# AE6170 Structural Optimization

Prerequisites: Graduate Standing and/or Consent of Instructor

Course Listing: Mathematical methods of constrained optimization, sensitivity analysis, approximation concepts, decomposition techniques, shape optimization in the context of structural design.

**1. Mathematical Statement of the Structural Optimization Problem** (1 hour)
Definition and classification of constraints
Solution process
Analysis and design formulations

**2. Classical Optimization Using Calculus of Variations** (3 hours)
Applications to beams of maximum strength
Columns and vibrating structures

**3. Linear Programming, Simplex Method, Duality** (5 hours)
Application to limit design of trusses and frames

**4. Nonlinear Optimization - Use of Linear Programming for Solving (Nonlinear) Structural Optimization Problems** (5 hours)
Separable programming
Stewart and Griffith's method
Kelley's cutting plane method

**5. Unconstrained Optimization as a Prelude to Nonlinear Constrained Optimization** (6 hours)
Conjugate directions method
Gradient methods

**6. Kuhn-Tucker Conditions for Optimality** (2 hours)
Computations of Lagrange multipliers

**7. Gradient Projection and Reduced Gradient Methods** (2 hours)
Applications to solving structural optimization problems

**8. Method of Feasible Directions** (5 hours)
Applications to solving structural optimization problems

**9. Penalty Method - Exterior and Interior Penalty Functions** (2 hours)
Quadratic and cubic extended penalty functions
Use of SUMT (Fiacco-McCormack's sequential unconstrained minimization technique) for solving structural optimization problems

**10. Introduction to Generalized Optimality Criteria and Dual Methods** (4 hours)
Connection between optimality criteria and mathematical programming

**11. Sensitivity Analysis** (7 hours)
Direct and adjoint methods for sensitivity derivatives
Approximation concepts

**12. Recent Developments in Multilevel and Decomposition Techniques** (3 hours)

**13. Shape Optimization** (4 hours)

**Midterm Exam** (1 hour)
**Total** (45 hours)

Ref: *Elements of Structural Optimization* by R. Hafta, Z. Gurdal & M.P. Kamat

*Structural Optimization: Status & Promise,* Ed. M.P. Kamat