# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 34889 |
| **Name** | Renewable energies and their conditioning |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2023 - 2024 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1403 - Degree in Telematics Engineering | School of Engineering | 3 | First term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1403 - Degree in Telematics Engineering | 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 teached 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 subjet 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

### 1403 - Degree in Telematics Engineering

- 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_Telematica/Memoria.pdf):

- Ability to use different sources of energy, especially photovoltaic and thermal solar, as well as the fundamentals of electrotechnology and power electronics (G3, R11).

- Ability to use different sources of energy, as well as the fundamentals of power electronics (G3, R11).

- Know the different sources of alternative energy 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

(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

(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

(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 hour for individual homework): Efficiency of a low temperature solar collector.

PRACTICE 2 (3 contact hours and 1 hour 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 termal 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

(10 contact hours of theoretical clases 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 charaterization of a photovoltaic installation Part I.

PRACTICE 5 (3 contact hours and 1 hours for individual homework): Electrical charaterization 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

(4 contact hours of theoretical clases 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: by continuous assessment or by an alternative assessment.

Throughout the course, students must make a Mini-Project and a Workshop Seminar (ST). For the Mini-project, It is evaluated, on the one hand, its exposition (Power-Point) and public defense (MP-EXP) and, on the other hand, the presented technical documentation (MP-DT) (evaluation of skills G5, G7 and R11). The grade of the Mini-project will be the average of the marks obtained in both parts. It will be an essential requirement, in order to pass the course, to obtain a minimum of 4/10 in the Mini-Project. The exposition and defense of the Mini-Project (MP-EXP) is considered a non-recoverable activity. The group will be uniquely graded and all its members will get the same grade in this part.

In the Workshop Seminar (ST) the degree of preparation, the quality of the presentation (Power- Point), the clarity of the presentation, as well as the rigor in the turn of answers (evaluation of G7 and R11 competencies) will be evaluated. The group will be uniquely graded and all its members will get the same grade in this part. The exhibition and defense of the Workshop Seminar is considered a non-recoverable activity.

An attendance to the laboratory sessions higher than 80% 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 a weighted 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 (Lab mark) will count 10% of the final mark. It will be an essential requirement to pass the laboratory part by continuous evaluation to obtain an average mark between Lab1 and Lab2 equal to or higher than 4/10, otherwise a laboratory test (Lab) must be done in official call.

In addition there will be a Final Exam of problems (EP) 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:

FINAL MARK= 0,20 x CTR1 + 0,15 x CTR2 + 0,1 x Lab + 0,35 x EP + 0,15 x (MP-EXP+MP-DT)/2 + 0,05 x ST

**Alternative Assessment System**

This assessment method must be followed by students who had not passed the course by continuous assessment because their weighted average mark between CTR1 and CTR2 is not higher than 4/10. This will also be the evaluation method in the second call. This is based, both on first and second call, on a Final Exam of Theory-Problems (EF) with a total weight of 70% distributed as follows: 35% for the Theory part and the other 35% for the Problems part (evaluation of competences G3, G5 and R11). A minimum of 4/10 is required to pass the subject both in the Theory and in the Problems part of this exam.

The laboratory mark, both on first and second call, will be obtained from the average mark between Lab1 and Lab2, as long as it is equal to or greater than 4, otherwise a laboratory test (Lab) must be done in official call.

The technical documentation of the Mini-Project (MP-DT) will have to be delivered again on second call for evaluation if the minimum Mini-Project grade of 4/10 was not reached on first call. In that case, it is recovered the obtained mark on the first call in the exposition and public defense of the Mini-Project (MP- EXP).

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

FINAL MARK = 0,7 x EF + 0,1 x Lab + 0,15 x (MP-EXP+MP-DT)/2 + 0,05 x 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

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