



## **EEL 5255: Advanced Power System Analysis**

*Department of Electrical and Computer Engineering*

*College of Engineering and Computer Science*

3 Credit Hours

### **Course Syllabus**

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Instructor:	Qun Zhou Sun	Term:	Spring 2025
Office:	HEC 358	Class Days:	F
Office Hours:	M 10:30 am -1:30 pm	Class Time:	9:00 am – 11:45 am
Phone:	407-823-3284	Class Location:	ENG1 O384
Email:	qz.sun@ucf.edu	Course Modality:	F2F

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### **Course Description**

This is an advanced course of power systems engineering, designed to provide a student with the knowledge of operation and control of modern power system and smart grid. Course content includes power generation characteristics, power system economic structure, economic dispatch, unit commitment, and power flow analysis.

### **Course format**

The course is interactive and problem driven. Students will be asked to work out problems as well as pick a topic to teach in class.

### **Required Texts**

Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheble, Power Generation, Operation, and Control, 3rd Edition, Wiley, 2013.

### **Supplemental Texts and Helpful Resources**

P. M. Anderson, A. A. Fouad, Power System Control and Stability, 2nd Edition, Wiley-IEEE Press, 2002.

A very helpful website (you can learn almost everything by yourself here): <https://cusp.umn.edu/power-systems/power-generation-operation-control>

### **Student Learning Outcomes**

#### **Course Objectives**

This course builds up and addresses the following goals:

- Acquire knowledge of steady-state analysis in power system operation and control.
- Develop the ability to apply knowledge of steady-state analysis to solve problems in power system operation and control.
- Develop basic understanding of optimization techniques.
- Develop skills to communicate effectively through writing and presentation.

- Prepare students for multidisciplinary research in power system area.

### ***Course Expectations***

Students are expected to understand the optimization formulations and solution methodologies behind power system operations and control. Students are expected to learn materials proactively by participating in class readings, discussions, and presentations. Students are expected to teach one topic and assign homework to fellow students. Attendance is required.

### **Enrollment Requirements**

EEL4216-Fundamentals of Electric Power Systems.

Familiar with power system analysis methods at the level of standard text books. Familiar with the topics of matrix algebra, calculus, network analysis theory including electric power flow analysis, and basic optimization concepts.

### **Course Activities**

- 1) Introduction
  - a. Overview of power system generation, operation, and control
  - b. Characteristics of power generation units
- 2) Industrial Organization and Power Economics
  - a. Business environments and evolving history
  - b. Macroeconomics and microeconomics
- 3) Economic Dispatch
  - a. Problem formulation
  - b. Solution: Linear programming
- 4) Unit Commitment
  - a. Problem formulation
  - b. Solution: Lagrange Relaxation
  - c. Solution: Mixed integer linear programming
- 5) Transmission System and Power Flow Analysis
  - a. Power system modeling
  - b. Power flow formulation
  - c. Solution: Newton-Raphson
  - d. DC power flow
  - e. Transmission losses
- 6) Power System Security Analysis
  - a. Generation and transmission outages
  - b. Voltage collapse
  - c. Sensitivity analysis
- 7) Optimal Power Flow
  - a. DCOPF
  - b. ACOPF
  - c. Solution: Iterative LP
  - d. Solution: Interior Point

## **Assessment and Grading Procedures**

### ***Homework Assignments***

- Homework is assigned weekly.
- Assignments are submitted online through webcourse.
- For textbook homework, please submit the derivation procedure.

### ***Teaching a Topic***

- Pick a topic highlighted in the course activities, or anything in the textbook that you are interested in. Topic selection starts in the second week on a first come first serve basis.
- Study the content using the textbook and online resources.
- Teach the topic in a one-lecture time period. Discussions and follow-ups can be done separately in another lecture, if necessary.
- Assign homework to fellow classmates and grade them.
- Receive feedback and evaluations from fellow classmates.

### ***Percent of Final Grade***

- Attendance and in-class discussion: 20%
- Homework: 40%
- Teaching a Topic: 40%

### ***Grading Scale***

*(Grades at the breakpoints will round up to the higher level, e.g., 90 will be granted A-)*

- A: 93-100
- A-: 90-93
- B+: 87-90
- B: 83-87
- B-: 80-83
- C+: 77-80
- C: 73-77
- C-: 70-73
- D+: 67-70
- D: 63-67
- D-: 60-63
- F: 0-60

### ***Make-up Assignments***

Our course policy regarding the late work include the following:

- Late work grade reduction policy: 1 day 10% reduction, 2-day 30% reduction, 3-day 50% reduction, 4-day 70% reduction, 5-day 100% reduction.
- Policy/process to request an exception to the late/make up work policy: students are required to provide written notices with reasons identified above.
- Policy to request an extension before the due date: students are required to provide written notices with reasons identified above.

## Policy Statements

### *Academic Integrity*

Students should familiarize themselves with UCF's Rules of Conduct at <https://scai.sdes.ucf.edu/student-rules-of-conduct/>. According to Section 1, "Academic Misconduct," students are prohibited from engaging in

1. Unauthorized assistance: Using or attempting to use unauthorized materials, information or study aids in any academic exercise unless specifically authorized by the instructor of record. The unauthorized possession of examination or course-related material also constitutes cheating.
2. Communication to another through written, visual, electronic, or oral means: The presentation of material which has not been studied or learned, but rather was obtained through someone else's efforts and used as part of an examination, course assignment, or project.
3. Commercial Use of Academic Material: Selling of course material to another person, student, and/or uploading course material to a third-party vendor without authorization or without the express written permission of the university and the instructor. Course materials include but are not limited to class notes, Instructor's PowerPoints, course syllabi, tests, quizzes, labs, instruction sheets, homework, study guides, handouts, etc.
4. Falsifying or misrepresenting the student's own academic work.
5. Plagiarism: Using or appropriating another's work without any indication of the source, thereby attempting to convey the impression that such work is the student's own.
6. Multiple Submissions: Submitting the same academic work for credit more than once without the express written permission of the instructor.
7. Helping another violate academic behavior standards.
8. Soliciting assistance with academic coursework and/or degree requirements.

### *Responses to Academic Dishonesty, Plagiarism, or Cheating*

Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, *The Golden Rule* <https://goldenrule.sdes.ucf.edu/>. UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an "F" letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a "Z" designation on one's transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let's avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

### *Unauthorized Use of Websites and Internet Resources*

There are many websites claiming to offer study aids to students, but in using such websites, students could find themselves in violation of academic conduct guidelines. These websites include (but are not limited to) Quizlet, Course Hero, Chegg Study, and Clutch Prep. UCF does not endorse the use of these products in an unethical manner, which could lead to a violation of our University's Rules of Conduct. They encourage students to upload course materials, such as test questions, individual assignments, and

examples of graded material. Such materials are the intellectual property of instructors, the university, or publishers and may not be distributed without prior authorization. Students who engage in such activity could be found in violation of academic conduct standards and could face course and/or University penalties. Please let me know if you are uncertain about the use of a website so I can determine its legitimacy.

#### *Unauthorized Distribution of Class Notes*

Third parties may attempt to connect with you to sell your notes and other course information from this class. Distributing course materials to a third party without my authorization is a violation of our University's Rules of Conduct. Please be aware that such class materials that may have already been given to such third parties may contain errors, which could affect your performance or grade.

Recommendations for success in this course include coming to class on a routine basis, visiting me during my office hours, connecting with the Teaching Assistant (TA), and making use of the Student Academic Resource Center (SARC), the University Writing Center (UWC), the Math Lab, etc. If a third party should contact you regarding such an offer, I would appreciate your bringing this to my attention. We all play a part in creating a course climate of integrity.

#### *In-Class Recording*

Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as part of a university course intended to present information or teach enrolled students about a particular subject. Recording class activities other than class lectures, including but not limited to lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, private conversations between students in the class or between a student and the faculty member, and invited guest speakers is prohibited. Recordings may not be used as a substitute for class participation and class attendance, and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct as described in the Golden Rule.

#### *Course Accessibility Statement*

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) <<http://sas.sdes.ucf.edu/>> (Ferrell Commons 185, [sas@ucf.edu](mailto:sas@ucf.edu), phone 407-823-2371). For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

#### *Campus Safety Statement*

Emergencies on campus are rare, but if one should arise during class, everyone needs to work together. Students should be aware of their surroundings and familiar with some basic safety and security concepts.

- In case of an emergency, dial 911 for assistance.
- Every UCF classroom contains an emergency procedure guide posted on a wall near the door. Students should make a note of the guide's physical location and review the online version at <<https://centralflorida-prod.modolabs.net/student/safety/index>>.

- Students should know the evacuation routes from each of their classrooms and have a plan for finding safety in case of an emergency.
- If there is a medical emergency during class, students may need to access a first-aid kit or AED (Automated External Defibrillator). To learn where those are located, see <https://ehs.ucf.edu/automated-external-defibrillator-aed-locations>.
- To stay informed about emergency situations, students can sign up to receive UCF text alerts by going to <https://my.ucf.edu> and logging in. Click on “Student Self Service” located on the left side of the screen in the toolbar, scroll down to the blue “Personal Information” heading on the Student Center screen, click on “UCF Alert”, fill out the information, including e-mail address, cell phone number, and cell phone provider, click “Apply” to save the changes, and then click “OK.”
- Students with special needs related to emergency situations should speak with their instructors outside of class.
- To learn about how to manage an active-shooter situation on campus or elsewhere, consider viewing this video (<https://youtu.be/NIKYajEx4pk>).

***Deployed Active Duty Military Students***

If you are a deployed active duty military student and feel that you may need a special accommodation due to that unique status, please contact your instructor to discuss your circumstances.