Subject Name : Optimization Techniques
Subject Code : CE 606-4 / IT 606-4

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
03	00	04	07	5	3	70	30	20	30	150

Learning Objectives:

- Introduction to optimization techniques using both linear and non-linear programming. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization too. After an adequate introduction to linear algebra and probability theory, students will learn to frame engineering minima maxima problems in the framework of optimization problems.

By the end of the course, students should be able to:

- Cast engineering minima/maxima problems into optimization framework.
- Learn efficient computational procedures to solve optimization problems.
- Use Matlab to implement important optimization methods.

Outline of the Course:

Sr. No	Title of the Unit	Minimum Hours
1	Mathematical preliminaries	12
2	Linear programming	12
3	Unconstrained optimization	8
4	Constrained optimization	6
5	Non-linear programming	7

Total hours (Theory): 45

Total hours (Lab): 60

Total hours: 105

Detailed Syllabus:

Sr. No	Topic	Lecture Hours	Weightage(%)
1	**Mathematical preliminaries** • Linear algebra and matrices • Vector space, eigen analysis • Elements of probability theory • Elementary multivariable calculus	12	20
2	**Linear Programming** • Introduction to linear programming model • Simplex method • Duality • Karmarkar's method	12	20
3	**Unconstrained optimization** • One-dimensional search methods • Gradient-based methods • Conjugate direction and quasi-Newton methods	8	20
4	**Constrained Optimization** • Lagrange theorem • FONC, SONC, and SOSC conditions	6	20
5	**Non-linear problems** • Non-linear constrained optimization models • KKT conditions • Projection methods	7	20
	Total	**45**	**100**

Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

Learning Outcome:

On successful completion of the course, the student will:

- Be able to model engineering minima/maxima problems as optimization problems.
- Be able to use Matlab to implement optimization algorithms.

Reference Books:

1. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak
2. Nonlinear Programming by Dimitri Bertsekas

List of experiments:

Sr. No	Name of Experiment
1	Matrix operations in Matlab
2	Differentiation of a vector and matrix in Matlab
3	Integration of a vector and matrix in Matlab
4	Simplex algorithm in Matlab
5	Implementation of Newton's method in Matlab
6	Implementation of Secant method in Matlab
7	Implementation of Lagrange multiplier method in Matlab
8	Implementation of KKT theorem in Matlab
9	Implementation of BFGS method in Matlab