## ECE6320 Syllabus

Power System Operation and Control, A, Q, 3 credits

Fall, 2026

## Instructor Information

**Instructor:** Prof. Santiago Grijalva

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## General Course Information

### Description

A comprehensive introduction to the secure and economic operation of large-scale electrical energy systems. Computational methods and software used in real-time power system operations: Security Assessment, Economic Optimization and Dynamic Analysis. Operation with distributed energy resources (solar PV, wind, energy storage, electric vehicles).

### Course Learning Outcomes

Upon successful completion of this course, you should be able to:

- Present computational methods for bulk power system operation and controly
- Describe modeling and simulation methods for power system security assessment.
- Describe economic optimization algorithms used in electrical energy systems.
- Describe the methods for system dynamics and transient analysis.
- Describe the architecture of energy management systems.
- Describe emerging trends on renewable energy integration, smart grids, AI applications, and electricity markets.

### Pre-Requisites

Graduate Standing

An undergraduate power systems curse such as ECE4320 is desirable.

**Required Course Materials**

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

*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.

1. Power System Analysis and Design (7th Edition), Glover, Sarma, Overbye, Birchfield, 2022.
2. Power Systems Analysis (2nd Edition), by Arthur R. Bergen, Vijay Vittal, 2000.
3. 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 It is a little outdated, but great material.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.

4. Power System Generation, Operation and Control, (3rd Edition), by Allen J. Wood, Bruce F. Wollenberg, 2013. This is sort of the "Bible", classical book, for Power System Operations and Control, now in the third edition.
5. Power System Dynamics and Stability: With Synchrophasor Measurement and Power System Toolbox (IEEE Press) 2nd Edition, by Peter W. Sauer (Author), M. A. Pai (Author), Joe H. Chow (Author), 2017
6. William Kersting, Distribution System Modeling and Analysis, (4rd Edition), 2017.

**Grading Policy:**

88-100: A

72-87: B

60-71: C

**Description of Graded Components**

Total: 100 points

a) Homework (20%) 7 Assignments for 2-3 points each

b) 3 Short Exams (15% each)

c) 1 Final Exam (35%)

## Topics

| **Lectures** |
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| L0. Pre-read: Review of Phasors |
| ***Module 1: Steady-State and Security Analysis*** |
| L1. Operation Paradigms |
| L2. Gauss Power Flow Computation |
| L3. Newton Raphson Power Flow |
| L4. Fast Power Flow Computation |
| Labor Day: No Class |
| L5. Reactive Power Flow Limits |
| L6. Sensitivity Analysis |
| L7. Contingency Analysis |
| Workshop 1 |
| L8. Available Transfer Capability |
| Exam 1 |
| ***Module 2: Economics*** |
| L9. Economic Dispatch |
| L10. Non-Linear Optimal Power Flow |
| L11. Linear Programming OPF |
| Fall Break: No Class |
| L12. Marginal Pricing |
| L13. Security-Constrained OPF |
| Workshop 2 |
| L14. Unit Commitment |
| L14. Unit Commitment, cont. |
| L15. Distributed Energy Resources |
| Exam 2 |
| ***Module 3: Transient Stability*** |
| L16. Introduction |
| L17. Machine Models |
| L18. Machine Models, cont. |

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| L19. Exciters and Governors |
| L20. Multi-machine Simulation |
| L21. Voltage Stability |
| L22. Workshop 3 |
| L23. Oscillations and Modal Analysis |
| Exam 3 |
| Thanksgiving Student Recess: No Class |
| L24. Stabilizers |
| L25. Energy Methods |
| L26. Future Grids and Course Wrap-Up |
| **Final Exam** |

## Course Policies

**Attendance and/or Participation**

Students are expected to attend class and to participate during lectures.

**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. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism 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 (404-894-2563) as soon as possible 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.

**Student-Faculty Expectations Agreement**

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and

cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

**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

## Campus Resources for Students

**Graduate Student Academic and Professional Success Resources:**

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and
- *Professional Development such as the programming from the Career Center and other professional development resources and events"*

**Student Well-Being:**

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)