

Academic Year: ( 2022 / 2023 )

Review date: 28-04-2022

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: USAOLA GARCIA, JULIO

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 2

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Wind power generation systems.  
 Photovoltaic solar energy.  
 Other renewable energies.

**OBJECTIVES****COMPETENCES THAT THE STUDENT ACQUIRES WITH THIS SUBJECT**

CB6 Possess and understand knowledge that provides a basis 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 unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study  
 CB8 That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of 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 in a clear and unambiguous way  
 CB10 That students possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.  
 CG2 Acquire adequate knowledge of electrical engineering and areas that have application here.  
 CG4 Project, calculate and design renewable energy products, processes, facilities and plants.  
 CG5 Direct, plan and supervise multidisciplinary teams that design or execute renewable energy projects.  
 CE2 Knowledge of the regulations that directly affect the use of renewable energies worldwide, as well as their origin, their validity and their application.  
 CE10 Knowledge of the requirements for the integration of renewable energies in the electricity markets.  
 CE11 Ability to design the integration of renewable energies in electricity markets.  
 CE12 Knowledge of electrical systems planning taking into account the integration of renewable energies.  
 CE13 Know how the operation of electrical networks with renewable energies is carried out.  
 CE18 Knowledge of the fundamentals of electricity markets  
 CE19 Knowledge of complementary services and the markets that regulate them  
 CE20 Knowledge of remuneration and income from renewable energies

**LEARNING RESULTS acquired by the student:**

- Ability to participate in the planning of electrical systems taking into account the integration of renewable energies.
- Ability to apply the regulation that determines the remuneration and income from renewable generation in Spain and in other neighboring countries.
- Being able to determine the positive and negative points of the different rules and regulations, as well as the advantages and disadvantages of the different existing support mechanisms.
- Ability to apply network analysis tools to real cases that are required in renewable energy integration studies.
- Acquisition of skills to search for complex and specific information on regulations and legislation, on issues related to renewable energy.
- Ability to determine the problems of integration of renewable energies, and the solutions to these problems, at an economic and regulatory level.

## DESCRIPTION OF CONTENTS: PROGRAMME

Energy overview. Basic concepts of electricity markets. Regulated sectors. Retail market  
General principles of electricity markets. Planning and economic equilibrium  
Operation of organized electricity markets. Price formation.  
Congestion managements. Zonal price mechanisms.  
Secondary markets. Ancillary services.  
Renewable energies in the electricity markets  
Participation of renewable energy in electricity markets.  
Participation under uncertainty  
Energy subsidies and costs  
Analysis of costs of renewable energy projects  
Scenarios for decarbonization of the energy system  
The operation of the system with renewable energy  
Renewable energy regulation  
Participation of renewable energy in electricity markets.

## LEARNING ACTIVITIES AND METHODOLOGY

Theoretical class 18 contact hours  
Theoretical practical classes 24 hours in person  
Individual student work 108 hours of student work

### TEACHING METHODOLOGIES

Presentation in class by the teacher with support of computer and audiovisual media, in which the main concepts of the subject are developed and the bibliography is provided to complement the students' learning.  
Resolution of practical cases, problems, etc.¿ posed by the teacher individually  
Preparation of papers and reports individually.

## ASSESSMENT SYSTEM

Questionnaires and exams throughout the course: 40% of the grade  
Individual or group work done during the course: 60% of the grade

<b>% end-of-term-examination:</b>	30
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	70

## BASIC BIBLIOGRAPHY

- I.J. Pérez-Arriaga (Ed.) Regulation of the Power Sector, Springer, 2013
- Kirschen & Strbac Fundamentals of Power System Economics, John Wiley & Sons, 2004
- Kirschen & Strbac Fundamentals of power system economics, Wiley, 2019
- Stoft Power System Economics., IEEE Press - Wiley Interscience, 2002
- Wood, Wollenberg & Sheblé Power generation, operation and control, Wiley, 2014