Course guides
230102 - IESF - Introduction to Photovoltaic Solar Energy

Last modified: 27/05/2019

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

Degree: BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2019 **ECTS Credits:** 6.0 **Languages:** English, Spanish

LECTURER

Coordinating lecturer: Pablo Ortega Villasclaras

Others: Domingo Biel Sole

PRIOR SKILLS

Basic of electronic circuits and semiconductor devices.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

TEACHING METHODOLOGY

* Lectures
* Individual work (Homework and final course exercise)
* Short answer tests (Exams during the course)
* Extended answer test (final exam)

The subject will be imparted in Spanish, although all the academic material is in English. Due to the experience of other years could be a high percentage of international students , for which, the subject (or a part of it) could be imparted in English if it is the best option for everybody.

The students can communicate in class and in the written and oral exercises either in Catalan, Spanish, or English.

LEARNING OBJECTIVES OF THE SUBJECT

Provide the fundamentals of solar energy, solar cells and photovoltaic systems.

STUDY LOAD

Type	Hours	Percentage
Self study	98,0	65.33
Hours large group	52,0	34.67

Total learning time: 150 h

CONTENTS

1. Photovoltaic solar energy fundamentals

Description:
1.1 Renewable and non-renewable energies
1.2 Energy and power units
1.3 Solar irradiance and irradiation
1.4 Spectral irradiance. AM0 and AM1.5 solar spectrums
1.5 Direct, diffuse and albedo components of solar radiation
1.6 Apparent movement of the sun. Sun paths diagrams
1.7 Irradiation on tilt panels. One and two axis tracking systems
1.8 Status of the photovoltaic solar energy

Full-or-part-time: 17 h
Theory classes: 6h
Self study : 11h

2. Solar cells: physical fundamentals, materials and technologies

Description:
2.1 Working principles. Photogeneration and light absorption.
2.2 Electrical model of a ideal solar cell under monochromatic light
2.3 External and internal quantum efficiencies. Spectral Response
2.4 The solar cell under spectral light
2.5 Materials and technologies

Full-or-part-time: 28 h
Theory classes: 10h
Self study : 18h 20m

3. Photovoltaic parameters of a solar cell

Description:
3.1 The ideal solar cell. Characteristic photovoltaic parameters
3.2 The non-ideal solar cell. Ohmic and recombination losses
3.3 Impact of temperature and concentration in solar cell electrical behavior
3.4 Photovoltaic conversion efficiency limits

Full-or-part-time: 25 h
Theory classes: 9h
Self study : 16h 40m

4. Module and photovoltaic arrays

Description:
4.1 Scaling rules in ideal photovoltaic modules and arrays
4.2 Impact of temperature and concentration on photovoltaic parameters
4.3 The non-ideal photovoltaic module. Bypass and blocking diodes

Full-or-part-time: 8 h
Theory classes: 3h
Self study : 5h 30m

5. Stand-alone photovoltaic systems

Description:
5.1 Balance of system (BOS) elements of a stand-alone photovoltaic system. Bateries, charge controllers, DC/DC and DC/AC converters
5.2 Sizing of Stand-alone photovoltaic systems

Related competencies :
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

Full-or-part-time: 35 h
Theory classes: 12h
Self study : 23h 10m

6. Grid connected photovoltaic systems

Description:
6.1 Balance of system elements of a grid-connected photovoltaic system. Inverters, maximum power point trackers
6.2 Sizing of a grid-connected PV system
6.3 Photovoltaic energy policy. Perspectives

Related competencies :
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

Full-or-part-time: 35 h
Theory classes: 12h
Self study : 23h 20m

GRADING SYSTEM

Exam 1: 35%
Exam 2: 15%
Homework assignements: 15%
Final Course exercise: 35%

BIBLIOGRAPHY

Basic:
- Castañer Muñoz, L.; Silvestre Berges, S. Modelling photovoltaic systems: using PSpice. Chichester: John Wiley & Sons, 2002. ISBN 0470845287.

Complementary:
- Markvart, T.; Castañer, L. Solar cells: materials manufacture and operation. Oxford [etc.]: Elsevier Science, 2005. ISBN 1856174573.

RESOURCES

Other resources: