

# Cover Sheet: Request 11430

## EEL 4XXX - Power System Protection

### Info

Process	Course New Ugrad/Pro
Status	Pending
Submitter	Chillingworth,Shannon M schill@ece.ufl.edu
Created	1/27/2017 2:24:47 PM
Updated	3/13/2017 4:53:24 PM
Description of request	New Course Approval

### Actions

Step	Status	Group	User	Comment	Updated
Department	Approved	ENG - Electrical and Computer Engineering 011905000	Fox, Robert M		1/30/2017
Deleted 5XXX_Power_Sys_Protection_Breatas_ucc1_syl.docx					1/27/2017
College	Approved	ENG - College of Engineering	Caple, Elizabeth		2/10/2017
Replaced 4XXX_Power Sys Protection_Bretas_ucc1_syl.docx					2/8/2017
University Curriculum Committee	Comment	PV - University Curriculum Committee (UCC)	Case, Brandon	Added to the March agenda.	2/27/2017
No document changes					
University Curriculum Committee	Pending	PV - University Curriculum Committee (UCC)			2/27/2017
No document changes					
Statewide Course Numbering System					
No document changes					
Office of the Registrar					
No document changes					
Student Academic Support System					
No document changes					
Catalog					
No document changes					
College Notified					
No document changes					

# Course|New for request 11430

## Info

**Request:** EEL 4XXX - Power System Protection  
**Description of request:** New Course Approval  
**Submitter:** Chillingworth, Shannon M schill@ece.ufl.edu  
**Created:** 3/13/2017 4:52:13 PM  
**Form version:** 3

## Responses

**Recommended Prefix**EEL  
**Course Level** 4  
**Number** XXX  
**Category of Instruction** Advanced  
**Lab Code** None  
**Course Title**Power System Protection  
**Transcript Title**Power Sys Protection  
**Degree Type**Baccalaureate

**Delivery Method(s)**On-Campus

**Co-Listing**Yes

**Co-Listing Explanation**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.

**Effective Term** Fall

**Effective Year**2017

**Rotating Topic?**No

**Repeatable Credit?**No

**Amount of Credit**3

**S/U Only?**No

**Contact Type** Regularly Scheduled

**Weekly Contact Hours** 3

**Course Description** This course presents power systems protection analytical methodologies and algorithms. Different methods for equipment and systems protection are analyzed. Wide-area monitoring techniques, which allow real-time operation and control are discussed. Cyber-physical security approaches for the smart grid are introduced. Numerical construction of protection methods considering realistic engineering hypothesis are realized.

**Prerequisites** (EEL 4251 or instructor permission)

**Co-requisites** None

**Rationale and Placement in Curriculum** This course is a follow up to the newly approved Power System Analysis course (EEL 4251). This course will expose students to a range of power system protection topics including circuit breakers, protection of distribution and transmission lines, and fault analysis.

**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.

**Course Textbook(s) and/or Other Assigned Reading**Textbooks and Software Required –

Title: Power System Relaying

Author: Stanley Horowitz, A G. Phadke

Publication date, edition, and company: 4th edition (2014), Wiley  
ISBN number: 978-1-118-66200-7

Recommended Reading –

Paul M. Anderson, Power Systems Protection, 1st edition, Wiley, 1998, ISBN number:  
978-0780334274

**Weekly Schedule of Topics** Week      Topic

Chapter

1	Unbalanced Load Flow: Newton Method	
2	Unbalanced Load Flow: Ladder Technique	
2	Fault Analysis on Distribution Systems	
3	Multi Machine Transient Stability	
3	Unbalanced State Estimation	
4	Introduction to Protective Relaying	
1		
4	Relaying Operating Principles	
2		
5	Nonpilot Overcurrent Protection	
4		
5	Nonpilot Distance Protection	
5		
6	Pilot Protection 6	
7	Rotating Machinery Protection	
7		
8	Exam 1, Transformer Protection	
8		
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	
14	Improved Protection with WAMS	
14		
15	Protection Considerations for Renewable Resources	15
16	Exam II	

**Links and Policies** 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>

#### Grading Scale –

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

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>

**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.

**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.

**Accommodation for Students with Disabilities** – Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**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

**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.

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>

**Grading Scheme 15.** Grading –  
Exams 80%  
Homeworks 20% Some programming skill may be required.

Two (2) Exams- Each exam 40% of grade.

Homework Assignments:

Undergraduates: A2, A4, A5, A7, A8, A9, A10, A11, A13, A16, A17, A21

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.

**Instructor(s)** Dr. Arturo Bretas

## EEL 4XXX Power System Protection

1. Catalog Description – (3 credits) This course presents power systems protection analytical methodologies and algorithms. Different methods for equipment and systems protection are analyzed. Wide-area monitoring techniques, which allow real-time operation and control are discussed. Cyber-physical security approaches for the smart grid are introduced. Numerical construction of protection methods considering realistic engineering hypothesis are realized.
2. Pre-requisites – EEL 4251 or Instructor Permission
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](mailto: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, 8<sup>th</sup> – 9<sup>th</sup> period (3:00-4:55 p.m.) and Thursday, 9<sup>th</sup> period (4:05 p.m. – 4:55 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 Required –
  - a. Title: Power System Relaying
  - b. Author: Stanley Horowitz, A G. Phadke
  - c. Publication date, edition, and company: 4<sup>th</sup> edition (2014), Wiley
  - d. ISBN number: 978-1-118-66200-7
12. Recommended Reading –

Paul M. Anderson, Power Systems Protection, 1<sup>st</sup> edition, Wiley, 1998, ISBN number: 978-0780334274
13. Course Outline –

<b>Week</b>	<b>Topic</b>	<b>Chapter</b>
1	Unbalanced Load Flow: Newton Method	
2	Unbalanced Load Flow: Ladder Technique	
2	Fault Analysis on Distribution Systems	
3	Multi Machine Transient Stability	
3	Unbalanced State Estimation	
4	Introduction to Protective Relaying	1
4	Relaying Operating Principles	2
5	Non-pilot Overcurrent Protection	4
5	Non-pilot Distance Protection	5
6	Pilot Protection	6
7	Rotating Machinery Protection	7
8	Exam I, Transformer Protection	8
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
14	Improved Protection with WAMS	14
15	Protection Considerations for Renewable Resources	15
16	Exam II	

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%  
Homeworks 20% Some programming skill may be required.

Two (2) Exams- Each exam 40% of grade.

Homework Assignments:

Undergraduates: A2, A4, A5, A7, A8, A9, A10, A11, A13, A16, A17, A21

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 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 with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

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>.

## EEL 5XXX Power System Protection

1. Catalog Description – (3 credits) This course presents power systems protection analytical methodologies and algorithms. Different methods for equipment and systems protection are analyzed. Wide-area monitoring techniques, which allow real-time operation and control are discussed. Cyber-physical security approaches for the smart grid are introduced. Numerical construction of protection methods considering realistic engineering hypothesis are realized..
2. Pre-requisites – Basic knowledge of power systems analysis
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) – NA
5. Relationship of course to program outcomes (ABET only – undergraduate courses) – NA
6. Instructor – Dr. Arturo Bretas
  - a. Office location: 427 NEB
  - b. Telephone: 352-392-4949
  - c. E-mail address: [arturo@ece.ufl.edu](mailto:arturo@ece.ufl.edu)
  - d. Class Web site: UF's E-learning (Canvas)
  - e. Office hours: Tuesdays and Thursdays
7. Teaching Assistant – TBD
  - a. Office location:
  - b. Telephone:
  - c. E-mail address:
  - d. Office hours:
8. Meeting Times and Location – Tuesday, 8<sup>th</sup> – 9<sup>th</sup> period (3:00-4:55 p.m.) and Thursday, 9<sup>th</sup> period (4:05 p.m. – 4:55 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 Required –
  - a. Title: Power System Relaying
  - b. Author: Stanley Horowitz, A G. Phadke
  - c. Publication date, edition, and company: 4<sup>th</sup> edition (2014), Wiley
  - d. ISBN number: 978-1-118-66200-7
12. Recommended Reading –

Paul M. Anderson, Power Systems Protection, 1<sup>st</sup> edition, Wiley, 1998, ISBN number: 978-0780334274

13. Course Outline –

<b>Week</b>	<b>Topic</b>	<b>Chapter</b>
1	Unbalanced Load Flow: Newton Method	
2	Unbalanced Load Flow: Ladder Technique	
2	Fault Analysis on Distribution Systems	
3	Multi Machine Transient Stability	
3	Unbalanced State Estimation	
4	Introduction to Protective Relaying	1
4	Relaying Operating Principles	2
5	Nonpilot Overcurrent Protection	4
5	Nonpilot Distance Protection	5
6	Pilot Protection	6
7	Rotating Machinery Protection	7
8	Exam I, Transformer Protection	8
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
14	Improved Protection with WAMS	14
15	Protection Considerations for Renewable Resources	15
16	Exam II Delivery	

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

Some simple programming skill may be required in order to complete the homeworks.

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 –

80%	Exams
20%	Homework

Homework Assignments:

Undergraduates: A2, A4, A5, A7, A8, A9, A10, A11, A13, A16, A17, A21

Graduates: A1, A2, A3, A4, A5, A6, A8, A9, A12, A13, A14, A15, A18, A19, A20, A22, A23

Note: This course is co-listed with the undergraduate 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.

16. 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

Graduate students, in order to graduate, must have an overall GPA of 3.0 or better (B or better).” Note: a B- average is equivalent to a GPA of 2.67, 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>

17. 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.

18. 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.

19. 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.

20. 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

21. 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.
22. 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>.