King Saud University
College of Engineering
Electrical Engineering Department

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2nd Semester 1434-1435 (2013-2014)

EE449 Power System Protection

- **Text Book**: Glover & Sarma, " Power System Analysis and design", 4th Ed. PWS Publishing 2002
- **Ref Books**: 1- Horowitz & Phadke, "Power System Relaying" Research Studies press, 2002

- **Course Objectives**:
  1. Understanding the fundamentals of unsymmetrical faults, system protection and components
  2. Studying the function and setting of different relay types: overcurrent, distance, differential ….
  3. Studying the relay applications to power system components: generator, transformers. Lines and buses

- **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. Generator and Motor Protection
8. Pilot protection
9. Digital relaying

EE449 Course Schedule:

Week	Topics	Text	Ref 1
1	**Unsymmetrical faults:** Introduction, 1-Line to ground (1-LG) fault	9.1, 9.2	-
2	Line-line (L-L) faults, double L-L faults, sequence bus impedance matrices	9.3-9.5	-
3	**Protection principles:** Objectives, bus-configuration, requirements, zones of protection, backup protection	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	**Over current protection of lines**: Over current 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
Mid-Term Exam I (Thursday 13.03.2014)			
7	**Distance protection of lines**: Stepped protection, R-X diagram	10.9	5.2-5.5
8	**Differential protection:** Differential relay, bus protection	10.10, 10.11	9.3
9	**Transformer protection:** Overcurrent, differential, inrush current	10.12	8.2-8.4
10	**Generator and Motor Protection:** Stator fault	-	7.2
11	Rotor fault, voltage / frequency, loss-of-excitation	-	7.3, 7.7, 7.8
12	**Pilot protection** Communication charnels, directional comparison, phase comparison	10.13	6.2-6.5, 6.9
Mid-Term Exam II (Thursday 08.05.2014)			
13	**Digital relaying**: Components of digital relays,	10.14	2.6
14	Algorithms of digital relays	-	

- **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.

- **Grading Policy**:

Two midterm exams	45	(on 13/03/2014 and 08/05/2014)
Quizzes & Homework	5	
Tutorials & Attendance	10	
Final Exam	40	
Total	100	

- **Attendance**:

  A student absent for more than 25% of lectures will not be allowed to appear in the final exam. This policy will be strictly enforced without any exception.

- **Teaching assistant:**

  Eng. Ameen Al-Assar, Office: 0B-92; Phone: 467-6913

- **Pre-requisites for this course**:

  EE341 (Power System Analysis)

- **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 sub-transmission/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.

F. 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.

G. 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.