

## 820743 - EFV - Photovoltaic Devices (DRAFT VERSION)

Coordinating unit: 820 - EUETIB - Barcelona College of Industrial Engineering  
Teaching unit: 710 - EEL - Department of Electronic Engineering  
Academic year: 2014  
Degree: MASTER IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
ERASMUS MUNDUS MASTER IN ENVIRONMENTAL PATHWAYS FOR SUSTAINABLE ENERGY  
SYSTEMS (Syllabus 2012). (Teaching unit Optional)  
ECTS credits: 5 Teaching languages: Catalan, Spanish, English

### Teaching staff

Coordinator: Joaquim Puigdollers  
Others: Cristobal Voz  
Ramon Alcubilla

### 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): resolution 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 acquired 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 acquired 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 of the 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: 125h	Hours large group:	0h	0.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	24.00%
	Guided activities:	15h	12.00%
	Self study:	80h	64.00%

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### Content

<p>Module 1. Crystalline silicon pn junction</p>	<p>Learning time: 41h Small group/Laboratory: 17h Guided activities: 2h Self study : 22h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Introduction to photovoltaic devices.</li> <li>- Absorption of photons and light-matter interaction.</li> <li>- Introduction to the physics of semiconductors.</li> <li>- Crystalline silicon solar cells.</li> </ul> <p>Related activities: Exercises and problems</p> <p>Specific objectives: To introduce students to the technology of photovoltaic devices. Understand the principles of operation of solar cells from crystalline silicon. Resolution of exercises of progressive difficulty.</p>	
<p>Module 2. Thin-Film solar cells</p>	<p>Learning time: 41h Small group/Laboratory: 17h Guided activities: 2h Self study : 22h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Thin-Film solar cells</li> <li>- Fabrication processes of Thin-film solar cells.</li> <li>- Electrical characterization (I-V) of solar cells.</li> <li>- Optoelectronic characterization (EQE) of solar cells.</li> </ul> <p>Related activities: Exercises and problems</p> <p>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).</p>	

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<p>Module 3. New concepts on photovoltaic conversion</p>	<p>Learning time: 33h Small group/Laboratory: 16h Guided activities: 6h Self study : 11h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Introduction to organic semiconductors</li> <li>- Organic Solar Cells</li> <li>- Manufacturing technologies of organic solar cells.</li> <li>- Introduction of new concepts for solar conversion: plasmons, nanotexturization, thermo-photovoltaic.</li> </ul> <p>Related activities:</p> <p>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.</p>	

### Planning of activities

<p>Exercises and problems</p>	<p>Hours: 60h Guided study: 5h Self study: 35h Laboratory classes: 20h</p>
<p>Degree competences to which the activity contributes:</p> <p>Description: Exercises and problems</p> <p>Support materials: Statement of the exercises and problems. References and data sources</p> <p>Specific objectives: Deepen in the theoretical knowledge and in its application to practical cases. The objective is to solve exercises with progressive difficulty.</p>	

### 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. Practical handbook photovoltaics : fundamentals and applications. Oxford: Elsevier, cop. 2003. ISBN 1856173909.

#### Complementary:

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