Electrical power system protection

Academic Year: (2023 / 2024) **Review date: 28/04/2023 13:42:21**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: SORRENTINO , ELMER

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Fundamentals of Electrical Engineering
Electrical Lines and Switchgear
Electric Power Systems
AC Electrical Machines
Electrical Installations
Magnetic circuits and transformers

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
COCIN1. Ability to draft, sign and develop projects in the area of industrial engineering for construction, renovation, repair, preservation, demolition, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and installations and automation and manufacturing processes.
COCIN4. Ability to resolve problems with initiative, decision-making, creativity, and critical reasoning skills and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering field.
COCIN5. Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar jobs.
COCIN6. Ability to deal with mandatory specifications, regulations and norms.
CEP1. Capacity to design a system, component or process in the area of electrical engineering in compliance with required specifications.
CEP2. Knowledge and ability to apply computational and experimental tools for analysis and quantification of electrical engineering problems.
ECRT3. Capacity for calculation and design of low and medium voltage electrical installations.
ECRT4. Capacity for calculation and design of high voltage electrical installations.

By the end of this content area, students will be able to have:
RA1.3. Coherent knowledge of the branch of electrical engineering including some at the forefront of their branch in electric power facilities.
RA2.1. The ability to apply their knowledge and understanding to identify, formulate and solve problems of electric power facilities using established methods.
RA2.2. The ability to apply their knowledge and understanding to analyse engineering products, processes and methods.
RA3.1. The ability to apply their knowledge and understanding to develop and realise designs to meet defined and specified requirements.
RA3.2. An understanding of design methodologies, and an ability to use them.
RA4.1. The ability to conduct searches of literature, and to use data bases and other sources of information.
RA4.2. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions.

RA5.1. The ability to select and use appropriate equipment, tools and methods in electric power facilities.
RA5.3. An understanding of applicable techniques and methods in electric power facilities, and of their limitations.
RA5.4. An awareness of the non-technical implications of engineering practice.
RA6.3. Demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice.

OBJECTIVES

The student obtains skills for selecting the settings of main electrical protections for electric distribution and transmission systems, as well as knowledge to understand the operation of these protections.

DESCRIPTION OF CONTENTS: PROGRAMME

-1: Fundamentals about electric power system protection. Basic definitions. Functions and features of protection systems.

-2: Short circuit analysis. Computation of short-circuit currents, using symmetrical components. Effects of fault currents.

-3: Protection of low-voltage electric systems. Description of protective devices. Coordination of protective devices.

-4: Protection of medium-voltage electric systems. Description of protective devices. Coordination of protective devices.

-5: Distance protection and differential protection. Fundamentals about distance protection. Self-polarization of distance protection and fault analysis. Communication-assisted trip for distance protections. Differential protection for transmission lines and differential protection for transformers.

-6: Protection of synchronous generators and other protection systems. Available protective functions for synchronous generators. Other available protections for transmission lines and transformers. Busbar protection. Breaker-failure protection. Other protective functions for electric power systems and wide area protection systems.

LEARNING ACTIVITIES AND METHODOLOGY

-Lectures, sessions for solving doubts in reduced groups, individual tutorials and personal work of the student, oriented to the learning of theoretical knowledge (3 ECTS credits).

-Analysis and solving of practical exercises in reduced groups, laboratory sessions, individual tutorials and personal work of the student, oriented to the obtaining of practical skills related to the contents of the subject (3 ECTS credits).

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

Continuous assessment, based on 3 exams, with the same weighting factor for each exam. The result of this continuous assessment can be taken as the 100% of the final grade for this course.

-Final exam in regular call:
The final exam is optional for students. Students can take the final exam, if they want; in such case, the weighting factor of the final exam is 60% and the weighting factor of continuous assessment is 40%.

-Extraordinary call:
If the student followed the continuous assessment, the weighting factor of the final exam is 60% and the weighting factor of continuous assessment is 40%. If the student didn't follow the continuous assessment, the exam of extraordinary call has a 100% of value in the final mark.

BASIC BIBLIOGRAPHY

- Blackburn, J. and Domin, T. Protective Relaying: Principles and Applications, CRC Press, 2014

- Das, J. Power System Protective Relaying, CRC Press, 2018

- Gers, J. and Holmes, E. Protection of Electricity Distribution Networks, IET, 2011

- Iriondo Barrenetxea, A. Protecciones de Sistemas de Potencia, Universidad del País Vasco, 1996

- Montané Sangrá, P. Protecciones en las Instalaciones Eléctricas: Evolución y perspectivas, MARCOMBO, 1993

- Suarez Creo, Juan M. Protección de Instalaciones y redes eléctricas, Andavira, 2011

- Ziegler, G. Numerical Distance Protection: Principles and Applications, Siemens, 2011

- Ziegler, G. Numerical Differential Protection: Principles and Applications, Siemens, 2012

BASIC ELECTRONIC RESOURCES

- IEEE . IEEE Std. 242-2001: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book): https://ieeexplore.ieee.org/document/974402

- IEEE . IEEE Std. C37.91-2008: IEEE Guide for Protecting Power Transformers: https://ieeexplore.ieee.org/document/4534870

- IEEE . IEEE Std C37.113-2015: IEEE Guide for Protective Relay Applications to Transmission Lines: https://ieeexplore.ieee.org/document/7502047

- IEEE . IEEE Std C37.102-2006: IEEE Guide for AC Generator Protection: https://ieeexplore.ieee.org/document/8526571