

EEE 256 – Advanced Power System Protection

Elective

Date: March 9, 2007

Power Systems

Course Coordinator: Mohammad Vaziri.

Catalog Description: The course objectives are to familiarize and develop the students' skills in advanced concepts and schemes used in power system protection including the various protective schemes used for Transmission Lines, Transformers, Machines, and other elements of a large interconnected power system. The course will also include the concepts in digital and microprocessor based relay design and analysis of typical protection subsystems, in conjunction with the protection of the power system as whole

Prerequisites: EEE141, EEE135 (EEE135 maybe taken concurrently)

Text: Protective Relaying, 2nd Ed, J. Lewis Blackburn, Marcel Dekker

Additional Resources: 1 - Power System Relaying, 2nd Ed. S. H. Horowitz & A.G. Phadkhe, Research Studies Press, John Wiley & Sons – Optional
2 - Symmetrical Components for Power System Engineering, J. L. Blackburn, Marcel Dekker - Optional

Course Objectives: Many of the advanced protection schemes and concepts currently being used by the industry are not covered in an introductory course in “System Protection” which is normally offered as an undergraduate level. A graduate level course is necessary in this area to prepare a graduate student in the power systems area before taking a professional career in power systems.

Prerequisites by Topic:

1. Basic Circuit Theory and Transient Analysis.
2. Analysis of balanced 3 phase power systems.
3. Analysis of Unbalanced 3 phase power systems using Symmetrical Components.
4. Basics of Communication Systems.
5. Basics of Controls and Logic Design

Topics Covered:

- 1) Analysis of various power system elements under various fault conditions,
- 2) Analysis of the concepts and schemes in Line Protection including the various Pilot and Non-Pilot schemes
- 3) Analysis of the various concepts and schemes for protection of Transformers, Generators, Motors, Capacitor Banks, Busses, SVCs, etc.
- 4) Mathematical foundations for filtering concepts, logic, and programming used in digital and microprocessor based relaying and fault recorder systems
- 5) Analysis of related topics in Stability, Reclosing practices, and Load Shedding schemes.

Evaluation: Homework (10% - 20%), Pop Quizzes (10% - 20%), very similar to homework and class lectures. Quizzes will be unannounced to serve as an incentive for attendance and doing the homework. Mid-term (15% - 30%, in class), Final (25% - 50%, in class), Project (10% - 20%) consisting of a “Proposal”, “Research”, and “Presentation” where team work is encouraged and promoted. Each of the team members will be graded for the areas of initiative, building agreement, persuasiveness, and communication skills. Each team can have 2 or 3 members. The projects involve acquisition and study of publications, computer programming, and presentation of the results.

Contribution of Course to the Professional Education Component: Indicate how this course fulfills this ABET requirement (e.g., developing student’s analytical and critical-thinking skills, science and design content, etc.) **Note: This section is not required for graduate courses.**

Relationship of Course to Program Outcomes: Indicate how this course fulfills this ABET requirement (e.g., knowledge of mathematics, engineering science, core topics in major, development of problem solving skills, etc.) **Note: This section is not required for graduate courses.**

Course Outline/Schedule

<i>Week</i>	<i>Topic</i>	<i>Text Reference</i>
1	Review of Basic Theory & General Concepts	Text / notes
2	Review of 3 Balanced 3 Phase and Per Unit systems	Text / notes
3	Transmission Line Protection – Non Pilot Schemes	Text / notes
4	Transmission Line Protection – Pilot Schemes	Text / notes
5	Relay/Digital Fault Recorder event report analysis	Text / notes
6	Generator Protection	Text / notes
7	Motor Protection	Text / notes
8	Midterm Exam	Text / notes
9	Transformer Protection	Text / notes
10	Bus Protection	Text / notes
11	Capacitor, SVC, & other equipment Protection	Text / notes
12	Stability Concerns & Remedial Action Schemes (RAS)	Text / notes
13	Load Shedding & Reclosing Schemes	Text / notes
14	Introduction to Microprocessor Relays and Digital Filtering	Ref -1 / notes
15	Relay Logics, Algorithms, & Programming	Ref - 1 / notes