Universidad Zaragoza

Academic Year/course: 2022/23

66375 - Protection systems in smartgrids

Syllabus Information

Academic Year: 2022/23
Subject: 66375 - Protection systems in smartgrids
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 636 - Master's in Renewable Energies and Energy Efficiency
ECTS: 3.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The main objective of this subject is to show the protection systems used today and how they can be affected by the increase in renewable and distributed generation. Likewise, the communication systems used by said protection systems will be shown.

These approaches and objectives are aligned with some of the **Sustainable Development Goals, SDG**, of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) and certain specific goals, in such a way that the acquisition of learning outcomes of the subject provides training and competence to the student to contribute to some extent to their achievement:

Goal 7: Affordable and clean energy

- Target 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services
- Target 7.2 By 2030, considerably increase the proportion of renewable energy in all energy sources
- Target 7.3 By 2030, double the global rate of improvement in energy efficiency

Goal 9: Industry, Innovation and infrastructure.

- Target 9.4. By 2030, modernize infrastructure and convert industries to be sustainable, using resources more efficiently, promoting the adoption of clean and environmentally sound technologies and industrial processes, and ensuring that all countries take action according to their respective capabilities.

Goal 13. Climate action

- Target 13.3 Improve education, awareness and human and institutional capacity regarding climate change mitigation, adaptation, reduction of its effects and early warning.

1.2. Context and importance of this course in the degree

This subject is included in the electrical systems optional module taught during the first year's second semester. The subjects of this optional module allow the student to intensify their skills and specialize in technologies related to renewable energies and energy efficiency concerning electrical systems.

After completing the subjects of the first semester, students must complete 30 ECTS of the specialization module to complete the training in renewable energies and energy efficiency. To obtain the "Electrical Systems" specialization, the student must complete at least 24 ECTS in subjects of this module and complete the TFM in the said specialization.

1.3. Recommendations to take this course

A series of previous knowledge is required from the students for correct learning of the subject. Above all, the student needs a background in electrical engineering and networks.

Previous knowledge is required for correct learning of the subject. Above all, the student needs a good base of solar photovoltaic energy and wind energy.

Following the lectures, problems, laboratory, and external practices are essential, as well as personal study and the

preparation of the assignments for the subject.

Continuous work is fundamental to good use of the knowledge transmitted in the classes and passing it successfully. To facilitate this ongoing work, the student has the teacher's advice, both during lessons and tutoring hours, specially designed for this purpose.

2. Learning goals

2.1. Competences

The following skills are developed in this subject:

BASIC SKILLS

CB6.- Possess and understand the knowledge that provides a base or opportunity to be original in the development and/or application of ideas, often in a research context.

CB7.- That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their study area.

CB8.- That students can integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to applying their knowledge and judgments.

CB9.- That students know how to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences clearly and unambiguously.

CB10.- That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

GENERAL COMPETENCIES

CG1.- Carry out research, development and innovation in products, processes and methods concerning energy efficiency.

CG2.- Carry out research, development and innovation in products, processes and methods concerning renewable energies.

CG4.- Follow the technological evolution of renewable energies and have prospective knowledge of this evolution.

CG5.- Apply knowledge of advanced sciences and technologies to the professional or investigative practice of efficiency.

CG6.- Identify current legislation and regulations applicable to the renewable energy and energy efficiency sector.

CG7.-Assess the application of emerging technologies in energy and the environment.

CG9.- Solve complex problems in the field of energy efficiency and sustainability.

SPECIFIC COMPETENCES

CE1.- Use and develop methodologies, methods, techniques, programs for a specific use, norms and computing standards.

CE8.- Describe the smartgrids associated with energy management and distribution.

CE17.- Calculate electric power generation, transport and distribution systems, and the integration of renewable energies in each

2.2. Learning goals

The student, to pass this course, must demonstrate the following results...

- Know the different protection systems that are applied in distribution and transport systems
- Know the influence that renewable and/or distributed generation can have on protection systems
- Know the communication systems used in the protection system

2.3. Importance of learning goals

The stability of electrical power systems depends to a large extent on the performance of the protection systems. These protection systems were designed for a generation based massively on large synchronous generators. The energy transition challenge and the rise of renewable generation make it necessary to review these protection systems and adapt them. Therefore, the system protection system must evolve to accommodate the new situation, using the advantages provided by communication systems.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

In the ordinary call, the evaluation will consist of:

- Academic works (including those derived from practice sessions): 60%
- Oral presentations and debates: 20%
- Objective tests (test type): 20%

The student who does not opt for the evaluation procedure described above in the first call will have the right to take a global evaluation test (the subject will be evaluated entirely in a single test).

The call for extraordinary evaluation will be carried out through a global test carried out in the period established for this purpose.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The subject is structured around three axes: lectures, problems and case resolution and practical sessions.

In the lectures, the basic concepts are explained and are related to the technical characteristics of the processes, combining them with the problem-solving sessions and cases (exercises that the students solve in class and are corrected), serving as support to fix understanding of concepts.

In the practical sessions, computer programs are used to study practical cases that are more complex than those presented on the board, where specific calculation power is necessary for their resolution.

4.2. Learning tasks

In order for students to achieve the learning outcomes described above and acquire the skills designed for this subject, the following training activities are proposed:

- A01 Lectures (6 hours): content presentation by the teaching staff or external experts to all the students of the subject.
- A02 Solving problems and cases (15 hours): carrying out practical exercises with all the students of the subject.
- A03 Laboratory sessions (15 hours): carrying out practical exercises in small groups of subject students.
- A05 Assignments (20 hours).
- A06 Personalized teacher-student tutoring (10)
- A07 Study (40 hours).
- A08 Assessment (5 hours).

The hours indicated are indicative and will be adjusted depending on the academic calendar of the course.

At the beginning of the course, the calendar of practical sessions will be informed. It will be set according to the progress of the program and the availability of laboratories and computer rooms.

4.3. Syllabus

The contents of this course are detailed below:

1. Introduction
2. Protection systems in the current SEP
3. Impact of distributed generation on protection systems
4. Prospects in protection systems

4.4. Course planning and calendar

The subject is taught four hours per week in the spring semester, in which theory and practical sessions will alternate.

At the beginning of the semester, the professors will inform about the planning of the teaching activities, the key dates of delivery of exercises and the final evaluation test of the subject.