CHEG 5336: Optimization, Spring 2017
Course Syllabus and Schedule

Instructor: Prof. Matthew Stuber
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Course Catalog Description: Advanced topics in optimization such as linear and nonlinear programming, mixed-integer linear and nonlinear programming, deterministic and stochastic global optimization, and interval global optimization. Example applications drawn from engineering. (3 credits, lecture)

Classes: Tue/Thu, 11:00AM-12:15AM, **Office Hours:** Tue/Thu 1:00PM-2:00PM

Textbooks and References:

1. Boyd, Stephen and Vandenberghe, Lieven. *Convex Optimization.* Cambridge University Press, 2009 (eBook)
2. Vanderbei, Robert J. *Linear Programming.* Springer, 2008 (eBook)
3. Walter, Eric. *Numerical Methods and Optimization: A Consumer Guide.* Springer, 2014 (eBook)
4. Antoniou, Andreas and Lu, Wu-Sheng. *Practical Optimization: Algorithms and Engineering Applications.* Springer, 2007 (eBook)

Goals and Outcomes: This course is designed to provide students with a sound foundation in optimization theory and methods with an emphasis on engineering applications. Students will prove theorems, implement methods on a computer, formalize and solve problems, and test software. Topics of study will include nonlinear programming (NLP), linear programming (LP), mixed-integer linear/nonlinear programming (MILP/MINLP), and global optimization. Applications will include planning and scheduling, optimal design, model validation, process synthesis, and blending. Upon completing the course, students will be able to:

1. formalize mathematically complex problems common in engineering,
2. model and simulate engineering problems and conduct computational experiments,
3. interpret results of simulation and numerical experiments,
4. communicate rigorously mathematical findings, and
5. discriminate between common methods for optimization.

Course Grading and Policies: Course grades will be based on the following overall rubric:

Classroom Participation	5%
Problem Sets	30%
Mid-Term Exam 1	20%
Mid-Term Exam 2	20%
Final Project (group effort)	25%
Total	100%

- Homework problem sets are due by 5PM on their respective due date. Physical copies of your solutions are to be submitted.
- Late homework can be turned in for 50% credit up to one week after the due date and 0% thereafter. Late homework will be graded with least priority (you may not get timely feedback).
- Students missing 4 or more homework problem sets will get an incomplete for the course.
- All homework problem sets are to be completed individually. Students may discuss problem sets together but each student must turn in their own version.
- Any computer code written must be submitted digitally on HuskyCT in addition to your physical solutions. Please print off your code and submit physical copies as an appendix to your homework solutions.
- All computer code written must contain sufficient commenting including input requirements, documentation of structure and subroutines, and sample output.
- The final project will be completed in groups depending on the class size. The final project will have a written report component, computational component, and an oral presentation component. The project will be an in-depth study of a specific engineering problem (and solution), advanced problem formulation (and solution), or an advanced topic beyond what was covered in class.
- **Inclement weather** may pose hazardous conditions for commuting. Use your best judgment when conditions are hazardous. Classes may be canceled at the University's or instructor's discretion. Email notification will be given and students are responsible for reviewing the day's lecture materials, available on HuskyCT.
- **Special consideration** will be granted for individuals with unique circumstances at the instructor's discretion. If you feel that your situation requires you to miss problem sets or an exam, please do not hesitate to discuss with the instructor. Situations such as chronic and acute illness, death in the family, mental health, etc. can be accommodated within reason.

Tentative Schedule

Tuesday		Thursday	
Jan 17th 1. Introduction: 1.1 Course Overview, 1.2 Intro to Optimization	**1**	19th 2. Theory: 2.1 Intro to Theory 2.2 Convex Analysis	**2**
24th 2.2 Convex Analysis	**3**	26th **Problem Set 1 Due** 3. Unconstrained NLP: 3.1 Optimality	**4**
31st 3.2 Gradient Methods	**5**	Feb 2nd No Class, Lecture Notes Online **Problem Set 2 Due** 3.2 Gradient Methods	**6**
7th 3.2 Gradient Methods	**7**	9th **Problem Set 3 Due** 3.3 Applications	**8**
14th 4. Constrained NLP: 4.1 Optimality and Lagrange Theory	**9**	16th **Problem Set 4 Due** 4.1 Optimality and Lagrange Theory, 4.2 Methods	**10**
21st 4.2 Methods, 4.3 Applications	**11**	23rd **Exam 1**	
28th 4.4 Duality	**12**	Mar 2nd **Problem Set 5 Due** 4.4 Duality	**13**
7th 4.5 Min-Max	**14**	9th **Problem Set 6 Due** 5. LP: 5.1 Introduction, 5.2 Geometry	**15**
14th **Spring Break - No Classes**		16th **Spring Break - No Classes**	
21st 5.2 Geometry, 5.3 Simplex	**16**	23rd 5.3 Simplex	**17**
28th 5.3 Simplex, 5.4 Duality	**18**	30th **Problem Set 7 Due** 5.4 Duality	**19**
Apr 4th 6. Mixed-Integer Programming: 6.1 MILP	**20**	6th **Exam 2**	

Tuesday	Thursday
11th **21** 6.2 MINLP	13th **22** **Problem Set 8 Due** 7. Global Optimization: 7.1 Deterministic v. Stochastic
18th **23** 7.2 Branch & Bound	20th **24** **Problem Set 9 Due** 7.3 Bounds and Relaxations
25th **25** 7.3 Bounds and Relaxations	27th **Final Presentations** **Problem Set 10 Due**