EE803 POWER SYSTEM OPTIMIZATION 3-0-0-3

Course Description:

This course gives an overview of modern heuristic techniques and covers specific applications of heuristic approaches to power system problems, such as optimal power flow, power system scheduling and operational planning, power generation expansion planning, reactive power planning, transmission and distribution planning, and power system control.

Objectives:

- Understand the advantages of heuristic over classical methods.
- Solve the generation and transmission expansion planning problem.
- Solve the reactive power planning problem.
- Solve the economic dispatch problem, optimal power flow problem.
- Solve the power system control problem.

UNIT 1:

Introduction: Power system optimization, Emerging optimization methods and application to power system. **Classical Vs Heuristic methods:** types of classical methods and heuristic methods, no free lunch theorem, advantages like simplicity, broad applicability, robust to dynamic changes, hybridization, and parallelism.**Fundamentals of Simulation Annealing:** Introduction, metropolis and SA algorithm, cooling schedule, and parallel SA.**Fundamentals of Genetic Algorithm:** Introduction, Encoding, Fitness Function, Selection methods, crossover, mutation operations, niching methods.**Fundamentals of Particle Swarm optimization:** Introduction, original PSO, discrete PSO, Hybrid PSO, lbest PSO, adaptive PSO, evolutionary PSO.

Application of SA: Travelling salesman problem and Transmission network expansion planning problem, solution by SA.**Application to System Planning: Part I:**Formulation of generation expansion and transmission expansion problems, Use of GA, PSO and SA for solving Generation expansion planning, and transmission expansion planning at transmission level and distribution level.

UNIT 2:

Fundamentals of Ant Colony search optimization: Introduction, behavior of real ants, ant system, ant colony system, max-min ant system, characteristics of ant colony search.**Fundamentals of Differential Evolution:** Introduction, DE fundamentals, operators of DE, and modification of DE.

Application to System Planning: Part II: Use of GA, PSO, SA, and DE for solving reactive power planning problem at transmission level and distribution level. **Application to Scheduling: Part I:**Formulation of economic dispatch problem and maintenance scheduling problem, Use of GA, PSO, ACS, and DE for solving Economic dispatch problem (Encoding, constraint handling, smooth/ non-smooth cost function, parameter tuning and result analysis), and maintenance scheduling (total operating cost, maintenance cost, penalty, and objective function).

UNIT 3:

Application to Scheduling: Part II: Formulation of optimal power flowproblem, Use of GA, PSO, ACS, and DE for solving optimal power flow (without and with line capacity / voltage limits).**Application to Power System Controls: Part I**: Formulation of Volt-Var control problem, Use of GA, PSO, ACS, and DE for solving VVC (volt-Var

control).**Application to Power System Controls: Part II:** Formulation of power plant controller design problem, Use of GA, PSO, ACS, and DE for solving power plant controller design (PI design).

TEXT BOOKS / REFERENCES:

1. Kwang Y. Lee, Mohamed A. El-Sharkawi, "Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems" IEEE Press Series on Power Engineering.

2. D. P. Kothari and J. S. Dhillon, "Power System Optimization", PHI Learning Pvt. Ltd., 2010.
3. Yong-Hua Song, "Modern Optimisation Techniques in Power Systems (Intelligent Systems, Control and Automation: Science and Engineering), First Edition, Springer.
4. Jizhong Zhu, "Optimization of Power System Operation, IEEE Press Series on Power Engineering.
5. James A. Momoh, "Electric Power System Applications of Optimization", CRC Press, 2000.
6. Loi Lei Lai, "Intelligent System Applications in Power Engineering: Evolutionary Programming and Neural Networks", John Wiley, 1998.