Course Code	Course Title	L	T	P	C
17CE020	STRUCTURAL OPTIMISATION	3	0	0	3

Course Objectives:

1. To introduce the concepts of design optimization and review major conventional and modern optimization methods used in structural optimization applications.
2. To understand the formulation of structural optimization problems.
3. To get familiarized with the application of linear and non-linear programming to structural optimization.
4. To get exposed to unconstrained and constrained optimization.
5. To understand direct and indirect methods, direct search and gradient methods.

Course Outcomes:

At the end of the course student will be able

1. To understand the causes of failure of structures.
2. To diagnose distress of structures.
3. To analyze the debonding pattern of externally plated members
4. To understand the significance of orientation of RC buildings.

Activities:

1. Identify the variables affecting a complex phenomenon and to perform a sensitivity analysis on them.
2. Solve a given Simplex problem using Mat-Lab.

Skills:

1. Aptitude to select the variables affecting a given phenomenon, so as to model the same.
2. 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.

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.

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.
3. K. K. Choi and N. H. Kim, "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.