Course guide
340670 - FSER - Renewable Energy Sources and Systems

Last modified: 14/05/2024

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Rodríguez Bernuz, Joan Marc

Others: Rodríguez Bernuz, Joan Marc

PRIOR SKILLS

It is recommended to have completed a course on electrical systems (e.g., Sistemes Elèctrics). Basic programming skills in Matlab and spreadsheets are also advisable.

REQUIREMENTS

There are no prerequisites for taking the course.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE28. Applied knowledge of renewable energies.

TEACHING METHODOLOGY

The subject is developed through theory classes and problem-solving sessions.
- The topics outlined in the curriculum will be presented in theory classes. These will consist of theoretical explanations supplemented with activities to stimulate student participation, discussion, and critical analysis.
- Problem-solving classes will involve the presentation and resolution of exercises individually or in groups.
- Group activities will complement specific sections of the subject's syllabus.

LEARNING OBJECTIVES OF THE SUBJECT

To combat climate change effectively, structural changes must be made in the near or distant future. Our society consumes large amounts of energy, much of it in the form of electricity, which must be produced from primary sources where fossil fuels (causing greenhouse gas emissions) have a significant weight.

In this regard, renewable energy sources have and must play a fundamental role in achieving, as soon as possible, a zero-emission energy system. Since the climate summit in Paris in 2015, different countries have committed to promoting these renewable energies within their territory, adopting various types of measures and/or policies to achieve this energy transition.

The basic objectives pursued in this subject are:

- Study the characteristics of different types of renewable energy sources that have or may have an important role in this transition we have mentioned.
- Analyze the weight of renewable energy sources in the electric mix and the current regulatory framework.
- Describe the different technological aspects of each of them, with particular emphasis on those that currently have a more significant weight, such as wind and photovoltaic generation.
- Learn to assess renewable resources available in a location.
- Dimension installations of renewable energies based on the resources obtained.
- Assess the profitability of the installations.
- Analyze the environmental impact.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1.- General concepts on renewable energies.

Description:
1.1.- Types and characteristics of renewable energy sources.
1.2.- Situation of the technologies within the electrical "mix".
1.3.- Regulatory framework. Renewable energy support plans. Specific remuneration.
1.4.- General perspective of the different technologies for the use of renewable resources.

Full-or-part-time: 11h
Theory classes: 4h
Laboratory classes: 2h
Self study : 5h

2. Basic concepts of devices in the control of renewable energy sources

Description:
3.1.- Basic concepts of a power converter and its role in the control of renewable energy sources.
3.2.- Basic parts and constituent elements of a converter.
3.3.- Basic operation concepts.
3.4.- Basic examples.

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

3.- Wind energy.

Description:
3.1.- The wind. Variability. Determination of the wind potential of a site.
3.2.- Fundamentals of aerodynamics. Types of wind turbines.
3.3.- Constituent parts of a wind turbine.
3.4.- Terrestrial and offshore wind farms. Network integration.
2.5.- Regulatory and environmental aspects.

Full-or-part-time: 44h
Theory classes: 7h
Laboratory classes: 4h
Self study : 33h

4.- Solar energy.

Description:
4.1.- Use of solar energy. Irradiance and irradiation. Model for the determination of incident solar radiation.
4.2.- Technological aspects on photovoltaic generation. Types of installations and constituent parts.
4.3.- Photovoltaic module. Operation, types and models.
4.4.- Other constituent parts: inverters, accumulators, ... Main features, types and configurations.
4.5.- Sizing networked installations. Self-consumption. Profitability.
4.6.- Dimensioning isolated photovoltaic installations.
4.7.- Overview of high-temperature solar generation. Solar thermal power plants.
4.8.- Regulatory and environmental aspects.

Full-or-part-time: 44h
Theory classes: 8h
Laboratory classes: 4h
Self study : 32h

5.- Hydraulic energy

Description:
5.1.- The water cycle. Hydraulic energy. Determination of water resources.
5.2.- Constituent elements of the hydraulic power station. Minihydraulics and microhydraulics.
5.3.- Initial sizing of a hydraulic power plant in a site.
5.4.- Ocean energy.
5.5.- Regulatory and environmental aspects.

Full-or-part-time: 20h
Theory classes: 5h
Laboratory classes: 2h
Self study : 13h

5.- Other sources of renewable energy. Geothermal, bBiomass, waste and biofuels.

Description:
5.- Current state of exploitation technologies.
5.2.- Constituent parts of the facilities.
5.3.- Regulatory and environmental aspects.

Full-or-part-time: 21h
Theory classes: 4h
Guided activities: 10h
Self study : 7h

GRADING SYSTEM

- Mid-term exam (30%)
- End-term exam. (40%)
- Practical sessions (20%)
- Course project (10%).

EXAMINATION RULES.

- Written exams are in-person and individual.
- In problem-solving classes and/or activities, if applicable, prior work will be assessed along with the presentation of activity results.

BIBLIOGRAPHY

Basic:
- Michaelides, Efstathios E. (Stathis). Alternative Energy Sources [Recurs electrònic] [on line]. Berlin, Heidelberg: Springer Berlin Heidelberg, 2012 [Consultation: 22/02/2022]. Available on: https://link.springer.com/book/10.1007/978-3-642-20951-2. ISBN 9783642209512.
- Hau, Erich. Wind Turbines [electronic resource] : Fundamentals, Technologies, Application, Economics [on line]. 3rd ed. Berlin: Springer, 2013 [Consultation: 03/05/2022]. Available on: https://link.springer.com/book/10.1007/978-3-642-27151-9. ISBN 3642271510.
- Kaltschmitt, Martin; Streicher, Wolfgang; Wiese, Andreas. Renewable energy : technology, economics and environment [on line]. Berlin [etc.]: Springer, 2007 [Consultation: 22/04/2022]. Available on: https://link.springer.com/book/10.1007/3-540-70949-5. ISBN 9783540709473.
- Ghosh, Tushar K.; Prelas, Mark A. Energy Resources and Systems [Recurs electrònic]. Vol. 1, Fundamentals and Non-Renewable Resources [on line]. Dordrecht: Springer Netherlands, 2009 [Consultation: 10/03/2022]. Available on: https://link.springer.com/book/10.1007/978-90-481-2383-4. ISBN 1280383984.
- Ghosh, Tushar K; Prelas, Mark A. Energy Resources and Systems [Recurs electrònic]. Vol. 2, Renewable Resources [on line]. Dordrecht: Springer Netherlands, 2011 [Consultation: 10/03/2022]. Available on: https://link.springer.com/book/10.1007/978-94-007-1402-1. ISBN 94-007-1402-5.