Universidad Zaragoza

Academic Year/course: 2022/23

66364 - Energy eficiency in electric systems

Syllabus Information

Academic Year: 2022/23
Subject: 66364 - Energy eficiency in electric systems
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 636 - Master's in Renewable Energies and Energy Efficiency
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The objectives of the course are the following:

- Know the fundamentals of energy efficiency and its relationship with energy saving.
- Have the skills to carry out studies, delving into the knowledge of loss mechanisms in the different systems.
- Calculate approximately the energy efficiency of equipment and processes.
- Be able to propose efficiency improvements in energy-consuming systems or processes, estimate the economic benefits associated with them, and conduct an economic evaluation of the necessary investment.

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 mandatory subject called "Energy Efficiency" taught during the first semester of the first year. The subjects that make up this subject will allow the student to know the main concepts related to energy efficiency in electrical systems, calculating losses and improving efficiency.

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 electromagnetism and circuit theory.

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.

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.

CG8.- Develop the ability to advise on the best way or channel to optimize energy resources concerning renewable energies.

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.

CE3.- Assess the importance and implications of energy use in the development of society.

CE4.- Assess the environmental impact of a RES installation or energy efficiency action.

CE5.- Identify the energy management, improvement and optimization processes in the industry.

CE6.- Evaluate energy-saving techniques in the domestic and tertiary sectors.

CE7.- Describe the technologies related to sustainable mobility.

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 fundamentals of energy efficiency and its relationship with energy saving.
- Have the skills to carry out studies, delving into the knowledge of loss mechanisms in the different systems.
- Calculate approximately the energy efficiency of equipment and processes.
- Be able to propose efficiency improvements in energy-consuming systems or processes, estimate the economic benefits associated with them, and conduct an economic evaluation of the necessary investment.
- Apply the theoretical foundations necessary for the numerical calculation of electromagnetic systems.
- Simulate electromagnetic systems using the finite element method.
- Interpret results of electromagnetic simulations by finite elements.
- Optimize the design of electromagnetic systems to improve their efficiency through numerical simulations.

2.3. Importance of learning goals

After passing the course, students can roughly calculate the energy efficiency of equipment and processes to propose efficiency improvements in energy-consuming systems or processes, estimating the economic benefits associated with them.

The finite element electromagnetic simulation method allows for studying problems of practical interest, both electrical (insulation, dielectric breakdown situations, etc.) and magnetic (transformers, rotating machines, permanent magnets, etc.), improving the design and optimising the efficiency of new products.

3. Assessment (1st and 2nd call)

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

In the ordinary call (first call), the evaluation will consist of:

- Academic works (including those derived from lab sessions) and oral presentation: 60%
- Written tests (open response and multiple choice): 40%

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 second call (or extraordinary call) 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 (12 hours): content presentation by the teaching staff or external experts to all the students of the subject.
- A02 Solving problems and cases (30 hours): carrying out practical exercises with all the students of the subject.
- A03 Laboratory practices (15 hours): carrying out practical exercises in small groups of subject students.
- A05 Application or research works (30 hours).
- A06 Personalized teacher-student tutoring (6 hours)
- A07 Autonomous work (52 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. Fundamentals of energy efficiency in electrical systems
2. Introduction to energy efficiency in electrical power systems
3. Electromagnetic analysis of systems and equipment
4. HVDC systems and energy efficiency
5. Introduction to power quality and continuity of supply

4.4. Course planning and calendar

The subject is taught in the first semester.

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.