EE3015 POWER SYSTEMS AND PROTECTION

Acad Unit: 3
Pre-requisite: EE2001 Circuit Analysis
Effective: Acad Year 2013-2014
Last update: May 2013

LEARNING OBJECTIVE

The learning objective of this course is to provide fundamental knowledge for B.Eng (EEE) students who wish to specialize in power engineering in their profession. It introduces the course participants to the overall structure of the electric power supply system, starting from power generation to power transmission and distribution. It includes basic concepts of power systems operation, fault analysis, and power systems protection techniques.

CONTENT

Fundamentals of Power Systems. Power Systems Operation and Analysis. Power Systems Fault Analysis. Over-current Protection of Distribution Systems. Differential Protection of Power Apparatus.

COURSE OUTLINE [Lectures: 26 hours Tutorials: 12 hours Laboratories: 3 hours]

S/N	Topic	Lecture Hours	Tutorial Hours
1	Fundamentals of Power Systems Energy sources. Per unit system. Power system components and representation: synchronous generators, transmission lines and cables. Load representations. Power transfer.	8	4
2	Power Systems Operation Power frequency control. Reactive power & voltage control.	4	2
3	Fault Analysis Three-phase faults and fault level calculations. Symmetrical components. Sequence impedances and sequence networks. Unsymmetrical faults.	6	3
4	Over-current Protection of Distribution Systems Instrument transformers. Overcurrent relay and protection. Coordination of overcurrent and earth relays for distribution systems.	4	2
5	Differential Protection of Power Apparatus Differential and directional relays. Protection of power transformers. Protection of transmission lines. Protection of motors and generators.	4	1

LAB DESCRIPTION (3 hours)

Operation of a Power Generation and Protection System. The objectives of this experiment are to study: (i) the synchronization of an AC generator to a large power system, (ii) the operation of a synchronous generator connected to a large power system, (iii) the operation of a synchronous generator in isolation, and (iv) the overcurrent relay setting and load voltage distribution system protection. After completing this experiment, students should be able to understand how generator synchronization is conducted at a power plant, how to operate a grid-connected or isolated generator and how power systems protection apparatus are operated and controlled.

LEARNING OUTCOME

After going through the course, the students will be able to handle routine technical problems relating to the electrical power system and have a better appreciation and understanding of power generation, transmission and distribution lines and loads and their analysis methods. A good understanding of how power system faults arise, and how they are analyzed and protected is important in many technical decisions which power engineers are expected to make.

STUDENT ASSESSMENT

Continuous Assessment	30 % [Quiz = 20%, Laboratory Assignment = 10%]
Final Examination	70 %

TEXTBOOKS

1. Chapman Stephen J, Electric Machinery and Power System Fundamentals, 1st Edition, McGraw-Hill, 2002. (TK2000.C466E)

2. Blackburn J Lewis, Protective Relaying: Principles and Applications, 3rd Edition, CRC Press, 2007. (TK2861.B628 2007)

REFERENCES

1. Wildi Theodore, Electrical Machines, Drives and Power Systems, 6th Edition, Pearson/Prentice-Hall, 2006. (TK2182.W673 2006)

2. Weedy Birron Mathew and Cory Brian John, Electric Power Systems, 4th Edition, John Wiley, ~~1998~~ 1. (TK1001.W394 ~~1998~~ 1)

3. Anderson Paul M, Power System Protection, McGraw-Hill, IEEE Press, 1999. (TK1010.A548)