Course:

Engineering Optimization

Instructor: Dr. M. Asgari

***Time*:** Saturday and Monday, 9:00-10:15 a.m.

Web site: http://wp.kntu.ac.ir/asgari/courses.html

Syllabus (Main Topics):

- Introduction to Optimum Design
  - What will be considered in Engineering Design, Analysis and Optimization?
- Problem Formulation and Optimization Concepts
  - Statement of Optimization Problems
  - Classification of Optimization Problems
  - Global and Local Optimum
  - Lagrange Multipliers and its Physical Meaning
  - Karush-Kuhn-Tucker (KKT) Conditions
  - Convex Programming Problem
- Classical Optimization Techniques
- Postoptimality and Sensitivity analysis
- Linear Programming Methods for Unconstrained and Constrained Optimum Design
  - Simplex Algorithms
  - Two-Phase Simplex Method
- Nonlinear Programming Methods for Unconstrained and Constrained Optimum Design
  - Elimination Methods
  - Interpolation Methods
  - Direct Search Methods
  - Descent Methods
  - Penalty Function Methods
- Optimum Design with MATLAB
- Modern Methods of Optimization
  - Genetic Algorithms
  - Simulated Annealing
  - Ant Colony Optimization
  - Particle Swarm Optimization
- Multi-objective Optimum Design Concepts and Methods
- Global Optimization Concepts and Methods
- Design Optimization with Implicit Functions
- Topology and Shape Optimization of Structures
- Automotive Structural Optimization

Required Text:
- Jasbir Arora*, Introduction to Optimum Design*, 2nd Edition, Academic Press, 2004.
- *Class Notes on Selected Subjects.*

Additional References:

General Engineering Optimization:

Singiresu S. Rao, *Engineering Optimization Theory and Practice*, Willy, 2009.
G. Vanderplaats, *Numerical Optimization Techniques for Engineering Design*, VR&D, 2001.
A. Belegundu, T. Chandrupatla, *Optimization Concepts and Applications in Engineering*, Cambridge University Press, 2011.
G. Mastinu, M. Gobbi, C. Miano, *Optimal Design of Complex Mechanical Systems* ***With Applications to Vehicle Engineering*****,** Springer-Verlag , 2006.
J. S. Arora, *Optimization of Structural and Mechanical Systems*, World Sc. Pub, 2007.
P. Venkataraman, *Applied Optimization with MATLAB Programming*, Wiley, 2009.

Topology and Structural Optimization:

B. Hassani, E. Hinton, *Homogenization and Structural Topology Optimization Theory, Practice and Software*, Springer, 1998.
M. P. Bendsoe, *Optimization of Structural Topology, Shape and Material*, Springer, 2004.
X., Huang, M. Xie, *Evolutionary Topology Optimization of Continuum Structures Methods and Applications*, John Wiley & Sons, 2010.

Modern Algorithms:

David E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning* , Addison-Wesley, 1989.
A. Abraham, R. Goldberg*, Evolutionary Multiobjective Optimization Theoretical Advances and Applications,* Springer-Verlag, 2005.

Topics for extra study and course seminar:

Dynamic Programming,
Stochastic Programming,
Modern Software for Optimization,
Finite Element-Based Optimization,
Neural-Network Based Optimization,
Reliability-Based Optimization,
Specific Topics in Optimization in Automotive Design,
Hybrid Methods in Optimization,
Multidisciplinary Design Optimization,
and etc.

Grading

- Homework
- Midterm exam
- Final Exam
- Term Project