Last update: 05-07-2019

# 230102 - IESF - Introduction to Photovoltaic Solar Energy

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Spanish, English

## Teaching staff

Coordinator: Pablo Ortega Villasclaras

Others: Domingo Biel Sole

## Opening hours

Timetable: To establish at the beginning of the course

## 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.

Last update: 05-07-2019

# 230102 - IESF - Introduction to Photovoltaic Solar Energy

## 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

| | | | |
|---|---|---|---|
| Total learning time: 150h | Hours large group: | 52h | 34.67% |
| | Self study: | 98h | 65.33% |

Last update: 05-07-2019

# 230102 - IESF - Introduction to Photovoltaic Solar Energy

## Content

### 1. Photovoltaic solar energy fundamentals

Learning time: 17h

Theory classes: 6h
Self study : 11h

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

### 2. Solar cells: physical fundamentals, materials and technologies

Learning time: 28h 20m

Theory classes: 10h
Self study : 18h 20m

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

### 3. Photovoltaic parameters of a solar cell

Learning time: 25h 40m

Theory classes: 9h
Self study : 16h 40m

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

Last update: 05-07-2019

# 230102 - IESF - Introduction to Photovoltaic Solar Energy

| 4. Module and photovoltaic arrays | Learning time: 8h 30m<br>Theory classes: 3h<br>Self study : 5h 30m |
|---|---|

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

| 5. Stand-alone photovoltaic systems | Learning time: 35h 10m<br>Theory classes: 12h<br>Self study : 23h 10m |
|---|---|

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

| 6. Grid connected photovoltaic systems | Learning time: 35h 20m<br>Theory classes: 12h<br>Self study : 23h 20m |
|---|---|

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

## Qualification system

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

Last update: 05-07-2019

# 230102 - IESF - Introduction to Photovoltaic Solar Energy

## 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.

### Others resources: