Course guide
230934 - DIFO - Photovoltaic Devices

Last modified: 09/11/2022

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

Degree: **Academic year:** 2022 **ECTS Credits:** 6.0
Languages: Catalan, Spanish

LECTURER

Coordinating lecturer:

Others:

PRIOR SKILLS

Semiconductor devices, power electronics and Control Theory

TEACHING METHODOLOGY

* Classroom lectures
* Laboratory practices
* Coursework

LEARNING OBJECTIVES OF THE SUBJECT

Photovoltaic solar energy fundamentals. Working principles and technology of solar cells and photovoltaic modules. Other involved involved in photovoltaic systems: charge regulators, DC-DC converters, Inverters and maximum power point trackers. Sizing of grid and off-grid PV systems.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,0	8.67
Hours large group	39,0	26.00
Self study	98,0	65.33

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. Reference solar spectrums AM0 and AM1.5
1.5 Direct, diffuse and albedo solar irradiation terms
1.6 Apparent movement of the sun. Solar paths maps
1.7 Irradiation on solar collectors. One and two-axis tracking systems
1.8 Status of the photovoltaic solar energy

Full-or-part-time: 15h 50m
Theory classes: 5h
Self study : 10h 50m

2. The solar cell

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

Full-or-part-time: 15h 50m
Theory classes: 5h
Self study : 10h 50m

3. Electrical parameters of the solar cell

Description:
3.1 The ideal solar cell. Characteristic photovoltaic parameters
3.2 The non-ideal solar cell.
3.3 Concentration and temperature impact on photovoltaic parameters
3.4 Limits of the photovoltaic conversion efficieny

Full-or-part-time: 24h 20m
Theory classes: 8h
Self study : 16h 20m

4. Modules, arrays and photovoltaic plants

Description:
4.1 Scaling rules of the photovoltaic parameters in modules, arrays and photovoltaic plants
4.2 Temperature and concentration impact on photovoltaic performance
4.3 The non-ideal module. Blocking and bypass Diodes

Full-or-part-time: 12h 50m
Theory classes: 4h
Self study : 8h 50m

5. Materials and solar cell fabrication technology

Description:
5.1 Introduction to solar cell technologies
5.2 Crystalline and multicristallyne silicon solar cells
5.3 III-V solar cells
5.4 Thin film solar cells

Full-or-part-time: 7h 10m
Theory classes: 4h
Self study : 3h 10m

6. Balance of System (BOS) components

Description:
6.1 Grid and off-grid photovoltaic (PV) systems
6.2 Batteries and charge regulators
6.3 CC-CC and CC-CA converters
6.4 Control strategies in photovoltaic conversion applications
6.5 Sizing of PV systems

Full-or-part-time: 38h 50m
Theory classes: 13h
Self study : 25h 50m

Practices of Photovolytaic devices

Description:
P1. PC-1D simulations of a solar cell (two sessions)
P2. PSpice/Orcad simulations of a photovoltaic system (two sessions)
P.3 Study of a mpp tracker system using Simulink/Matlab (two sessions)

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

GRADING SYSTEM

Final Mark = Maximum(Ctrl_1*0.45+Ctrl_2*0.25+Prob*0.05+ Lab*0.25, Exa_final*0.75+Lab*0.25)

Ctrl_1 : Mark of the course exam 1
Ctrl_2: Mark of the course exam 2
Exa_Final: Final exam mark
Prob: coursework
Lab: Laboratory mark

BIBLIOGRAPHY

Basic:
- Smets, A. [i 4 més]. Solar energy: the physics and engineering of photovoltaic conversion, technologies and systems. Cambridge: UIT Cambridge LTD, 2016. ISBN 9781906860325.
- Castañer, L.; Silvestre, s. Modelling photovoltaic systems using PSpice. Chichester: John Wiley & Sons, 2002. ISBN 9780470845271.