ECE 4520 (Spring 2015) **Syllabus**

Operation and Optimization of the Power Grid

1 Instructor Information

Instructor:	Eilyan Bitar
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Course website: Blackboard

2 Course Description

Broadly, this coarse aims to acquaint students with the economics and optimal operation of modern electric power systems. Topics include optimal power flow, economic dispatch, electricity markets, and emerging techniques for renewable energy integration. Strong emphasis will be placed on the development and application of techniques to solve convex and stochastic optimization problems. By the end of the course, students will have developed a firm grasp of optimal power system operations, the emerging challenges facing deep renewable energy integration, and tools to effectively tackle said challenges.

Tentative Course Outline

- *Power Flow*
  - Models and numerical methods
  - Cascading failures
- *Convex Optimization*
  - Convex sets and functions
  - Weak and strong duality
- *Optimization of Power Flow*
  - Convex approximations and relaxations
- *Renewable Energy Integration*
  - Models of uncertainty
  - The role of stochastic optimization
- *Electricity Markets*
  - Market design
  - Learning, strategic behavior, and market equilibria

3 Lectures

Lectures will be held Monday/Wednesday (2:55 - 4:10 PM) in 1150 Snee Hall.

4 Prerequisites

ECE 2200, ECE 3100, Linear Algebra, and comfort with Matlab programming.

5 Textbooks

The course lectures will be self-contained. The following two textbooks will serve as supplements to the lectures and homeworks.

1. Taylor, Joshua. *Convex Optimization of Power Systems.* Cambridge university press, 2015. **Hardcopy will be provided by the instructor – to be returned at the end of the semester.**

2. Boyd, Stephen P., and Lieven Vandenberghe. *Convex optimization.* Cambridge university press, 2004. **Available online:** http://www.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf

The following textbooks are not required, but may serve useful as auxiliary or reference texts.

1. Glover, J. Duncan, Mulukutla S. Sarma, and Thomas J. Overbye. *Power system analysis and design.* CengageBrain.com, Fifth Edition. 2012.

2. Wood, Allen J., Bruce F. Wollenberg, and Gerald B. Sheble . *Power generation, operation, and control.* John Wiley & Sons, Third Edition. 2014.

6 Software

We will occasionally make use of the following Matlab software packages. There will be two tutorial sessions explaining how to use each package.

1. Grant, Michael, Stephen Boyd, and Yinyu Ye. *CVX: Matlab software for disciplined convex programming.* 2008. **Available online:** http://cvxr.com/cvx

2. Zimmerman, Ray D., Carlos E. Murillo-Snchez, and Deqiang Gan. *Matpower.* PSERC, Cornell University. **Available online:** http://www.pserc.cornell.edu/matpower/

7 Grading

Your final grade will be based on **homework** (45%, assignments equally weighted, lowest score dropped), **midterm** (20%), and **final project** (35%).

8 Collaboration and Code of Conduct

Every student attending this course is expected to abide by the Cornell University Code of Academic Integrity, which can be found at cuinfo.cornell.edu/Academic/AIC.html. Any piece of work you turn in for credit must be your own work. Discussion with other students about specific homework problems is permitted to the extent that discussion is limited to problem approach and does not include note taking. In writing up your homework solution, you must acknowledge anyone with whom you collaborated. If you use papers or books or other sources (e.g. material from the web) to help obtain your solution, you must cite those sources. You may not discuss exam problems with other students. Please ask if you are unclear as to what constitutes excessive collaboration.

9 Misc

The midterm will take place in the evening to provide students with ample test time. To compensate students for the additional time commitment outside of normal class hours, two to three regular lectures will be canceled.