ESE	45-50%

TeachingPlan

Week No	Topics	LearningOutcomes
1	Introduction and Overview	Understand the basic components and configurations of power systems.Identify the primary functions of power system operation and control.
2-6	Power and Energy Interchange, Generation Control, Power System Security	Explain the concepts of power pools and energy markets. Analyse economic dispatch and load scheduling problems.Develop production cost models for powersystems.Understand the principles of generation control. Differentiate between primary, secondary, and tertiary control.Implement automatic generation control (AGC) strategies.Define power system security and its importance.Conduct contingency analysis for power systems.Develop strategies for N-1 and N-2 contingency planning
7-8	Introduction to Optimization Economic Dispatch and Unit Commitment	Understand the fundamentals of optimization.Formulate linear programming (LP) problems.Apply the simplex method to solve LP problems.Formulate and solve economic dispatch problems.Understand unit commitment and its importance in power systems.Apply mixed-integer programming (MIP) to unit commitment problems.Formulate and solve optimal power flow (OPF) problems.Apply techniques for solving non-linear programming problems
9	**MIDTERMEXAM**	
10-12	Dynamic Programming, Metaheuristic Algorithms, Convex Optimisation	Understand the principles of dynamic programming.Apply dynamic programming to hydro-thermal coordination.Manage energy storage using dynamic programming techniques. Understand the principles of metaheuristic algorithms.Apply genetic algorithms and particle swarm optimization to power systems.Use simulated annealing and other heuristics for power system optimization.
13-17	Convex Optimisation , Distributed Optimisation, Multi Objective Optimisation	Understand the basics of convex optimization.Apply convex relaxations to non-convex power system problems.Optimize voltage control and network reconfiguration using convex optimization.Understand the principles of decentralized control and optimization.Apply distributed optimization techniques to microgrids.Control distributed generation using decentralized approaches. Conduct Pareto optimal optimisation on power flow algorithm.

18	**FINALEXAM**