King Saud University
Electrical Engineering Department
EE 449: Power System Protection

First Semester 1426/27 (2005/2006)

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***Textbook*:** J.D. Glover & M Sarma, "Power system analysis and Design", 3rd edition, PWS Publishing, 2002.

***Reference Book**:* Horowitz & Phadke, "Power System Relaying", Research Studies Press, 1992.

Description:

Concepts of power system protection, unsymmetrical fault calculations, Overcurrent, differential, distance and pilot protection systems

Prerequisite: EE 341.

Course Topics:

1- Unsymmetrical Faults
2- Protection Principles
3- Overcurrent Protection of Lines
4- Distance Protection of Lines
5- Differential Protection
6- Transformer Protection
7- Pilot Protection of Lines
8- Digital Relaying

Course Objectives:

Understanding the fundamentals of unsymmetrical faults, system protection and its components. Studying the function and setting of different relay types: overcurrent, directional, distance, differential, and pilot. Studying the relay applications to power system components: generators, transformers, and lines, buses.

Class/Tutorial Schedule:

Class is held three times per week in 50-minute lecture sessions. There is also a 50-minute weekly tutorial associated with this course.

Evaluation:

Mid-Term I:	20 %
Mid-Term II:	20 %
Tutorial &Home Works	10 %
Course Project	10 %
Final Exam	40 %
Total	100 %

***Course Project* :**

Each student has to select a topic in power system protection particularly that is related to industrial applications. the deliverables for the project are a) a detailed report for the instructor, b) an abstract for the students c) a power-point representation. The course projects are discussed in two-sessions. The students are allowed to contribute in the discussion by questions, comments added information.

Weekly Teaching Plan

week	Topics	Text	Reference
1	**Unsymmetrical Faults**: Introduction, Single-Line-To-Ground fault	9.1, 9.2	-
2	Line-Line fault, Double-L-L fault, Sequence Bus Impedance matrices	9.3-9.5	-
3	**Protection principles**: Objectives, Bus configurations,	10.8	1.1-1.4
4	System components, Current transformers, Voltage Transformers	10.1,10.2	1.5,3.2,3.6,3.7
5	**Overcurrent Protection of Lines**: Overcurrent Relays, Fuses,	10.3,10.5	4.1-4.4
6	Radial system protection, Directional relays applied to 2-source	10.4,10.6,10.7	4.5,4.6
7	**Distance Protection of Lines**: Stepped protection, R-X	10.9	5.2-5.5
8	**Differential Protection**: differential relay,	10.10, 10.11	
9	Bus protection, Machine winding protection		9.3
10	**Transformer Protection**: overcurrent, differential, inrush current.	10.12	8.2-8.4
11	**Pilot Protection of Lines**: Communication channels,	10.13	
12	Directional comparison, Phase comparison		6.2-6.5, 6.9
13	**Digital Relaying**: Components of digital relay,	10.14	2.6
14	Algorithms of digital relay	-	

Outcome Coverage:

a. Apply math, science and engineering

a.1 Applying symmetrical components method for the analysis of unsymmetrical faults and design of protective relays particularly distance relays.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

None

c. An ability to design a system, component, or process to meet desired needs.

c.1 Design of coordinated overcurrent protection for radial lines.
c.2 Design of differential protection for transformers.
c.3 Design of distance protection for subtransmission/transmission lines.

d. An ability to function on multi-disciplinary teams.

None

e. Identify, formulate and solve engineering problems

e.1 Analyzing and calculating unsymmetrical faults.

g. An ability to communicate effectively.

The students are requested to prepare a course project. Each student has to select a topic in power system protection particularly that is related to industrial applications. the deliverables for the project are a) a detailed report for the instructor, b) an abstract for the students c) a power-point representation. The course projects are discussed in two-sessions. The students are allowed to contribute in the discussion by questions, comments added information.

f. An understanding of professional and ethical responsibility

This concept is conducted implicitly throughout the course.

h. Broad education necessary to understand the impact of engineering solutions in a global and societal context

None.

I. Recognition of the need for and an ability to engage in life-long learning.

This concept is clarified through the repeated comparison between an engineer and a technician. Having a strong background of power engineering enables the engineer to engage in life-long learning. Some illustrative examples are used for the changes in power technologies with the continuous need to upgrade the engineering knowledge.

J. Knowledge of contemporary issues.

None

K. Use of modern engineering tools

This is conducted through giving examples on the use of microprocessors, artificial intelligence techniques to solve real-life power engineering problems.

Preparer: Hossam Eldin Abdallah Talaat
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