

Power Systems Economics (ECE 5630-001/6630-001)

Fall Semester 2021

Tuesdays, Thursdays, 12:25 PM – 1:45 PM, to be held in person in WEB 1460

Credit hours: 3.0

Instructor: Dr. Masood Parvania

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Office Number: (801) 585-0030

Office Location: MEB 2222

Instructor Office Hours: Monday, Wednesday, 11:00AM – 12:00PM. Please send emails to schedule appointments for meeting out of office hours.

Teaching Assistant: TBA

TA office hours: TBA

Locker number for homework: TBA

Textbook and Materials

- [1] A. J. Woods, B. F. Wollenberg, G. Sheble, *Power Generation, Operation, and Control*, 3rd Ed., John Wiley & Sons, New York, 2013.
- [2] D. S. Kirschen, G. Strbac, *Fundamentals of Power System Economics*, John Wiley & Sons, London, 2004.
- [3] Lecture notes and slides, and supplemental online material

Course Description

This course will introduce the market structure of electric power systems, and introduce the market agents including: system operators, generating companies, and customers. The course will first describe basic market concepts from micro-economics and will then continue by introducing the tools and models for electricity market operation, including economic dispatch, optimal power flow, and unit commitment.

Learning Objectives

By the end of this course, you will be able to:

- Understand the organization and regulatory structure of the electric power industry
- Understand the functions of electricity markets
- Formulate and solve the Economic Dispatch problem and calculate optimal generation dispatch
- Understand the marginal pricing of electricity and calculate the electricity prices
- Model the power transmission network using DC power flow models
- Formulate and solve the Optimal Power Flow problem for economic and environmentally-friendly operation of power systems
- Understand the locational marginal pricing of electricity and calculate the locational electricity prices
- Understand, formulate and solve the Unit Commitment problem

Class Structure

The class structure will include the following parts:

Part 1, Lecture: We learn the new material through a traditional lecture format. Powerpoint presentation will be used to better communicate the course material, while the mathematical formulations and derivations will be written on the board for better understanding.

Part 2, Homework: homework will be given during the semester as a tool for you to practice what you have learned in the class, and for me to assess your understanding of the course.

Part 3, Exams: Three exams will be held during the semester and each will be graded from 100.

Part 4, Practice/Review/Discussion: At the beginning of each class session, we will quickly review the prior material so that everyone can start the lecture with the same understanding. During this time, we will also review the homework that was due before the class.

Part 5, final project: the course will involve a final project to work on as a team or as an individual.

Feedback: I take your feedbacks and suggestions seriously. Please feel free to send me your feedbacks and suggestions regarding the course structure, the teaching method, and the topics. Based on your feedback, I will try to modify and improve the course as the course progresses. Two surveys will be conducted during the semester.

Grade Distribution

Homework ¹	40%
Exams ²	60%

¹ Homework should be submitted online in the Canvas before the class begins on the due date. In order to be fair and to give the same time and opportunity for all the students, no late submission is accepted. Each homework will be graded from 100. Your lowest grade homework will be dropped at the end of the semester.

² Not showing up for an exam will result in a grade of zero for that exam.

Final Grading Policy

A : > 93.3	A- : 90-93.3	
B+ : 86.6-90	B : 83.3-86.6	B- : 80-83.3
C+ : 76.6-80	C : 73.3-76.6	C- : 70-73.3
D+ : 66.6-70	D : 63.3-66.6	D- : 60-63.3
E : < 60		

Course Policies

Attendance: While attendance is not graded, it is an integral part of each class that can help you learn the material. Lectures will include regular homework help, graded quizzes, and discussions and demonstrations of the subject material.

Collaboration: To solve homework assignments, healthy discussion and collaboration amongst classmates is encouraged. Healthy collaboration includes:

- Discussing and explaining general course material
- Discussing assignments for better understanding
- Providing assistance for general programming and debugging issues

Electronic Devices in Class: Please avoid using any electronic device during the online class. You will be asked to bring and use your laptops in some classes when we will use software. No electronic device with possibility of networking is allowed during exams.

University Policies

1. **Americans with Disabilities Act (ADA)**: The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.
2. **Cheating and plagiarism**: While collaboration is encouraged, you are expected to submit your own work. Submitting work completed by another student is considered plagiarism and will be dealt with according to university policy. In general, if you do not fully understand your solution, the work is not your own. Examples of cheating/plagiarism:
 - Copying (or allowing someone to copy), even partially, an assignment solution or program from the course
 - Submitting material, particularly a program, using material taken from another source without a proper citation
 - Obtaining solutions to assignments or exams through inappropriate meansAdditional information can be found in the “Code of Student Rights and Responsibilities” found here: <http://regulations.utah.edu/academics/6-400.php>
3. **University Safety Statement**. The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit <http://safeu.utah.edu>.
4. **Addressing Sexual Misconduct**. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-COPS (801-585-2677).

Please see the most recent student regulations for the department of Electrical and Computer Engineering at: <https://www.ece.utah.edu/ugpolicies>

Legal Note:

The syllabus is not a binding legal contract. This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class or unforeseen circumstances. Any changes will be announced in class and posted on Canvas under Announcements.

Course Schedule

Date	Topic	Reading
Tuesday, Aug 24	Course overview	-
Thursday, Aug 26	US power system structure; Market concepts from economics	Chapter 1 and 2 of [2]
Tuesday, August 31	Market concepts from economics (Cont'd)	Chapter 2 of [2]
Thursday, Sept 2	Electricity market structure; Electricity pricing	Chapter 2 of [1] Chapter 3 of [2]
Tuesday, Sept 7	US ISOs (HW1 Presentations)	Bring your homework!
Thursday, Sept 9	Modeling generating units	
Tuesday, Sept 14	Introduction to Mathematical Optimization	Chapter 1 of [1]
Thursday, Sept 16	Introduction to Mathematical Optimization	Chapter 3-Appendix of [1]
Tuesday, Sept 21	Introduction to Mathematical Optimization	Chapter 3-Appendix of [1]
Thursday, Sept 23	Economic Dispatch Models and Solutions Introduction to GAMS	Chapter 3 of [1] GAMS Manual
Tuesday, Sept 28	Economic Dispatch Models and Solutions	Chapter 3 of [1]
Thursday, Sept 30	Marginal Electricity Pricing	Chapter 3 of [1]
Tuesday, Oct 5	Review of Economic Dispatch for exam	Chapter 3 of [1]
Thursday, Oct 7	Exam #1	Be ready for the exam!
Tuesday, Oct 12	Fall Break (no class)	Have fun!
Thursday, Oct 14	Fall Break (no class)	Have fun!
Tuesday, Oct 19	Review of Power Flow Methods	Chapter 6 of [1]
Thursday, Oct 21	Review of Power Flow Methods	Chapter 6 of [1]
Tuesday, Oct 26	Optimal Power Flow Models	Chapter 8 of [1]
Thursday, Oct 28	Optimal Power Flow Models	Chapter 8 of [1]
Tuesday, Nov 2	Optimal Power Flow Models	Chapter 8 of [1]
Thursday, Nov 4	Locational Marginal Pricing	Chapter 8 of [1]
Tuesday, Nov 9	Locational Marginal Pricing	Chapter 8 of [1]
Thursday, Nov 11	Review of Optimal Power Flow for exam	Chapter 8 of [1]
Tuesday, Nov 16	Exam #2	Be ready for the exam!
Thursday, Nov 18	Unit Commitment Models and Solution	Chapter 4 of [1]
Tuesday, Nov 23	Unit Commitment Models and Solution	Chapter 4 of [1]
Thursday, Nov 25	Thanksgiving Break (no class)	Chapter 4 of [1]
Tuesday, Nov 30	Unit Commitment Models and Solution	
Thursday, Dec 2	Commercial Software for Unit Commitment	Have fun!
Tuesday, Dec 7	Unit Commitment Models and Solution	Chapter 4 of [1]
Thursday, Dec 9	Final Review	Bring your questions!
TBA	Exam #3	Time: 10:30 am – 12:30 pm