

**COURSE DATA****Data Subject**

Code	34807
Name	Renewable energies and their conditioning
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1402 - Grado de Ingeniería Electrónica de Telecomunicación	School of Engineering (ETSE)	3	First term

Subject-matter

Degree	Subject-matter	Character
1402 - Grado de Ingeniería Electrónica de Telecomunicación	13 - Renewable energy and their conditioning	Obligatory

Coordination

Name	Department
EJEA MARTI, JUAN BAUTISTA	242 - Electronic Engineering
GARCIA GIL, RAFAEL	242 - Electronic Engineering

SUMMARY

The subject "Renewable Energy and its Conditioning" is part of the common block of specific matters of the branch of telecommunications. The subject is taught in the first quarter of the third year of the Degree in Telecommunication Electronics Engineering and the Degree in Telematics Engineering and as optional subject in the fourth year of the Degree on Industrial Electronics Engineering. The overall teaching load is 6 ECTS. The workload for the student is 150 hours over the semester: 90 hours of individual homework and 60 hours of classroom lessons.

In this subject the student will acquire the skill to specify, select and manage the various existing alternative energy sources, especially solar-thermal and photovoltaic. Also they learn about the principles of power electronics in order to define, design and project an alternative energy system level block diagram. The student will also learn to evaluate the technical, legislative, economic and environmental impact of these energy sources.

The general objectives of the subject are to provide students with the necessary knowledge to understand the working principle and different applications of existing alternative energy sources with particular emphasis on solar thermal and photovoltaic. Students will learn the rules applicable to facilities based on renewable energy and will have the ability for sizing the solar power plants (both photovoltaic as solar thermal of low temperature).



PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The needed background to follow the course of the subject are acquired in the subjects of "physics" and "Electronic Circuits that are taught in first course of the Degree and Electronic and photonic devices" that is taught in second course.

OUTCOMES

1402 - Grado de Ingeniería Electrónica de Telecomunicación

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G7 - Ability to analyze and assess the social and environmental impact of technical solutions.
- R11 - Ability to use different sources of energy, especially solar photovoltaic and thermal, as well as the fundamentals of electrotechnics and power electronics.

LEARNING OUTCOMES

This subject allows to obtain the following learning results, which are related to the competences that appear in the Verification Report of the Title (http://www.uv.es/graus/verifica/Eng_%20Electronica_Telecomunicacio/Memoria.pdf):

- Know the fundamentals of electrotechnology and power electronics (G3, R11).
- Know the different alternative energy sources and its sustainability. Implications for the environment (G7, R11).
- Know how to specify different sources of alternative energy, especially solar photovoltaic and solar thermal (G5, G7, R11).
- Know the different electronic circuits to condition the energy supplied, both in autonomous systems and in grid injection (G3, R11).
- Be able to design and project an alternative energy system at the block diagram level (G3, G5, R11).



DESCRIPTION OF CONTENTS

1. INTRODUCTION TO RENEWABLE ENERGY

Topic 1: INTRODUCTION TO RENEWABLE ENERGY

(3 contact hours of theoretical clases and 2 hours for individual homework)

- 1.1. Concept of renewable energy.
- 1.2. Classification of renewable energy.
- 1.3. Impact on energy saving and the environment.
- 1.4. Governing Law.
 - 1.4.1. European Directives.
 - 1.4.2. National Energy Plan.

2. SOLAR RADIATION

Topic 2. SOLAR RADIATION. (3 contact hours of theoretical clases and 4 hours for individual homework)

- 2.1. Solar radiation. Spectrum of solar radiation.
- 2.2. Solar radiation at the surface of the earth.
 - 2.2.1. Variation of radiation
 - 2.2.2. Terrestrial coordinates.
 - 2.2.3. Movements of the earth.
 - 2.2.4. Radiation on a flat surface.
 - 2.2.5. Radiation on an inclined plane.
- 2.3. Measuring apparatus.

3. SOLAR THERMAL ENERGY

Topic 3. SOLAR THERMAL ENERGY. (10 contact hours of theoretical clases and 12 hours for individual homework)

- 3.1. Main elements of a low temperature solar thermal system.
 - 3.1.1. Solar collectors. Efficiency.
 - 3.1.2. Distribution system.
 - 3.1.3. Storage system.
 - 3.1.4. Conventional support system.
- 3.2. Types of low temperature solar systems.
- 3.3. Applications of low temperature solar thermal energy: Heating and domestic hot water (DHW).
- 3.4. Sizing of facilities and applicable regulations.
- 3.5. Medium and high temperature solar thermal energy. Applications.

Practical classes (problems): 5 hours in classroom and 6 hours for homework.

PRACTICE 1 (3 contact hours and 1 hours for individual homework): Efficiency of a low temperature solar collector.

PRACTICE 2 (3 contact hours and 1 hours for individual homework): Dynamic simulation to design and optimize a solar thermal DHW installation by using commercial software.

PRACTICE 3: Mini-Project of a solar thermal installation (3 contact hours for all the presentations and 10 hours for work in group): Calculation and dimensioning of a solar thermal ACS installation.

4. PHOTOVOLTAIC ENERGY



Topic 4. PHOTOVOLTAIC ENERGY. (10 contact hours of theoretical classes and 12 hours for individual homework)

- 4.1. Photovoltaic panels.
 - 4.1.1. Components of a panel.
 - 4.1.2. Manufacture of panels.
 - 4.1.3. Characterization of the panel: current-voltage curves and its dependence on temperature and the incident radiation.
 - 4.1.4. Panel efficiency.
 - 4.1.5. Types of panels.
 - 4.1.6. Certification procedure.
- 4.2. Photovoltaic systems.
 - 4.2.1. System Components: Batteries, regulators, DC/DC converters, inverters (DC/AC).
 - 4.2.2. Types of photovoltaic systems.
 - 4.2.2.1. Centralized and decentralized autonomous photovoltaic system.
 - 4.2.2.2. Grid connected photovoltaic system.
 - 4.2.2.3. Hybrid system.
- 4.3. Applications.
- 4.4. Sizing of facilities and applicable regulations.

Practical classes (problems): 5 hours in classroom and 6 hours for homework.

PRACTICE 4 (3 contact hours and 1 hours for individual homework): Electrical characterization of a photovoltaic installation Part I.

PRACTICE 5 (3 contact hours and 1 hours for individual homework): Electrical characterization of a photovoltaic installation Part II.

PRACTICE 6 (3 contact hours and 1 hours for individual homework): Dynamic simulation to design and optimize an autonomous photovoltaic solar installation by using commercial software.

5. OTHER RENEWABLE ENERGY SOURCES

Topic 5: OTHER RENEWABLE ENERGY SOURCES (4 contact hours of theoretical classes and 5 hours for individual homework)

- 5.1. Wind energy.
 - 5.1.1. Operation of a wind turbine.
 - 5.1.2. Wind Turbine Components.
 - 5.1.3. Types of wind turbines.
 - 5.1.4. Applications.
- 5.2. Biomass.
 - 5.2.1. Concept and principle of operation.
 - 5.2.2. Sources of biomass.
 - 5.2.3. Treatment of biomass.
 - 5.2.4. Electricity production from biomass.
- 5.3. Energies from the sea. Geothermal and hydroelectric energy.
 - 5.3.1. Concept and principle of operation.
 - 5.3.2. Applications.
- 5.4. Fuel cells.
 - 5.4.1. Concept and principle of operation.
 - 5.4.2. Types of fuel cells.
 - 5.4.3. Applications.

PRACTICE 7 (2 hours in classroom and 8 hours of work in group): Presentation of some type of renewable energy (biomass, energies from the sea, geothermal energy, hydroelectric energy or fuel cells).

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	18,00	0
Study and independent work	20,00	0
Preparing lectures	35,00	0
Preparation of practical classes and problem	17,00	0
TOTAL	150,00	

TEACHING METHODOLOGY

The development of the course is structured around three axes: learning with the teacher (theory sessions, workshop and problems), laboratory sessions and performing a mini-project.

a) Learning in group with the teacher

In the theory sessions will use the lecture model. The professor exposes the fundamental contents of the course (G3, R11), using the media at their disposal, (presentations, transparencies, blackboard).

In the problem sessions, the professor will explain several problems corresponding to topics 3 and 4 (G5, R11).

The theoretical concepts introduced in lectures will be complemented by performing a seminar-workshop (G7, R11). This seminar will be prepared by all students organized into small groups (2-4 students). The work will be presented in class laboratory and evaluated both the quality of the presentation and the response to the questions made by the teacher and other students.

b) Laboratory sessions

Lab sessions are aimed to analyse the behaviour of solar thermal collectors and solar panels, and the management of dynamic simulation tools to design and optimize a solar thermal SHW installation or an autonomous solar photovoltaic installation (G3, G5, R11).

These lab sessions will be organized around working groups of a maximum of two people.

c) Completion of a mini-project (work in group)

The same groups that were formed to carry out the seminar-workshop (2 to 4 students) must prepare a mini-project based on the calculation and dimensioning of a solar domestic hot water installation (G5, G7, R11). Each team must submit a copy of their project that will also be presented and defended.

Individual mentoring



Students will have a schedule of individual mentoring whose purpose is to solve problems, questions, guidance on homeworks, etc. The schedule will be indicated at the beginning of the academic course. The students will also have the opportunity to clarify some questions via email or discussion forums by using the tool "Aula Virtual" which is provided by the University of Valencia.

EVALUATION

The knowledge acquired by the student shall be assessed in the following two ways: firstly by continuous assessment on the first call or by an alternative assessment on second call.

Throughout the course, students must make a Mini-Project (MP) and a Workshop Seminar (ST). Competences G5, G7 and R11 are evaluated in the MP and competences G7 and R11 are evaluated in the ST. A minimum of 4/10 is required in the MP and the ST to pass the subject and an attendance higher than 80% to the laboratory sessions is mandatory to pass the subject.

Continuous Assessment System

Throughout the course two controls that contain theoretical (CTR1, CTR2) and laboratory (Lab1, Lab2) issues will be made (evaluation of competences G3, G5 and R11). CTR1 will count 20% and CTR2 15% of the final mark. It will be mandatory to obtain an average mark between CTR1 and CTR2 higher than 4/10.

Lab1 and Lab2 will be made simultaneously with the respective CTR1 and CTR2 controls. The average mark between Lab1 and Lab2 will count 10% of the final mark.

In addition there will be a Final Exam (EP) of problems with a 35% weight in the final mark (evaluation of competences G3, G5 and R11). A minimum of 4/10 is required in this exam to pass the subject.

In this way, the total grade of the subject will be obtained in the form:

$$\text{Final Mark} = 0,20 \times \text{CTR1} + 0,15 \times \text{CTR2} + 0,1 \times (\text{Lab1} + \text{Lab2}) / 2 + 0,35 \times \text{EP} + 0,15 \times \text{MP} + 0,05 \times \text{ST}$$

Second Call Assessment

This is based on a Final Exam of Theory-Problems (EF) with a weight of 70% (evaluation of competences G3, G5 and R11). A minimum of 4/10 is required in this exam to pass the subject.

The laboratory mark will be obtained from the average mark between Lab1 and Lab2, as long as it is equal to or greater than 5, otherwise a laboratory test (Lab) must be done.

The final grade of the subject will be obtained in the form:

$$\text{FINAL MARK} = 0,7 \times \text{EF} + 0,1 \times \text{Lab} + 0,15 \times \text{MP} + 0,05 \times \text{ST}$$

Advance call assessment

To apply for advance examination session, students must have made in advance the laboratory sessions and moreover shall provide documentation of the requested ST and MP.



In any case, the evaluation system will be set by " Reglamento de Evaluación y Calificación de la Universidad de Valencia para Grados y Masters" (<https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639>)

REFERENCES

Basic

- Pareja Aparicio, M., Radiación solar y su aprovechamiento energético, Editorial Marcombo, 2010. ISBN: 978-84-267-1559-3 (ebook).
- González Velasco, J., Energías Renovables, 1ª Edición, Editorial Reverté, S.A, 2009. ISBN: 978-84-291-9312-1 (ebook).
- Méndez Muñiz, J. M., Energía Solar Térmica, 3ª Edición, FC EDITORIAL, 2011. ISBN: 978-84-156-8375-9 (ebook).
- M.Ibáñez Plana, J.R. Rosell Polo, J.I. Rosell Urrutia, Tecnología Solar, Ediciones Mundi-Prensa, 2005, ISBN: 84-8476-199-1
- Méndez Muñiz, J. M., Energía Solar fotovoltaica, 7ª Edición, FC EDITORIAL, 2011. ISBN: 978-84-156-8374-2 (ebook).
- M. Alonso Abella, Sistemas fotovoltaicos: introducción al diseño y dimensionado de instalaciones de energía solar fotovoltaica. SAPT Publicaciones Técnicas, 2005.
- Fernández Salgado, J. M., Guía completa de la energía eólica. AMV Ediciones.

Additional

- Fernández Salgado, J. M., Guía completa de la energía solar térmica termoeléctrica. (Adaptada al Código Técnico de la Edificación (CTE) y al nuevo RITE) 4ª Edición ampliada, actualizada y corregida, AMV Ediciones, 2010.
- Fernández Salgado, J. M., Compendio de energía solar: fotovoltaica, térmica y termoeléctrica. AMV Ediciones.
- Anne Labouret, Michel Viloz, Energía solar fotovoltaica. Manual práctico. AMV Ediciones.
- Mario Ortega Rodríguez, Energías Renovables. Editorial Paraninfo, 2001.
- Agencia Valenciana de la Energía (AVEN), Guía práctica de la energía solar térmica, 2008.
- M. Castro, C. Sánchez, Energías geotérmicas y de origen marino. Monografías técnicas de Energías Renovables. Ed. PROGENSA, 2000.
- M. Castro, C. Sánchez, Energía hidráulica. Monografías técnicas de Energías Renovables, Ed. PROGENSA, 2000.
- Castro, M y Colmenar, A., Energía solar térmica de Baja Temperatura. Monografías técnicas de Energías Renovables Tomo 5. Ed. PROGENSA, 2000.
- Lorenzo, E., Electricidad solar fotovoltaica. Monografías técnicas de Energías Renovables Vol I y Vol II. Ed. PROGENSA, 2006.
- CENSOLAR, Sistemas Solares Térmicos. Diseño e Instalación. Ed. Solar Praxis. Sevilla 2006.



ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available

