Last update: 08-05-2019

820743 - EFV - Photovoltaic Devices

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN RENEWABLE ENERGIES (Syllabus 2011). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN ENVIRONOMICAL PATHWAYS FOR SUSTAINABLE ENERGY SYSTEMS (Syllabus 2012). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN ENVIRONOMICAL PATHWAYS FOR SUSTAINABLE ENERGY SYSTEMS (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: Joaquim Puigdollers

Others: Cristobal Voz

Opening hours

Timetable: monday 11 - 13h 15 - 16h
tuesday 11 - 13h
wednesday 11 - 13h 15 - 16h
thursday 11 - 13 h

Prior skills

Background in semiconductor device physics.

Degree competences to which the subject contributes

Specific:

CEMT-1. Understand, describe and analyse, in a clear and comprehensive manner, the entire energy conversion chain, from its status as an energy source to its use as an energy service. They will also be able to identify, describe and analyse the situation and characteristics of the various energy resources and end uses of energy, in their economic, social and environmental dimensions, and to make value judgments.
CEMT-4. Efficiently collect data on renewable energy resources and their statistical treatment and apply knowledge and endpoint criteria in the design and evaluation of technology solutions for using renewable energy resources, for both isolated systems and those connected to networks. They will also be able to recognise and evaluate the newest technological applications in the use of renewable energy resources.
CEMT-7. Analyse the performance of equipment and facilities in operation to carry out a diagnostic assessment of the use system and establish measures to improve their energy efficiency.

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Teaching methodology

During the development of the course the following teaching methods will be used:

- Lecture or conference (EXP): presentation of the topics from professors lectures or by outsiders experts (through invited lectures).
- Participatory classes (PART): ressolution of exercises (individually or by group), group discussions with the professors about specific topic, classroom presentation of an activity carried out individually or in small groups.
- Theoretical or practical work supervised by the professor (TD): completion of a classroom activity or exercise (theoretical or practical), individually or in small groups with the professor's guidance.
- Project activity (PR): Learning activities focused on the development of an individual (or small group) activity of limited complexity and/or length, applying previous knowledge adquired at during the course and presentation of the results.
- Project work (PA): learning based on the design, planning and implementation of a project with higher complexity complexity, with the objective to extend the knowledge adquired at the class courses. A writing report summarizing the objectives, development, results and conclusions will be performed.
- Evaluation activities (EV).

Learning objectives of the subject

At the end ofthe course the student will understand the principles of operation of solar cells, both inorganic and organic. Manufacturing technologies will be also studied, and the student will be able to propose alternative technologies that would result in the production of more efficient photovoltaic devices.

Study load

Total learning time: 138h 21m	Hours large group:	30h	21.68%
	Guided activities:	15h	10.84%
	Self study:	93h 21m	67.47%

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Content

Module 1. Crystalline silicon pn junction	Learning time: 41h Laboratory classes: 17h Guided activities: 2h Self study : 22h

Description:
- Introduction to photovoltaic devices.
- Absorption of photons and light-matter interaction.
- Introduction to the physics of semiconductors.
- Crystalline silicon solar cells.

Related activities:
Exercises and problems

Specific objectives:
To introduce students to the technology of photovoltaic devices. Understand the principles of operation of solar cells frcm crystalline silicon. Ressolution of exercises of progressive difficulty.

Module 2. Thin-Film solar cells	Learning time: 41h Laboratory classes: 17h Guided activities: 2h Self study : 22h

Description:
- Thin-Film solar cells
- Fabrication proceses of Thin-film solar cells.
- Electrical characterization (I-V) of solar cells.
- Optoelectronic characterization (EQE) of solar cells.

Related activities:
Exercises and problems

Specific objectives:
- The student will understand the principles of operation of thin-film solar cells, manufacturing technologies and be able to propose alternative technologies that would result in the production of more efficient photovoltaic devices.
- The student understands the principles of electrical and optoelectronic characterization of solar cells and is capable of solving exercises related to this topic (with progressive difficulty).

Module 3. New concepts on photovoltaic conversion	Learning time: 33h Laboratory classes: 16h Guided activities: 6h Self study : 11h

Description:
- Introduction to organic semiconductors
- Organic Solar Cells
- Manufacturing technologies of organic solar cells.
- Introduction of new concepts for solar conversion: plasmons, nanotexturitzation, thermo-photovoltaic.

Related activities:
The student will understand the working principles of organic solar cells, manufacturing technology, and will be able to propose alternative technologies that would result in the production of more efficient photovoltaic devices.

Planning of activities

Exercises and problems	Hours: 60h Guided activities: 5h Laboratory classes: 20h Self study: 35h

Description:
Exercises and problems

Support materials:
Statement of the exercises and problems.
References and data sources

Specific objectives:
Deepen in the theoretical knowledge and in its application to practical cases. The objective is to solve exercises with progressive difficulty.

Qualification system

Written control test (PE): 50%
Work done individually or in groups throughout the course (TR): 40%
Attendance and participation in classes and laboratories (AP): 5%
Quality and performance of group work (TG): 5%

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Bibliography

Basic:

Green, Martin A. Solar cells : operating principles, technology, and system applications. Prentice Hall, 1981. ISBN 0138222703.

Markvart, T ; Castañer Muñoz, Luis ; McEvoy, Augustin. Practical handbook photovoltaics : fundamentals and applications. 2n ed. Amsterdam: Academic Press, 2011. ISBN 9780123859341.

Complementary:

Neamen, Donald A. Semiconductor physics and devices : basic principles. 4th ed. New York: McGraw-Hill, cop. 2012. ISBN 9780073529585.