

## Course guide

# 230366 - IPE - Introduction to Power Electronics

Last modified: 11/05/2022

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

**Degree:** **Academic year:** 2022 **ECTS Credits:** 2.5  
**Languages:** Spanish, English

### LECTURER

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**Coordinating lecturer:** Biel Sole, Domingo  
Guinjoan Gispert, Francisco Juan

**Others:** Biel Sole, Domingo  
Guinjoan Gispert, Francisco Juan

### REQUIREMENTS

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Basic knowledge on linear circuits and systems as well as on electronic devices.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEE1. Ability to understand and apply the principles of operation of power electronic systems in regulation, undulation and amplification applications.

CEE24. Ability to identify and evaluate innovative ideas and products in the area of electronic technology.

CEE12. Ability to use semiconductor devices taking into account their physical characteristics and limitations.

CEE4. Ability to design continuous and discrete time controllers for power electronic systems.

**Transversal:**

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

### TEACHING METHODOLOGY

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Master class  
Autonomous work  
Problems based learning

### LEARNING OBJECTIVES OF THE SUBJECT

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The course introduces the analysis and design techniques of power electronics circuits and their applications to the supply of electronic and electromechanical systems as well as in renewable energy systems.



## STUDY LOAD

Type	Hours	Percentage
Hours large group	20,0	32.00
Self study	42,5	68.00

**Total learning time:** 62.5 h

## CONTENTS

### Power electronics: why and where?

**Description:**

Objectives and application of power electronics

**Specific objectives:**

Introduction to electrical power processing. Definitions of energy, power and average power. The energy conversion chain: examples

**Related activities:**

Master class

**Full-or-part-time:** 4h 30m

Theory classes: 2h

Self study : 2h 30m

### Power processing circuits: objectives and circuit elements

**Description:**

Objectives of a power processing system: efficiency and control of power flow. Circuit elements. Electrical Interconnection Rules. Type of power conversion : DC-DC, DC-AC, AC-DC. Basic electronic circuits for power conversion. Principle of operation.

**Specific objectives:**

Objectives description of a power processing system: efficiency and control of power flow. Introducing the Circuit elements and Electrical Interconnection Rules of these circuits. Present different types of power conversion : DC-DC, DC-AC, AC-DC. Basic electronic circuits for power conversion. Buck DC Dc converter Bridge inverter and rectifier. Principle of operation.

**Related activities:**

Master class

Simulation lab exercise

Problems to solve.

**Full-or-part-time:** 10h

Theory classes: 2h

Self study : 8h

### DC-DC Conversion: steady-state operation and components sizing

**Description:**

Linear voltage regulators drawbacks. Elementary switching converters: buck, boost and buck-boost converters. Principle of operation in steady state. Electrical components and switching frequency sizing for steady-state compliance.

**Specific objectives:**

Waveforms periodicity in steady-state: relationships of interest. Ripple. Components sizing: power transistors and diodes: conduction and switching losses, drivers, thermal aspects,. Reactive components.

**Related activities:**

Master class  
Simulation lab exercise  
Problems to solve

**Full-or-part-time:** 24h

Theory classes: 8h  
Self study : 16h

### Dynamic modeling and control of power converters

**Description:**

Controlled sources switches modelling. PWM Modulators. Transfer functions deduction. Linear control design

**Specific objectives:**

Controlled, disturbances and control variables. Characterization of control variables. Models and averaged linearization. Power Converter linearized model. Limitations. Linear controller design

**Related activities:**

Master class  
Simulation lab exercise  
Problems to solve

**Full-or-part-time:** 24h

Theory classes: 16h  
Self study : 8h

## GRADING SYSTEM

30% Simulation exercises+30% proposed problems+40%Final exam

## BIBLIOGRAPHY

**Basic:**

- Erickson, R. W. Fundamentals of power electronics [on line]. 2nd. ed. Dordrecht: Kluwer Academic Publishers, 2001 [Consultation: 15/06/2017]. Available on: <http://link.springer.com/book/10.1007/b100747/page/1>. ISBN 0792372700.