Course guide
820743 - EFV - Photovoltaic Devices

Last modified: 08/04/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Joaquim Puigdollers Gonzalez

Others: Cristobal Voz Sanchez
Edgardo Saucedo Silva

PRIOR SKILLS

Background in semiconductor device physics and materials science

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.

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

Understanding the operating principles of solar cells.
Knowledge of the manufacturing technology and specific operating principle of solar cells based on crystalline silicon.
Knowledge of cells based on emerging semiconductors (Kesterites, Chalcogenides, Calcohalides)

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	32.51
Self study	93,4	67.49

Total learning time: 138.4 h

CONTENTS

Working principles of solar cells

Description:

What is a solar cell. photovoltaic parameters
Cell types.
Movement of electric charges.
Principles of operation. Absorber and selective contacts.

Specific objectives:
Understanding the working principle of a solar cell

Related competencies :
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.

Full-or-part-time: 15h
Theory classes: 15h

Crystalline silicon solar cells

Description:
Principles of operation of crystalline silicon cells
Manufacturing technology of crystalline silicon solar cells

Related competencies :
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.

Full-or-part-time: 15h
Theory classes: 15h

Solar Cells based on Emerging Semiconductor

Description:
Synthesis and deposition of emerging thin-film semiconductors (Kesterites, Chalcogenides, Calcohalides, etc.)
Structural, chemical and electrical properties
Solar cells based on these semiconductors.

Related competencies :
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.

Full-or-part-time: 15h
Theory classes: 15h

ACTIVITIES

Exercises and problems

Description:
Exercises and problems

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

Material:
Statement of the exercises and problems.
References and data sources

Full-or-part-time: 60h
Laboratory classes: 20h
Guided activities: 5h
Self study: 35h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Written control test (PE): 70%
Work done individually or in groups throughout the course (TR): 30%

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.

RESOURCES

Other resources:
Scientific papers provided during the course