Universidad Zaragoza

Academic Year/course: 2021/22

30035 - Renewable Energies

Syllabus Information

Academic Year: 2021/22
Subject: 30035 - Energías renovables
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 436 - Bachelor's Degree in Industrial Engineering Technology
ECTS: 6.0
Year: 4
Semester: First semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The objectives of the subject are of two types:

1. Theoretical: It is pursued that the student knows and handles the basic theoretical contents that support the renewable energies. At the end of the course the student will be able to:

- Understand the behavior of the basic aspects of the different types of Renewable Energy.
- Select the most suitable renewable energies according to the needs.

2. Practical: It is intended that the student knows how to perform in a real environment, applying and analyzing the practical scope of the theoretical contents learned. At the end of the course the student will be able to:

- Identify physically the different types of renewable energies
- Identify and understand the behavior of solar thermal energy.
- Identify and understand the behavior of photovoltaic solar energy.
- Identify and understand the behavior of wind energy
- Identify and understand the behavior of hydraulic power.
- Identify and understand the behavior of tidal energy
- Identify and understand the behavior of biomass energy
- Identify and understand the behavior of geothermal energy

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) in such a way that the acquisition of the results of Learning the subject provides training and competence to contribute to some extent to its achievement:

1.2. Context and importance of this course in the degree

Renewable Energies is a subject of the intensification in Energy of the Degree in Engineering of Industrial Technologies. In this context the basic concepts of the different renewable sources of energy are presented. The students have studied in previous semesters basic subjects, necessary to understand the use of the different natural resources. At the end of the course the student is able to understand the transcendence of renewable energies and their importance in industrial processes and electricity generation

1.3. Recommendations to take this course

The student is encouraged to actively attend classes, as well as a continuous study of the contents of the subject, the preparation of the practical cases that can be solved in later sessions, the study of the scripts and the continuous elaboration of the results of the practices.
Continuous work is fundamental to overcome with maximum use this subject, since each part is studied gradually with a progressive procedure. Therefore, when doubts arise, it is important to resolve them as soon as possible to ensure the correct progress in this matter. To help you solve your doubts, the student has the advice of the teacher, both during the classes and in the hours of tutoring intended for this purpose.

2. Learning goals

2.1. Competences

By passing the subject, the student will be more competent to:

General competences

1. Ability to combine the basic and specialized knowledge of Industrial Engineering to generate innovative and competitive proposals in the professional activity.
2. Ability to use the techniques, skills and tools of the Industrial Engineering necessary for the practice

Specific competences:

1. Know and know how to apply the scientific-technical foundations of industrial technologies, using them at work professionally during all stages of the product or service life cycle
2. Specific and integrated knowledge about plants, systems and processes of the energy type, and on the tools of industrial electronics, automatic and industrial computing that control them
3. Ability to apply acquired knowledge and solve problems of industrial technologies in new or little known environments within broader and multidisciplinary contexts

2.2. Learning goals

The student, to overcome this subject, must demonstrate the following results:

1. It knows a wide range of systems of production and distribution of renewable energies, and its applications in the energy industry or as an auxiliary part of other industries
2. It identifies the relationships of knowledge and capabilities on various industrial technologies acquired in the previous subjects with their application in the specific domain of renewable energies
3. Applies techniques and methods of various disciplines for the analysis and design of processes in renewable energies

2.3. Importance of learning goals

The learning results of this subject equip the student with analytical capacity to introduce renewable energies in the different industrial processes and the integration of Renewable Energies in Electrical Networks and enable him to propose schemes and calculate the adequate parameters that allow to fulfill some requirements , as well as to propose solutions of improvement and efficiency in already existing processes. These results, and the skills and abilities derived from them, are of great importance in the industrial environment, where renewable energies are a key and fundamental element for economic and environmental development.

3. Assessment (1st and 2nd call)

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

According to the regulations of the University of Zaragoza the evaluation of this subject is of a global type. The student is evaluated by means of a theoretical practical exam at the end of the semester and the evaluations of the internships and tutored works carried out throughout the course. The assessment of each part in the final grade will be:

- Theoretical-practical written exam: 70%
- Practices: 10%
- Tutored work: 20%

The conditions to approve the subject are:

1. Present the practices
2. Deliver and defend tutorship works on the dates announced.
3. Get at least a 5 on the exam.
4. Obtain at least a 5 of global grade in the subject. The grade shall be calculated from the following equation:

$$A = (0.7 \times Et) + (0.1 \times Pra) + (0.2 \times Pro)$$

Where:

- A is the note about 10 (or overall grade in the subject)
- Et is the theoretical-practical exam note on 10
- Pra is the practice on 10
- Pro is the work of tutors on 10

If the grade of A is less than 5, the note of the tutored papers and the practices for the calls for the same academic year will be saved.
If a student does not deliver and / or defend the tutored work and / or practices on the agreed dates, he must take a practical exam, in addition to the theoretical-practical at the end of the semester.

In this case the conditions to approve the subject are:

1. Get at least a 5 on the hands-on exam.
2. Obtain at least a 5 in the theoretical-practical type examination.
3. Obtain at least a 5 of global grade in the subject. The grade shall be calculated from the following equation:

$$A = (0.5 \times Et) + (0.5 \times Ep)$$

Where:

- A is the note on 10 (or overall grade in the subject)
- Et is the theoretical-practical exam note on 10
- Ep is the practical exam note on 10

No exam notes or work / practice for subsequent calls

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this subject is based on the following:

1. Lectures by teachers.
2. Resolution of problems raised in class.
3. The development of practices by students, supervised by teachers. They will gradually apply, in a simulated or real environment, their theoretical knowledge, facing the limitations and constraints inherent in real systems.
4. The development of tutored works by the students. They will apply their knowledge and skills gradually, serving as training and deepening.
5. Personal study by the students.
6. Academic tutorials: the teacher will make available to the student certain procedures for approaching and solving doubts. The use of these tutorials is highly recommended to ensure adequate progress in learning.

4.2. Learning tasks

The course includes the following learning tasks:

1.- Lectures
With the presentation of theoretical contents and examples of application. The contents that are developed are the following:

- Introduction to Renewable Energies: Introduction, Future Forecast, Renewable Energy Situation
- Solar Energy: General Concepts of Solar Energy, Earth-Sun Geometry, Solar Radiation
- Solar Thermal Energy: Active Collection Systems: Introduction, Low-Temperature Solar Thermal Plants, Selection of a Low-Temperature Solar System, Thermal Solar Energy: Bioclimatic Architecture
- Photovoltaic solar energy: Introduction, Solar photovoltaic potential and current situation, Technologies to take advantage of photovoltaic solar energy, Physical fundamentals of the solar cell, Photovoltaic module, Autonomous photovoltaic systems and connected to the grid, Power conditioning subsystem:

Inverters and dc / dc converters, Other subsystems: structures, solar tracking, energy storage, protection and measurement systems, Sizing of isolated photovoltaic systems, Sizing of grid-connected photovoltaic systems

- Wind energy: Introduction to wind energy, Wind resource, Wind energy applications, Wind power potential in electricity production and current situation, Components of wind turbines: sub-systems for capture, transmission, orientation, regulation and control.
- Hydraulic Power Plants: Hydraulic power potential. Current situation of the exploitation of water energy, Types of hydraulic power stations, Substations of hydraulic power stations, Evaluation of the use of a hydraulic power plant
- Generation of electricity by use of wave energy (wave power), tidal and tidal power, Wave energy potential and current situation, Technologies to take advantage of wave energy, Tidal energy potential and current situation, Technologies to take advantage of the tidal power, Potential of the energy and current situation, Technologies to take advantage of the energy of the sea.
- The Energy of Biomass: Introduction, The Energy Transformation of Biomass, Biofuels
- Geothermal Energy: Energy Efficiency Systems

2.- Performance of exercises by the student.
3.- Performing laboratory and computer simulation practices.
4.- Development of tutored works. For its realization will be used as support the computer tools of analysis and simulation

4.3. Syllabus

The course will address the following topics:

1. Introduction to Renewable Energies
   1.1 Introduction

   1.2 Future forecast

   1.3 Status of Renewable Energies: in the world, in the European Union, in Spain

2. Solar Energy

   2.1 General concepts of the Solar Energy: Sun-Earth geometry

   2.2 Solar Irradiance

3. Solar Thermal Energy

   3.1 Active Systems for solar collection.

   3.1.1 Thermal solar installation of medium and high temperature

   3.1.1.1 Thermosolar power stations

   3.1.2 Thermal solar installation of low temperature

   3.1.2.1 Selection of a Thermal solar installation of low temperature

   3.2. Solar Thermal Energy: Bioclimatic architecture

   3.2.1 Natural architecture. Thermal comfort

   3.2.2 Bioclimatic architecture

   3.2.2.1 Passive solar systems: Direct and indirect gain, and greenhouses

   3.2.2.2 Energy analysis in buildings. The 5000 method

4. Biomass energy

   4.1. Introduction

   4.2. Energy transformation of biomass

   4.3. Biofuels

5. Geothermal energy

5.1 Systems of thermal exploitation

6. Photovoltaics

6.1 Introduction to photovoltaics.

6.2 Potential of photovoltaics and current status

6.3 Technologies for photovoltaic solar energy exploitation

6.4 Solar cells fundamentals

6.5 Photovoltaic modules

6.6 Standalone and grid-connected PV systems.

6.7 Solar inverters and dc/dc converters.

6.8 Other sub-systems: solar tracking, structures, energy storage, protection and measurement systems

6.9 Sizing of stand-alone PV systems.

6.10 Sizing of grid-connected PV systems.

7. Wind energy

7.1 Introduction to wind energy

7.2 Wind resource.

7.3 Wind energy applications

7.4 Potential of wind energy for electricity generation and current status.

7.5 Wind Energy Conversion systems

7.6 Power curve in a wind generator

7.7 Energy estimation

7.8 Grid-connected wind farms. Civil and electrical infrastructure

7.9Offshore wind farms

8. Hydroelectric energy

8.1 Potential of hydroelectric energy. Current status of the exploitation of water energy.

8.2 Types of hydropower stations

8.3 Sub-systems of hydropower stations

8.4 Energy generation estimation in a hydropower station

9. Tidal energy

9.1 Generation of electricity from wave energy.

9.2 Potential and current situations of wave energy

9.3 Wave energy technologies

9.4 Potential of tidal energy and current status

4.4. Course planning and calendar

The calendar of the subject for classroom sessions and practices is set by the Center.
Other activities related to learning that can be done during the course will be announced well in advance.

The start and end dates of the course and the specific teaching hours for each group can be found on the website of the Degree: http://titulaciones.unizar.es/
From the beginning of the semester, students will have a detailed calendar of activities (laboratory practices and experiences, ...) that will be provided by the corresponding teacher

4.5. Bibliography and recommended resources

Link:
http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30035