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| **King Saud University****College of Engineering****Electrical Engineering Department** |    |

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**Instructor:** Prof. Yasin Khan **Office**: 2C-123 **Phone**: 467-6759

**E-mail**: yasink@ksu.edu.sa 1st Semester 1444 (2022-2023)

**EE449 Power System Protection**

* **Text Book**: Glover & Sarma, " Power System Analysis and design", 5th 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, ….etc.
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 Protection8. Pilot protection 9. Digital relaying

**EE449 Course Schedule:**

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| **No.** | **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**  |
| 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**  |
| 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 65-minutes lecture sessions. There is also a 65-minutes weekly tutorial associated with this course.

* **Grading Policy**: Two midterm exams 45

 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:**

Dr. Yasin Khan

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

EE441 (Power System Analysis)

* **Course Learning Outcome (CLO) Coverage**:

**CLO1:** Clearly understand the basic concepts of the fundamentals of various faults, system protection and its components.

**CLO2:** Studying the function and setting of different relay types overcurrent, directional, distance, differential, and pilot relays.

**CLO3:** Design key functions of contemporary protection system for electric power systems.

**CLO4:** Acquire the basic skills of how to approach and deal with real life situations and solve design and operating problems using conventional and modern tools.

| **ABET** | **Students Outcomes (SO) Description** |
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| **SO1** | An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. |
| **SO2** | An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and .. |
| **SO3** | An ability to communicate effectively with a range of audiences. |
| **SO4** | An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must con.. |
| **SO5** | An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment. |
| **SO6** | An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusion. |
| **SO7** | An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. |
| **K1** | An ability to gain knowledge of facts, concepts and theories of mathematics, Science, Islamic values and Arabic literature. |