STRUCTURAL OPTIMIZATION

I Semester: ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BSTB08	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

Structural optimization is a discipline dealing with optimal design of load-carrying mechanical structures. A growing subfield of structural optimization is topology optimization, where a typical problem might be as follows: Given a predefined design domain (in two or three dimensions), some given supports in connection to the design domain, some given external loads, and a given material to be used, the problem consists of designing an optimal structure to carry the given loads. This should be done by finding the optimal subdomain, of the given design domain, to fill with material. The objective might be to minimize the total weight of the structure subject to constraints on displacements and stresses in the structure under the given loads. In order to attack this problem numerically, the design domain is discretized by a finite element model. One thus considers a discretized universe" in which for each individual discrete point.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The principles of structural optimization and be able to solve them analytically.
II. Structural optimization problems in the framework of calculus of variations as well as finite-variable optimization.
III. Contemporary literature on structural optimization in general and topology optimization in particular.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:		
CO 1	Classify optimization and various techniques.	Understand
CO 2	Solve various linear and Non-linear problems.	Apply
CO 3	Solve a problem by geometric programming and dynamic programming.	Apply
CO 4	Apply optimization to various structural elements	Apply
CO 5	Apply optimization to various structural elements	Apply
CO 6	Evaluate optimization to various structural elements	Evaluate

SYLLABUS

UNIT-I	INTRODUCTION	Classes: 09

Definition, Variables, Objective Function, Constraints, Simultaneous Failure Mode and Design, Classical External Problems

UNIT-II	CALCULUS OF VARIATION	Classes: 09
Differential calculus, Optimality criteria, Variational Principles with Constraints, Single variable optimization Multivariable optimization		
UNIT-III	**LINEAR PROGRAMMING**	**Classes: 09**
Integer Programming, Nonlinear Programming, Dynamic Programming, Geometric Programming and Stochastic Programming. Problem formulation, Graphical solution, Analytical method, Standard form, Slack, surplus and artificial variables		
UNIT-IV	**APPLICATIONS**	**Classes: 09**
Structural Steel and Concrete Members, Trusses and Frames, Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory.		
UNIT-V	**DESIGN**	**Classes: 09**
Frequency Constraint, Design of Layouts, Minimum weight design for truss members, Fully stressed design-Optimization principles to design of R.C. structures such as multi-storey buildings.		
Text Books:		
1. Spillers, William R, Keith M. MacBain, "Structural Optimization", Springer, 2009. 2. M. P. Bendsoe, O. Signmund, "Topology Optimization: Theory, methods and Applications" Springer.		
Reference Books:		
1. Haftka, Raphael T., Gürdal, Zafer, "Elements of Structural Optimization", Third Revised and Expanded Edition, kluver academic publishers. 2. Andrej Cherkaev, "Variational methods for Structural optimization", Springer.		
Web References:		
http://nptel.ac.in/courses/112108211/25		
E-Text Books:		
http://eprints-phd.biblio.unitn.it/1343/1/PhD.pdf		