

Course Information Booklet for Bachelor Course on Electrical and Energy Engineering

At Institute of Technology of Cambodia

Type of recognition planned: HEI Degree

Level of the course: Bachelor 4th Year of Engineering Degree

Contributors: Department of Electrical and Energy Engineering

Planned Teachers: Ms. Eng Samphors

Title course: Power System Architecture and Protection

Course Objectives

The objective of this course is to study the architecture and protection concept of power systems. This is to provide students the fundamentals and to enable them to solve the problem and to identify the structure and different protection schemes as well as relay setting of the power systems. **The concept of operation and management of power systems based on the application of automation systems is also provided to the students.** The practice works based on simulation and **experiment** are also provided to students toward narrowing the theory-practice gap of teaching.

Description of the Course (TOPICS/CHAPTERS), number of hours & type (Lecture or tutorial or laboratory works or Self-Learning)

Chapters	Topics	Number of hours	Type
Introduction to Power System Architecture and Protection	<ul style="list-style-type: none"> • Power System Overview • Consequences of fault occurrence • Protection system requirements • Protection System Elements • System Protection Components 	3h	Lecture
Power System Structure	<ul style="list-style-type: none"> • HV and MV Consumer Substations • HV Transmission Systems • MV Distribution Systems • LV Distribution Systems 	3h	Lecture
Earthing Systems	<ul style="list-style-type: none"> • LV Earthing Systems • MV Earthing Systems • HV Earthing Systems 	3h	Lecture
Symmetrical Components	<ul style="list-style-type: none"> • Sequence Components • Sequence Networks 	6h	Lecture and Tutorial
Fault Calculations	<ul style="list-style-type: none"> • The Per-Unit Systems • Impedance Matrix • Fault Calculations (LLL, LL, LLG, SLG) 	9h	
Instrument Transformers	<ul style="list-style-type: none"> • Current Transformers • Voltage Transformers 	3h	Lecture and Tutorial
Protection Functions and Apparatus Protection	<ul style="list-style-type: none"> • Overcurrent Relays, Radial System Protection, Reclosers, Fuses • Directional Overcurrent Relays, Two-Source System Protection • Zones of Protection • Distance Relays and Line Protection • Differential Relays, Generator Protection, Bus Protection, Transformer Protection 	15h	Lecture and Tutorial

<p>Application of Automation System in Power Systems</p>	<ul style="list-style-type: none"> • Introduction to Power System Automation <ul style="list-style-type: none"> - Introduction to SCADA, IEDs, RTUs, PLCs, and Communications - Automation System for Power Generating Stations - Automation System for Substations • Smart Grid & Distribution Automation (DA) <ul style="list-style-type: none"> - Introduction to Smart Grid & DA - Advantage of DA - Consumer Information Service (CIS) - Geographical Information System (GIS) - SCADA System - Automation System for Power Distribution Systems - Automation System for Hybrid Renewable Energy Systems • Programmable Logic Controller (PLC) <ul style="list-style-type: none"> - Introduction to PLC - How Does a PLC Work - Structure of PLC - PLC Type - PLC Programming - Ladder Logic - Function Block Diagram - Structure Text - Education tool 	<p>6h</p>	<p>Lecture (New)</p>
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Prerequisite: Power system analysis and optimization, 4th Year, Electrical and Energy Engineering, Option Electrical Energy

Learning Outcomes

Upon completion of this course, students will be able to identify different structures, protection system schemes, fault calculation of power systems. **The students will be able also to get knowledge of the concept and main components used for managing and monitoring electrical power systems through automation systems.** Besides, they will also comprehend the solving of distribution system management such as reconfiguration, restoration, voltage control using their developed algorithms and optimization methods and also identify the different protection system schemes with selected protective devices.

References:

- [1] J. D. Glover, T. J. Overbye, and M. S. Sarma, "Power System Analysis and Design," Cengage Learning, 6th Edition, 2017.
- [2] J. M. Gers and E. J. Holmes, "Protection of Electricity Distribution Networks," IET Power and Energy Series 47, 2nd Edition, 2004.
- [3] H. A. Gabbar, "Smart Energy Grid Engineering," Academic Press, 1st Edition, 2016.

(*) The updated course content associated with automation systems is highlighted in red text.