Optimization Techniques (AEPE3006)

Course Objectives

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming,
- Constrained and unconstrained optimization techniques for solving and optimizing real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

Course Outcomes

After completing the course, students will be able to:

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problems
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

Module 1: Introduction and Classical Optimization Techniques

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.

Classical Optimization Techniques: 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.

Module 2: Linear Programming

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.

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

Module 3: Unconstrained Nonlinear Programming

Unconstrained Nonlinear Programming**:** One-dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method.

Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method.

Module 4: Constrained Nonlinear Programming

Constrained Nonlinear Programming: Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

Module 5: Dynamic Programming

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Textbooks:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt.
   Ltd., 2004

Reference Books:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.