THE UNIVERSITY OF ARIZONA®

COLLEGE OF ENGINEERING
Systems & Industrial Engineering

SIE 545: Fundamentals of Optimization
Fall 2017

Time and Location: Tuesday and Thursday, 11:00am–12:15pm, ENGR 301
Instructor: Jianqiang Cheng
Office Location: ENGR 123
Office Hours: Tuesday and Thursday, 12:15pm-1:30pm
Email: jqcheng@email.arizona.edu

Course Description: This is a graduate level introductory course on optimization, with an emphasis on the classical mathematical concepts, theories and techniques for linear and nonlinear optimization problems. The course will cover fundamental concepts in optimization, modeling nonlinear/linear problems, basic results in convex analysis, and optimality conditions for constrained and unconstrained problems, duality theory, and some algorithms.

Prerequisite(s): SIE 340 – Deterministic Operations Research, or equivalent. Knowledge of elementary calculus and matrix algebra.

Credit Hours: 3

Textbook: M.S. Bazaraa, H.D. Sherali, and C.M. Shetty, *Nonlinear Programming: Theory and Algorithms*, 3rd edition, Wiley & Sons Inc, New Jersey, 2006.
Supplementary: Boyd, Stephen, and Lieven Vandenberghe, *Convex optimization*, Cambridge university press, 2004.

Course Website: We'll be using D2L(https://d2l.arizona.edu/). All class materials, including homework assignments, lecture notes, supplementary readings, etc. will be distributed from D2L. I will also be sending emails

to the whole class throughout the semester using the classlist in D2L. You must check the announcements in D2L and your email at least twice a week.

Course Objectives:
At the completion of this course, students will:

1. improve their ability to formulate real-world problems as optimization problems by some modeling and reformulation tricks, and recognize when problems they consider are nonlinear programming problems
2. extend knowledge and understanding of the mathematical foundations of optimization
3. be able to understand optimality conditions for both unconstrained and constrained nonlinear programming problems
4. be able to understand when and how to apply optimality conditions for solving particular problems
5. be able to apply some basic computational algorithms for nonlinear programs.

Course Outline (subject to change):

1. Mathematical modeling (5 lectures)

2. Convex analysis:
   Convex sets (3 lectures)
   Convex functions and generalizations (4 lectures)

3. Optimality conditions and duality:
   Optimality conditions for unconstrained and constrained problems (6 lectures)
   Lagrangian duality and saddle point optimality conditions (4 lectures)

4. Algorithms (3 lectures)

Course Requirements:

- Lectures: Students are expected to attend and participate in all lectures. Lecture materials will be posted in D2L, and you can print and take them to class to make notes. Some questions left in lectures will require you study by yourself.

- Reading: Reading materials from textbook or supplementary posted in D2L will be mentioned in the end of lecture notes. Students are responsible for completing these readings.
- Homework assignments: There will be 6–8 problem sets due approximately every two weeks. The due date will be given in class and shown in dropbox of D2L. Late homework will not be accepted, and all homework submissions should be electronically through D2L as a PDF-file produced by LaTex.
- Exams: There will be two midterm exams and one final exam. Two midterm exams are in-class with 75-minute limit for each. The final exam has 2-hour limit. The schedule of exams is as follows.
- Grading distribution:
  Homework: 6 – 8 sets (20%)
  Exams:
  Midterm exam 1: (25%) 11:00am-12:15pm, September 28, 2017
  Midterm exam 2: (25%) 11:00am-12:15pm, November 9, 2017
  Final exam: (30%) 10:30am-12:30pm, Monday, December 11, 2017

Academic integrity policy: Students are welcome to discuss class related materials, homework assignments with your classmates. However, students must write solutions individually and cite references, including discussions with classmates.

You are encouraged to make recommendations to improve the class and my teaching skills.