CE6730 - Structural optimization

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:0

Course Type: Theory

Description: To impart the knowledge of applying optimization algorithms to obtain optimum design of structures. To improve understanding of the mathematical basics and formulation to solve optimization problems. To enable making the choice of an appropriate optimization tool, and estimating the numerical effort.

Course Content: 1. Formulation of Structural Optimization problems: Design variables - Objective function - constraints. Fully stressed design. 2. Review of Linear Algebra: Vector spaces; basis and dimension; canonical forms. Linear Programming; Revised Simplex method, application to structural optimization. 3. Numerical Optimization Techniques: Nonlinear Programming fundamentals 4. Unconstrained Optimization: Direct search and gradient methods; one dimensional search algorithms; DFP and BFGS algorithms 5. Constrained Optimization: Kuhn-Tucker conditions;- SLP, SQP and Sequential Unconstrained Minimization Technique (SUMT); Penalty function 6. Application to Optimal Structural Design Problems: Optimality criteria based methods; Reanalysis techniques; Approximation concepts; Design sensitivity; Optimization of sections, steel and concrete structures, framed structures, bridge structures. 7. Evolutionary Computational Methods: Genetic Algorithms; Binary coding; Genetic Operators; Selection schemes; sharing and inching; genetic modeling; discrete size and topology / shape optimization; multi-objective optimization; Simple Genetic Algorithm (SGA) and Variable length Genetic Algorithm (VGA) application to problems. 8. Other Methods: Simulated annealing; Applications to discrete size; Configuration and shape optimization problems; Artificial Intelligence and Artificial Neural Networks based approaches for structural optimization problems.

Text Books

1. Haftka, R.T. and Gardaíz, Elements of Structural Optimization, 3rd Ed., Springer, 1992.

2. Arora, J.S., Introduction to Optimum Design, 2nd Ed Elsevier, 2004.

3. Rao, S.S., Engineering Optimization: Theory and Practice, 4th Ed., John Wiley and Sons, 2009.

4. Morris, A.J., Foundations of Structural Optimization - A Unified Approach, 3rd Ed., John Wiley and Sons, 2003.

5. Choi, K.K. and Kim, N.H., Design Sensitivity Analysis for Linear and Nonlinear Structures, Springer, 2005.

6. Deb, K., Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 1995

7. Michalewicz, Z., Genetic Algorithms +Data Structures = Evolution Programs, Springer Verlag, 1996.

Reference Books: NIL

Prerequisite: NIL

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