EEL 4271/5275 Power System Protection

1. Catalog Description – (3 credits) multi-machine stability; unbalanced load flow; fault analysis on distribution systems; balanced and unbalanced state estimation; power systems reliability; principles of protection, relay classification; circuit breakers; protection of distribution and transmission lines, transformers, generators, motors/buses, reactors/capacitors, and distributed generation; fault location.

2. Pre-requisites – EEL 4251 or equivalent

3. Course Objectives – The student will be able to develop appropriate models for all power system relays. Students will be able to demonstrate power systems protection setting and coordination for generation, transmission and distribution equipment

4. Contribution of course to meeting the professional component (ABET only – undergraduate courses) – 1.5 credits of Engineering Science and 1.5 credits of Engineering Design

5. Relationship of course to program outcomes (ABET only – undergraduate courses) – a, c

6. Instructor – Dr. Arturo Bretas
    a. Office location: 427 NEB
    b. Telephone: 352-392-4949
    c. E-mail address: arturo@ece.ufl.edu
    d. Class Web site: UF's E-learning (Canvas)
    e. Office hours: Tuesdays and Thursdays

7. Teaching Assistant – TBD

8. Meeting Times and Location – Tuesday, 7th period (1:55-2:45 p.m.) and Thursday, 7th-8th period (1:55 – 3:50 p.m.)

9. Class/laboratory schedule – 3 class periods each week consisting of 50 minutes each

10. Material and Supply Fees – None

11. Textbooks and software recommended –
    a. Title: Power System Relaying
    b. Author: Stanley Horowitz, A G. Phadke
    c. Publication date, edition, and company: 4th edition (2014), Wiley
    d. ISBN number: 978-1-118-66200-7

12. Recommended additional reading –
    Paul M. Anderson, Power Systems Protection, 1st edition, Wiley, 1998, ISBN number: 978-0780334274

13. Course Outline –

Week	Topic	Chapter
1	Multi Machine Transient Stability	
2	Unbalanced Load Flow: Newton Method	
2	Unbalanced Load Flow: Ladder Technique	
3	Fault Analysis on Distribution Systems	
3	Unbalanced State Estimation	
4	Power Systems Reliability	
5	Introduction to Protective Relaying	1
5	Relaying Operating Principles	2
6	Nonpilot Overcurrent Protection	4
7	Nonpilot Distance Protection	5
8	Midterm	
8	Pilot Protection	6
9	Rotating Machinery Protection	7
9	Bus, Reactor, and Capacitor Protection	9
10	Power System Phenomena and Relaying	10
11	Relaying for System Performance	11
12	Switching Schemes and Procedures	12
13	Monitoring Performance and Power Systems	13
13	Improved Protection with WAMS	14
14	Fault Location	15
16	Final Exam	

14. Attendance and Expectations – Cell phones and other electronic devices are to be silenced. No text messaging during class or exams.

    Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

15. Grading –
    Exams 80%
    Homework 20%. Some simple programming skill may be required.

    Note:
    This course is co-listed with the graduate class. The homework portion of the graduate section will involve additional work and more advanced concepts with respect to the undergraduate section. The exams will also involve more advanced concepts with respect to the undergraduate section.

    Grading for the homework and projects are different from the undergraduate course. The homework has a lower grading percentage while the project has a higher grading percentage. Graduate students will present material from a research paper of their choosing and will also submit a written report.

Grading Scale –

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

16. Make-Up Exam Policy - If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed work. University attendance policies can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

    Otherwise, make-up exams will be considered only in extraordinary cases, and must be taken before the scheduled exam. The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

17. Honesty Policy – UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

18. Accommodation for Students with Disabilities – Students requesting classroom accommodation must first register with the Dean of Students Office. That office will provide documentation to the student who must then provide this documentation to the course instructor when requesting accommodation.

19. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
    - UF Counseling & Wellness Center, psychological and psychiatric services, 3190 Radio Rd, 392-1575, online: http://www.counseling.ufl.edu/cwc/Default.aspx,
    - Career Resource Center, Reitz Union, career and job search services, 392-1601.
    - University Police Department, 392-1111 or 911 for emergencies

20. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as

appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

21. Course Evaluation – Students are expected to provide feedback on the quality of instruction in this course based on 10 criteria. These evaluations are conducted online at: https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at: https://evaluations.ufl.edu/results.