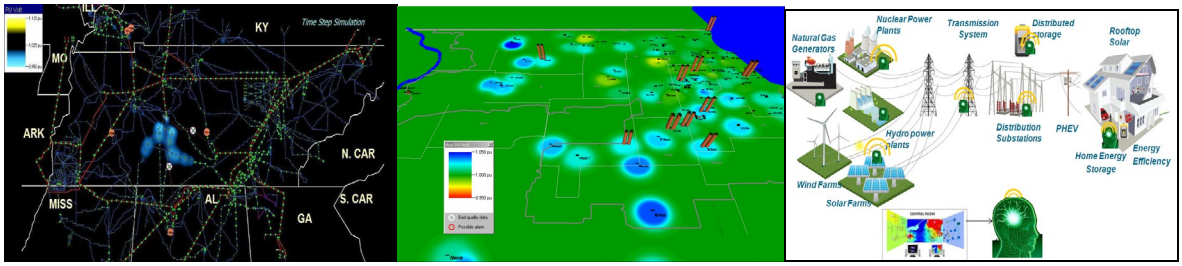
ECE 6320 Power System Control and Operation



Fall 2023, Prof. Santiago Grijalva

Course Description

A comprehensive introduction to the secure and economic operation of modern electrical energy systems. Computational methods used in real-time operations. Economic optimization methods. Operation with distributed energy resources (solar PV, energy storage, wind, electric vehicles). Technologies of modern energy control centers, Energy Management Systems (EMS) and Distribution Management Systems (DMS).

Course Objectives

- Present computational methods for bulk power and distribution systems operation and control.
- Describe economic optimization algorithms used in electrical energy systems.
- Presents algorithms for system state estimation.
- Describe the architecture of energy management systems.
- Describe emerging trends on renewable energy integration, smart grids, and electricity markets.

Pre-requisites:

Graduate Standing

ECE4320 or similar undergraduate power system analysis course is highly desirable.

Time and Place:

Section A of this course is face to face on campus

- Course times are Monday and Wednesday, 0930-1045 am
- Classroom is Sustainable Education, Room 110.
- All course lectures will be recorded and will be available online.
- This course includes a set of hands-on workshops where we will use software to simulate power systems. Two or three workshops will take place in the assigned classroom using some of the assigned course times.

Instructor

Prof. Santiago Grijalva

e-mail: sgrijalva@ece.gatech.edu

Office Hours: Wednesdays 11-12 ET, Online: Team Meeting

Grading Policy:

Homework (20%)

2 Midterm Exams (15% each), 1 Final Exam (30%); Total 60%

Term Project, will be to write a paper (20%)

Text:

Instructor will provide full set of electronic notes. Lectures will be posted on Canvas under Files/Lecture PDFs

Tentative Course Schedule:

Day	Date	Lectures	Homework/Project
M	Aug 21	L0. Pre-read: Review of Phasors	
		Module 1: Steady-State	
M	Aug 21	L1. Operation Paradigms	
W	Aug 23	L2. Gauss Power Flow Computation	
M	Aug 28	L3. Newton Raphson Power Flow	
W	Aug 30	L4. Fast Power Flow Computation	
M	*Sep 4*	*Labor Day: No Class*	
W	Sep 6	L5. Reactive Power Flow Limits	Hw01 due
M	Sep 11	L6. Sensitivity Analysis	
W	Sep 13	L6. Sensitivity Analysis, Cont.	Project Deliverable 1 due
M	Sep 18	Workshop 1	HW02 due
W	Sep 20	L7. Contingency Analysis	
M	Sep 25	L8. Available Transfer Capability	
W	Sep 27	**Exam 1**	
		Module 2: Economics	
M	Oct 2	L9. Economic Dispatch	
W	Oct 4	L10. Non-Linear Optimal Power Flow	Hw03 due
M	*Oct 9*	*Fall Break: No Class*	
W	Oct 11	L11. Linear Programming OPF	
M	Oct 16	L12. Marginal Pricing	
W	Oct 18	L13. Security-Constrained OPF	Project: Deliverable 2 due
M	Oct 23	L14. Unit Commitment	Hw04 due
W	Oct 25	L15. Distributed Energy Resources	
M	Oct 30	Workshop 2	
		Module 3: Estimation	
W	Nov 1	L16. Review of Statistics (Background Material)	Hw05 due

		L17. WLS State Estimation	
M	Nov 6	**Exam 2**	
W	Nov 8	L18. WLS State Estimation, Cont.	
M	Nov 13	L19. Enhanced Estimation L20. Bad Data Detection	
W	Nov 15	L21. Automatic Generation Control	
		Module 4: EMS	
M	Nov 20	L22. Distribution Systems	Hw06 due
W	*Nov 22*	*Student Recess: No Class, No Office Hours*	
M	Nov 27	L23. Substation Automation/PMU	
W	Nov 29	L24. Central System L25. Visualization	
Saturday	Dec 2		**Project Final Deliverable Due**
M	Dec 4	L26. Future Grids and Course Wrap-Up	Hw07 due
W	Dec 13	**Final Exam** 8:00 am - 10:50 am	

Supplemental References

Background Texts:

These are texts you may want to review if you feel you need to enhance your power systems background. These are the types of texts used in classes that are prerequisites to EC6320. If you are planning a career in power systems, I suggest you have copies of at least 1 and 2.

Power System Analysis and Design (6th Edition), Glover, Overbye, Sarma 2015.

Power Systems Analysis (2nd Edition), by Arthur R. Bergen, Vijay Vittal, 2000.

Power System Analysis, by John Grainger, Jr., William Stevenson, 1994. This is the book that I used when I originally took the undergraduate power system class. It is a little outdated, but great material.

Texts:

These are texts you can read to complement the material presented in ECE6320 lectures.

Power System Generation, Operation and Control, (3rd Edition), by Allen J. Wood, Bruce F. Wollenberg, 2014. This is sort of the “Bible”, classical book, for Power System Operations and Control, now in the third edition.

Power System State Estimation: Theory and Implementation, Ali Abur and Antonio Gomez-Exposito, 2004. We will use a few chapters of this book for the State Estimation module of ECE6320.

Computational Methods for Large Sparse Power Systems: An Object-Oriented Approach (With CD-ROM), by S.A. Soman, et al., 2001. This is good book if you are interested in coding applications or future research on computational power systems.

William Kersting, Distribution System Modeling and Analysis, (4rd Edition), 2017.

Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/ (Links to an external site.).

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/ (Links to an external site.), to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Assignments are provided with significant notice. Unless you have an emergency, no late assignments or missed exams will be accepted