IV Year II Semester 17EE831

L	Т	Р	С
3	1	0	3

OPTIMIZATION TECHNIQUES (Professional Elective-III)

Preamble:

Optimization techniques have gained importance to solve many engineering design problems by developing linear and nonlinear mathematical models. The aim of this course is to educate the student in developing a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming technique. This course covers classical optimization techniques, linear programming, nonlinear programming and dynamic programming techniques.

Learning objectives:

- 1. To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- 2. To state single variable and multi variable optimization problems, without and with constraints.
- 3. To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- 4. To state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.
- 5. To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
- 6. To explain Dynamic programming technique as a powerful tool for making a sequence of interrelated decisions.

Unit – I

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.

Unit – II

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.

Unit – III

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 – IV

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 – Special cases in transportation problem.

Unit – V

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 – VI

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.

Learning Outcomes:

- 1. State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- 2. Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- 3. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- 4. Solve transportation and assignment problem by using Linear programming Simplex method.
- 5. 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.
- 6. Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Text books:

- 1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
- 2. "Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer (India), Pvt. LTd.

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. Operations Research by Dr. S.D.Sharma, Kedarnath, Ramnath & Co.