Electrical power system protection

Academic Year: (2023 / 2024) **Review date: 28-04-2023**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: SORRENTINO , ELMER

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Electrical power engineering fundamentals
Electrical Technology

SKILLS AND 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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

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

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.

% end-of-term-examination 60
% of continuous assessment (assigments, laboratory, practicals...) 40

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

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 C37.102-2006: IEEE Guide for AC Generator Protection: http://ieeexplore.ieee.org/document/8526571
- IEEE . IEEE Std. 242-2001: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book): http://ieeexplore.ieee.org/document/974402
- IEEE . IEEE Std. C37.91-2008: IEEE Guide for Protecting Power Transformers: http://ieeexplore.ieee.org/document/4534870
- IEEE . IEEE Std C37.113-2015: IEEE Guide for Protective Relay Applications to Transmission Lines: http://ieeexplore.ieee.org/document/7502047