Course guide
230734 - FSD - Fundamentals of Semiconductor Devices

Last modified: 11/04/2025

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

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: ISIDRO MARTIN GARCIA

Others: Primer quadrimestre:
ISIDRO MARTIN GARCIA - 10

PRIOR SKILLS

Basic knowledge of general physics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

2. 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.

TEACHING METHODOLOGY

- Lectures
- Application classes
- Problem deliveries
- Exams with short questions and problems
- Short oral presentations

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of this course is to teach students at an introductory level about the physical principles of semiconductor devices and offer them an overview about the reasons why semiconductor devices are the basis of the electronics industry.
In particular we go in depth in the physical foundations, then we will present in detail diodes and bipolar transistors. Additionally, a brief description and analysis of fundamental properties of basic electron devices will be done.

Learning results of the subject:

- Ability to analyse and predict the general behaviour of semiconductor devices.
- Ability to quantify the electrical properties.
- Ability to obtain the different electrical models to be applied in circuit analysis and design.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	31.20
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

1. Fundamentals

Description:
- Crystal structure
- Atomic structure and wave properties
- Energy bands
- Carrier concentrations
- Currents in semiconductors
- The continuity equation

Full-or-part-time: 60h
Theory classes: 17h 30m
Self study : 42h 30m

2. P/N juntions

Description:
- Band diagram in thermal equilibrium
- Electrostatics
- Steady state I-V characteristics
- Small signal model
- Junction breakdown

Full-or-part-time: 30h
Theory classes: 7h 30m
Self study : 22h 30m

3. Bipolar junction transistor.

Description:
- The transistor effect
- Band diagram
- Common-base I-V characteristics
- Ebers-Moll model
- Small signal model
- Non idealities

Full-or-part-time: 30h
Theory classes: 8h
Self study : 22h

4. Other electron devices

Description:
- Description and analysis of basic optoelectronic devices like photoconductors, photodiodes, solar cells, LED's, lasers, TFT, etc.

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h

GRADING SYSTEM

Final examination: 45%
Partial examinations and controls: 45%
Oral presentation: 10%

BIBLIOGRAPHY

Basic:
- Sze, S.M.; Lee, M.K. Semiconductor devices: physics and technology. 3rd ed.; int. stud. version. Singapore: Wiley, 2013. ISBN 9788126556755.
- Prat Viñas, L.; Calderer Cardona, J. Dispositivos electrónicos y fotónicos : fundamentos [on line]. 2a ed. Barcelona: Edicions UPC, 2006 [Consultation: 20/06/2016]. Available on: http://hdl.handle.net/2099.3/36596. ISBN 8483018543.