Fall 2019 ECE 508
Introduction to power system market operations

Instructor: Prof. Siddharth Suryanarayanan
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Office hours: 230pm–330pm TR
Other times by appointment only (for Prof. Suryanarayanan's calendar, see: `https://goo.gl/Uu9VbV`)
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Lecture time and venue: 4pm–515pm TR, Room: Engineering B4

Textbook:
D. Kirschen and G. Strbac, Fundamentals of Power System Economics, 2nd Edition, Hoboken, NJ: John Wiley & Sons, Inc., 2019.

Reference (No need to buy):

- M. Shahidehpour, H. Yamin, and Z. Li, Market operations in electric power systems: forecasting, scheduling, and risk management, New York, NY: John Wiley & Sons, 2002.
- Notes and technical papers will be supplied by the instructor as deemed fit.

Prerequisites:

- *Familiarity with electric power systems, such as covered in ECE461/462 Power Systems-I/Laboratory

Course objectives: The structure and operation of electric power systems have vastly changed in the last two decades due to deregulation of the electric power industry in the United States. Deregulation has introduced new aspects of restructuring, markets, and auctions to the electric power industry. This graduate-level course is designed to provide an introduction to the structure and techniques (tools) of market operations in deregulated electric power systems. The emphasis of the course is on topics related to participants in electric power markets, system security, investments in generation and transmission, auctions, ancillary services, and congestion management.

In this course students will:

- Recall the physical structure of the electricity grid and its components
- Explain the uniqueness of electricity as a commodity
- Identify the various players in the electricity market
- Examine and evaluate the concepts of deregulation of electricity industry and the associated impacts on electric power systems operations
- Apply concepts from matrix algebra and differential calculus to study the functioning of an electricity market

*OR instructor's approval.

- Develop methods for considering the physical limits imposed by transmission networks on the functioning of an electricity market
- Evaluate the different cases of system security, ancillary services, and nodal pricing in power systems
- Explain the concepts of investment in generation and transmission sectors of the power grid

Assignment of course grade: The grade will be based on the weighted index as shown below.

Homework	20 %
Mid-term examination	20 %
Term paper	20 %
Project	20 %
Final exam	20 %

Course Outline: Tentative schedule †

Week 1	Introduction to course; history of electricity trading in the US
Week 2 & Week 3	Basic concepts of economics and optimization
Week 4 & Week 5	Participating in markets for electrical energy
Week 6 & Week 7	System security & ancillary services & *Mid term exam*
Week 8	Transmission networks & electricity markets *Term paper assigned*
Week 9	Transmission networks & electricity markets
Week 10 & Week 11	Nodal pricing
Week 12	Investing in generation & *Term paper due*
Week 13	Investing in transmission & *Project*
Week 14	*Fall break*
Week 15	*Term paper presentations*
Week 16	*Project submission*
Week 17	*Final exam*

†The instructor may be on business-related travel on some of the lecture dates. In such cases of a conflict in schedule, the respective lecture will be recorded sans audience and made available via the class URL on Canvas or a guest lecturer may be invited to substitute or the lecture may be canceled.

Course Policy:

Attendance: Regular attendance is strongly encouraged. Please check the Canvas site for the class, and have your preferred email account linked with Canvas for receiving all announcements. In specific, this course will include a frequently assigned (weekly) reading assignment that typically requires studying the course material equivalent to a book chapter, which includes reading and understanding the theoretical narrative of the text and relating this material to the class lectures, performing independently (by the student) the associated derivations from the textbook, and carrying out independently (by the student) the examples (worked-out problems and exercises) from the textbook and/or reference sources. The reading assignments are essential for the successful and efficient performance on projects and class participation, and as such are evaluated and assessed through all assessed/graded items included in the course outline.

Canvas use policy: The instructor will exclusively use the Canvas facility to communicate with the individual and the class regarding the course. So, it is imperative that the student has a functioning email (usually it is the colostate.edu email id) associated with the Canvas website to receive all notifications. The instructor does not take any responsibility for sending information to students via any other means or to another email id than the one associated with Canvas.

Make-up: Except under documented cases of extenuating circumstances, there will be no opportunity for a make-up for any portion of the class component towards the final grade.

ADA Statement: Students with disabilities are encouraged to register with the Office for Student Services to determine the appropriate classroom accommodations. Any student with verification of a disability should contact the instructor as soon as possible, and will be accommodated in an appropriate manner.

Term paper: Each student team (of no more than 3 students) enrolled in the course is required to choose a contemporary topic of research interest in the field of deregulated electric power system markets. The instructor will assign this project in the 8^{th} week of classes in the semester. The team is expected to perform high quality literature search and draw conclusions about state-of-the-art and the future of the topic chosen. A technically sound research paper on the topic of choice written in the form of a conference paper (according to the IEEE PES template) is a required deliverable from each student/team in the 12^{th} week of classes in the semester. The template will be provided to the students or can be obtained at the following link (`https://goo.gl/8iKeQ9`). Each team is required to present its paper in the form of a short presentation to the class and take questions from the audience during the 15^{th} week of classes in the semester.

Project: In the 13^{th} week of classes in the semester, each student team (of no more than 3 students) enrolled in the course is required to conduct a project on electricity trading and investment. Each team is expected to submit a final report on this project assignment on the 16^{th} week of classes in the semester.

Academic Honesty: Academic integrity is of utmost importance. For a description on practicing academic integrity, go to: `https://tilt.colostate.edu/integrity/knowTheCode/`
Departures from accepted norms of academic integrity will be dealt with full compliance to CSU policies. Colorado State University's Writing Center defines plagiarism as "the unauthorized or unacknowledged use of another person's academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding credit be given where credit is due."
Departures from accepted norms of academic integrity will be dealt with full compliance to CSU principles published in the CSU General Catalog. Visit `http://goo.gl/6opQt7` for information on the CSU policies pertaining to this.
The instructor may use a CSU designated resource for verification of plagiarism in any work that is submitted by a student for grade in the ECE508 course.
Visit `http://goo.gl/6opQt7` for familiarizing with the CSU Honor Pledge.