Department of Electrical and Computer Engineering
University of Central Florida

EEL 6938 Special Topic: Power System Optimization
Fall Semester 2018

Designation: Graduate Elective
Course ID: EEL 6938
Section Number:
Units: 3 units

2018-19 Catalog Description: Fundamentals of mathematical programming (including linear, nonlinear, mixed-integer, and convex programmings), modeling of power systems, economic dispatch, unit commitment, AC/DC optimal power flow, electric market, introduction to convex optimization, optimization of energy storage systems and water-energy nexus.

Pre-requisite(s): EEL 4216

Class location and time: BA1 O216A, Tu&Th, 15:00-16:15 pm

Office hours:

Instructor: Prof. Qifeng Li
Office: RB1-150G
Phone: 407-823-0159
Email: qifeng.li@ucf.edu

Course Objectives: The course is to provide students with a working knowledge of fundamental optimization techniques with applications in power systems and smart grids. The course offers an introduction to the basic concepts of power system operation and planning along with necessary theories and methods in optimization. The advanced optimization techniques are introduced for improving the computational efficiency of solving large-scale power system optimization problems. The goal is to expose students

to emerging technologies in this broad field of power system optimization so the students become prepared for employment as well as research.

Learning Outcomes: By the end of this course, graduate students will be able to:

1. Students will understand fundamentals of power generation, operation and planning as well as the core issues that need to be addressed in modern and future power grids.
2. Students will have the ability of properly modeling and analyzing power systems under different levels.
3. Students will learn the basic knowledge of mathematical programing.
4. Students will be able to apply optimization algorithms to solve fundamental power generation, operation, and planning problems: economic dispatch, unit commitment, demand response, AC/DC optimal power flow, and electric market.
5. Students will learn to solve the new optimization challenges in modern and future power grids: the functionality of smart grids: demand response, and optimization problems in distribution systems considering renewable energy, battery energy storage systems, and water-energy nexus.

Textbook Required: Selected topics and chapters from the references. All required support materials will be made available through Canvas and no copyrighted materials will be included in these resources.

References:

- J. J. Grainger and W. D. Stevenson Jr., *Power Systems Analysis*, McGraw Hill, 1994.
- J. Wood and B. F. Wollenberg, *Power Generation, Operation, and Control*, 2nd edition, John Wiley & Sons, Inc, 1996.
- J. A. Momoh, *Electric Power System Applications of Optimization*, 2nd Edition, CRC Press, Boca Raton, 2008.
- D. Bertsimas and J. Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific, 1997.
- D. Bertsekas, *Nonlinear Programming*, 3rd edition, Athena Scientific, 2016
- S. Boyd and L Vandenberghe, *Convex Optimization*, Cambridge University Press, 2004.
- J. Nocedal and S. Wright, Numerical Optimization, 2nd edition, Springer, 2006.

Homeworks, Projects, and Grading:

- For in-class students:

- Homework: 3 homework assignments, 100 points each. *10% of the total grade.*
- Projects: 3 projects, 2 to 3-week time each, 100 points each, use standard software available. *20% of the total grade each.*
- Final paper (a 4-page IEEE journal format paper about the 3 projects) + a presentation of the paper*. 15% of the total grade.*
- Participation in class: Students interrupt, ask questions in class, and will be scored at the instructor's discretion. *7.5% of the total grade.*
- Attendance: Students are absent less than 4 classes will get all the points for this part, otherwise, get zero. *7.5% of the total grade.*

- For on-line students:

- Homework: 3 homework assignments, 100 points each. *15% of the total grade.*
- Projects: 3 projects, 2 to 3-week time each, 100 points each, use standard software available. *20% of the total grade for projects 1 and 2, 25% of total grade for project 3.*
- Final paper (a 4-page IEEE journal format paper about the 3 projects) + a presentation of the paper*. 20% of the total grade.*

A = > 90%	C+ = 70-73.9%
A- = 86-89.9%	C = 65-69.9%
B+ = 82-85.9%	C- = 60-64.9%
B = 78-81.9%	F = < 60%
B- = 74-77.8%	

Instructional Delivery: This course will be 70% lecture, 20% projects and homeworks, and 10% discussions.

Lecture Modules:

Module #	Module Title
1	Introduction to power system optimization, Part I
2	Introduction to power system optimization, Part II
3	Linear programming, Part I
4	Linear programming, Part II
5	Linear programming, Part III
6	Economic dispatch and DC optimal power flow

7	DC optimal power flow and power market
8	Introduction to Mixed-integer Programming
9	Unit Commitment
10	Introduction to nonlinear programming
11	AC optimal power flow (transmission networks)
12	AC optimal power flow (distribution networks)
13	Introduction to convex optimization
14	Convex models of power systems
15	Convex optimal power flow
16	Optimization of battery energy storage systems
17	Optimization of water-energy nexus (demand response of water systems)

Academic Integrity

You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation, including but not limited to improper citation of sources, using another student's work, and any other form of academic misrepresentation, will result in a minimum academic penalty of your failing the assignment. You will be referred to the Office of Integrity and Ethical Development for possible additional disciplinary measures.

You are NOT allowed to redistribute the course materials to anyone that is NOT a part of this course.

Attendance Policy

This is a graduate level course where participation is expected. Hence, absence in excess of 10% of class meetings (i.e. 3 classes) will result in loss of 7.5% of the total grade. This policy is only applied to in-class students

Disability Services

Any student with a documented disability should contact the Student Accessibility Services (SAS)
at 407-823-2371 to make arrangements for appropriate accommodations.

Submission of Assignments

All submissions should be done through Canvas, UCF webcourse portal www.webcourses.ucf.edu

Distance Learning Related Components

All learning outcomes in this distance learning mode are equivalent to face-to-face version of this course.

This course is an asynchronous online course. Students will work at different times from different locations and will not be required to attend any face-to-face or synchronous meetings at the same time.

All discussion board posts and emails will be responded to within 24 hours. Feedback will be provided on all assignments within 48 hours.

Online lectures will be provided through Canvas. Therefore, students must have access to the Internet to view/hear lectures. No special software is required. Students will also submit all assignments and take all quizzes/tests through Canvas.

Minimal technical skills are needed in this online course. All work in this course must be completed and submitted online. Therefore, students MUST have consistent and reliable access to a computer and the Internet. Before starting this course, students must feel comfortable doing the following. The minimal technical skills students should have included the ability to:

- organize and save electronic files,
- use email and attached files,
- check email and Blackboard daily, and
- download and upload documents.

Contribution of course to meeting the Professional Component: Math & Science Topics (40%), Engineering Topics (50%), General Education (energy, 10%)