OPTIMUM STRUCTURAL DESIGN

Instructor: Fazıl Önder Sönmez

Class hours: Wednesdays 10.00–11.00 (M 2152), 11.00–12.00 (M 1200), 16.00–17.00 (M 2171)

Office hours: Mondays 10.00–12.00, Wednesdays 13.00–15.00, or drop by

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Assistant: Mustafa Şengör, mustafa.sengor@boun.edu.tr

Prerequisite: CmpE 150: Introduction to Computing, ME 345: Mechanics of Materials

Course Objectives: Applying optimization algorithms to obtain optimum design of structures (to minimize the weight (or cost) or to maximize performance); improving understanding of the mathematical basics, the ability to make a mathematical formulation to solve optimization problems, to make the choice of an appropriate optimization tool, and estimate the numerical effort.


Grading:

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Projects</td>
<td>26%</td>
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<td>Quizzes</td>
<td>18%</td>
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<td>Midterms</td>
<td>30%</td>
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<td>Final</td>
<td>26%</td>
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No make-up exam unless in emergency with written excuse.
Midterms and final are closed book and notes. Only one A4 paper is permitted containing formulas.

Week   Topics
1      Introduction: Comparison of analysis and design formulations; basic concepts of design optimization (design variable, objective function, constraint, design domain, feasible region); types of design optimization: Size, shape, and topology optimization
2-4    Classical tools in structural optimization
       Differential Calculus, Variational Calculus, Lagrange Multipliers, Karush-Kuhn-Tucker conditions
       Quiz 1
       Quiz 2
       Midterm 1
5-6    Linear programming: Simplex method
       Quiz 3
       Nonlinear Programming I: Unconstrained optimization
7-8    Minimization of functions with one variable
       Zero order methods: Bracketing, golden section search,
       First order methods: Bisection,
       Second order methods: Newton’s method
9-10   Minimization of functions with several variables
       Sequential simplex (Nelder-Mead) method
       Steepest descent method
       Quadratic convergence and conjugate directions
       Fletcher & Reeves conjugate gradients method
       Project 1
       Midterm 2
11-12  Nonlinear programming II: Constrained optimization
       Method of feasible directions
       Penalty function methods
       Project 2
13     Optimization with surrogate models: Response surface method, artificial neural networks
14     Global optimization methods: Simulated annealing, genetic algorithms