Course Code	Course Title	L	T	P	C
20SE010	STRUCTURAL OPTIMIZATION	3	0	0	3

PRE-REQUISITE COURSES: ENGINEERING MATHEMATICS

COURSE OBJECTIVES:

To study the optimization methodologies applied to structural Engineering. The concepts of design optimization and review major conventional and modern optimization methods used in structural optimization applications and the formulation of structural optimization problems. Students get knowledge in linear and non-linear programming and exposed to unconstrained and constrained optimization. Understand direct and indirect methods, direct search and gradient methods.

COURSE OUTCOMES:

At the end of the course student will be able to

CO's	Course Outcomes	PO's
1	Attain knowledge in various optimization techniques used in structural design	1
2	Understand the linear programming and Non- linear programming in optimization	1,2
3	Become expertise in various computer methods used in optimization	1
4	Understand the diagnosis and assessment of distress	1,2
5	Apply the applications in Structural Engineering	1,3

SKILLS:

- ✓ Aptitude to select the variables affecting a given phenomenon, so as to model the same.
- ✓ Ability to apply optimization techniques using Mat-Lab.

UNIT-I:

INTRODUCTION: Formulation of Structural Optimization problems: Design variables - Objective function – constraints - Fully stressed design - Review of Linear Algebra: Vector spaces, basis and dimension, canonical forms - Single variable optimization - Multivariable optimization with no constraints

UNIT –II:

LINEAR AND NON LINEAR PROGRAMMING: Linear Programming: Revised Simplex method - Application to structural Optimization - Nonlinear Programming: Deterministic Methods - Unconstrained and constrained Optimization - Kuhn-Tucker conditions, Direct search and gradient methods - One dimensional search methods - DFP and BFGS algorithms, constrained Optimization - Direct and Indirect methods – Successive Linear Programming(SLP), Sequential quadratic programming(SQP) and SUMT, Application of Non-Linear Programming (NLP) methods to optimal structural design problems.

UNIT-III:

OPTIMALITY CRITERIA BASED METHODS: Reanalysis techniques - Approximation concepts - Design sensitivity, Optimization of sections, steel and concrete structures - framed structures, bridge structures.

UNIT-IV:

STOCHASTIC OPTIMIZATION METHODS: Stochastic Optimization Methods: Genetic Algorithms - Binary coding - Genetic Operators - Simple Genetic Algorithm (SGA) and variable length Genetic Algorithm (VGA) - Simulated annealing - Applications to discrete size, Configuration and shape optimization problems.

UNIT-V:

ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS: Artificial Intelligence and Artificial Neural Networks based approaches for structural optimization problems. **STRUCTURAL APPLICATIONS**: Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory.

TEXT BOOKS:

1. Haftka, R. T. and Gurdal, Z., "Elements of Structural Optimization", Springer, 3rd Edition, 1992.
2. Gurdal, Z, Haftka, R. T., and Hajela, P., "Design and Optimization of Composite Materials", Wiley, 1998. s
3. Choi, K. K. and Kim, N. H. "Design Sensitivity Analysis for Linear and Nonlinear Structures", Springer, 2005.

REFERENCES:

1. Arora, J. S., "Introduction to Optimum Design", Elsevier, 2nd Edition, 2004.
2. Rao. S. S. "Optimization Theory and Applications", Wiley Eastern (P) Ltd., 1984.
3. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997

4. Spunt, “Optimization in Structural Design”, Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
5. Uri Krish, “Optimum Structural Design”, McGraw Hill Book Co. 1981