FAIRFIELD UNIVERSITY - SOE
EE377/ECE477: Power Security and Reliability

Preliminary - Summer, 2015

This course focuses on Power System Protection and Relaying to allow the design of robust and reliable power systems. After reviewing the need for protection of power system elements (motors, generators, transformers, and transmission/distribution lines), the course: Explores developments in the creation of smarter, more flexible protective systems based on advances in the computational power of digital devices and the capabilities of communication systems that can be applied within the power grid, Examines the regulations related to power system protection and how they impact the way protective relaying systems are designed, applied, set, and monitored, Considers the evaluation of protective systems during system disturbances and describes the tools available for analysis, Addresses the benefits and problems associated with applying microprocessor-based devices in protection schemes' Contains an expanded discussion of internal protection requirements at dispersed generation facilities. MatLab is used to solve homework problems and do team design projects.
(Prerequisite: EE385/ECE495 or equivalent) Three Credits

Class location: TBD, Tuesday evenings from 6:00 to 10:00 pm.

Learning Objectives - TBD

	Learning Outcome	Cognitive Level	ABET a-k
1.	Fundamental principles of fuse and overcurrent protection and application to feeder and motor protection.	Evaluation	
2.	Fundamental principles of distance relaying and application to transmission system protection	Knowledge	
3.	Fundamental principles of differential protection and application to transformer, bus bar and generator armature winding protection	Synthesis	
4.	Role of Current and Voltage transformers in power system protection	Knowledge	
5.		Analysis	

Grade distribution – TBD (Updated after each Exam)

BLACKBOARD

The Blackboard system along with our course web site will be used to manage this course. Students must submit their assignments into Blackboard for archival and grading. All work is to be typed (including equations), drawings are to be computer-base, not scanned, hand written work.

Text: Class Notes, Lecture Notes, Lecture Videos

References:

Electrical Machinery and Power System Fundamentals, Steven J.Chapman, McGraw Hill Education, 2002
Power Electronics: Converters, Apps. And Design, N. Mohan, T.M. Undeland, and W. P. Robbins, John Wiley & Sons., 2003
Introduction to MatLab for Engineers and Scientists, Etter, Prentice-Hall, 1996, ISBN 0-13-519703-1
Prof. A.K. Sinha, IIT Kharagpur – A full set of Power System Lecture Videos

Required Software:

MatLab, Student Ed. (**Fairfield Student Download Instructions**) or
Octave (An Open Source MatLab Clone)
MatLab Tutorial by B. Aliane, **Simulink Power Electronics tutorial**

Grade allocation:

Exams (2)	50%
Quizzes/Participation	25%
Design Project	25%
Total	100%

Academic Dishonesty:

Students are sometimes unsure of what constitutes academic dishonesty. In all academic work, students are expected to submit materials that are their own and are to include attribution for any ideas or language that are not their own. Examples of dishonest conduct include, but are not limited to:

- Falsification of academic records or grades, including but not limited to any act of falsifying information on an official academic document, grade report, class registration document or transcript.
- Cheating, such as copying examination answers from materials such as crib notes or another student's paper.
- Collusion, such as working with another person or persons when independent work is prescribed. .
- Inappropriate use of notes.
- Falsification or fabrication of an assigned project, data, results, or sources.
- Giving, receiving, offering, or soliciting information in examinations.
- Using previously prepared materials in examinations, tests, projects, or quizzes.
- Destruction or alteration of another student's work.
- Submitting the same paper or report for assignments in more than one course without the prior written permission of each instructor.
- Appropriating information, ideas, or the language of other people or writers and submitting it as one's own to satisfy the requirements of a course – commonly known as plagiarism.
  Plagiarism constitutes theft and deceit. Assignments (compositions, term papers, computer programs, etc. .) acquired either in part or in whole from commercial sources, publications, students, or other sources and submitted as one's own original work will be considered plagiarism.
- Unauthorized recording, sale, or use of lectures and other instructional materials.

In the event of such dishonesty, professors are to award a grade of zero for the project, paper, or examination in question, and may record an F for the course itself. When appropriate, expulsion may be recommended. . A notation of the event is made in the student's file in the academic dean's office. The student will receive a copy.

CLASS EXPECTATIONS

I. TEACHER

Distribute and review the syllabus.
Clearly explain material.
Relate material to "real world" situations when possible.
Answer questions.
Be available to discuss problems.

Google Voice:	(203) 513-9427
Email:	jeffrey.denenberg@ieee.org or jdenenberg@fairfield.edu
Home Page:	http://doctord.dyndns.org or http://doctord.webhop.net
Class Office Hours:	5:00-6:00 PM, Tuesdays before class in BNW301C Or after class

Prepare and administer quizzes and grade fairly.

II. STUDENT

Be familiar with the prerequisite material
Ask questions and stay current.
Study the material described in the syllabus. Preferably before it is covered in class.
Obtain/review class notes if a class is missed. View lecture videos.
Be prepared for Quizzes.
Ask for help from me (I have office hours) and/or your fellow students.

III. DISABILITY

If you have a documented disability and wish to discuss academic accommodations, please contact: David Ryan-Soderlund at Academic and Disability Support Services (203) 254-4000, x2615, or email drsoderlund@mail.fairfield.edu, and notify the course instructor within the first two weeks of the semester.

Course Schedule:

Week	Topic	Lecture Notes	Videos	References
5/19	**Module 1 : Fundamentals of Power System Protection** Lecture 1 : Introduction Lecture 2 : Protection Paradigms - Apparatus Protection Lecture 3 : Protection Paradigms - System Protection Lecture 4 : Desirable Attributes of Protection	 Lecture-1.pdf Lecture-2.pdf Lecture-3.pdf Lecture-4.pdf	Introduction	
5/26	**Module 2 : Current and Voltage Transformers** Lecture 5 : Introduction to CT Lecture 6 : CT Tutorial Lecture 7 : CT Saturation and DC Offset Current Lecture 8 : Introduction to VT Lecture 9 : VT Tutorial	 Lecture-5.pdf Lecture-6.pdf Lecture-7.pdf Lecture-8.pdf Lecture-9.pdf		
Not covered in this course	**Module 3 : Sequence Components and Fault Analysis** (Selected topics from ECE496: Power Fault Analysis) Lecture 10 : Sequence Components Lecture 11 : Sequence Components (Tutorial) Lecture 12 : Sequence Modeling of Power Apparatus Lecture 13 : Sequence Modeling (Tutorial)	 Lecture-10.pdf Lecture-11.pdf Lecture-12.pdf Lecture-13.pdf		
6/2	**Module 4 : Overcurrent Protection** Lecture 14 : Fuse Protection Lecture 15 : Fundamentals of Overcurrent Protection Lecture 16 : PSM Setting and Phase Relay Coordination (Tutorial) Lecture 17 : Earth Fault Protection using Overcurrent Relays	 Lecture-14.pdf Lecture-15.pdf Lecture-16.pdf Lecture-17.pdf		
6/9	**Module 5 : Directional Overcurrent Protection** Lecture 18 : Directional Overcurrent Relaying Lecture 19 : Directional Overcurrent Relay Coordination (Tutorial) Lecture 20 : Directional Overcurrent Relay Coordination in Multi-loop Systems	 Lecture-18.pdf Lecture-19.pdf Lecture-20.pdf		
6/16	**Module 6 : Distance Protection** Lecture 21 : Introduction to Distance Relaying Lecture 22 : Setting of Distance Relays Lecture 23 : Pilot Protection with Distance Relays	 Lecture-21.pdf Lecture-22.pdf Lecture-23.pdf		
6/23	**Module 7 : Out of Step Protection** Lecture 24 : Power Swings and Distance Relaying Lecture 25 : Analysis of Power Swings in a Multi – Machine System Lecture 26 : Power Swing Detection, Blocking and Out-of-Step Relays	 Lecture-24.pdf Lecture-25.pdf Lecture-26.pdf		

6/30	**Module 8 : Numerical Relaying I : Fundamentals** Lecture 27 : An Introduction Lecture 28 : Sampling Theorem Lecture 29 : Least Square Method for Estimation of Phasors - I Lecture 30 : Least Square Method for Estimation of Phasors - II Lecture 31 : Fourier Algorithms	 Lecture-27.pdf Lecture-28.pdf Lecture-29.pdf Lecture-30.pdf Lecture-31.pdf		
7/7	**Module 9 : Numerical Relaying II : DSP Perspective** Lecture 32 : Fourier Analysis Lecture 33 : Discrete Fourier Transform Lecture 34 : Properties of Discrete Fourier Transform	 Lecture-32.pdf Lecture-33.pdf Lecture-34.pdf		
7/14	**Module 9 : Numerical Relaying II : DSP Perspective (continued)** Lecture 35 : Computation of Phasor from Discrete Fourier Transform Lecture 36 : Fast Fourier Transform Lecture 37 : Estimation of System Frequency	 Lecture-35.pdf Lecture-36.pdf Lecture-37.pdf		
7/21	**Module 10 : Differential Protection of Bus, Transformer and Generator** Lecture 38 : Bus Protection Lecture 39 : Transformer Protection Lecture 40 : Generator Protection	 Lecture-38.pdf Lecture-39.pdf Lecture-40.pdf		
7/28				
8/4				

* Topic not covered in the following exam

** Computer Simulation HW