1. OVERVIEW

Subject area	Physical Electronics
Degree	Bachelor's Degree in Physics
School/Faculty	School of Architecture, Engineering and Design
Year	Third
ECTS	6
Type	Compulsory
Language(s)	Spanish
Delivery mode	On campus
Semester	2nd semester

2. INTRODUCTION

This compulsory subject area belongs to the subject "The Structure of Matter", which includes the following subject areas:

- Solid-State Physics
- Physical Electronics
- Nuclear and Particle Physics

This subject area continues exploring aspects of physics related to crystalline networks and solid-state physics, focusing on the physics of semiconductors, essential materials in electronics.

The aim is to introduce the transport properties of semiconductors (electron and hole statistics, carrier scattering, unbalanced carrier generation and recombination).
Students will show how these properties, together with optical properties, determine the characteristics, efficiency and limitations of some microelectronic and nanoelectronic devices.

3. SKILLS AND LEARNING OUTCOMES

Key skills (CB, by the acronym in Spanish):

- CB4 - Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
- CB5: Students have developed the learning skills necessary to undertake further study in a much more independent manner.

Transversal skills (CT, by the acronym in Spanish):

- CT5. Problem solving: Be able to critically evaluate information, separate complex situations into their constituent parts, recognise patterns, and consider alternatives, different approaches and perspectives in order to find optimal solutions and negotiate efficiently.

Specific skills (CE, by the acronym in Spanish):

- CE01 - To estimate orders of magnitude in order to interpret diverse phenomena.
- CE02 - To describe and analyse physical systems, identifying fundamental concepts and principles to make the approximations needed to build a simplified model.
- CE04 - To understand the laws and principles of physics, to identify their logical and mathematical structure, their experimental basis and the phenomena described through them.
- CE09 - To understand the processes for obtaining materials and the physical fundamentals and uses of materials.

Learning outcomes (RA, by the acronym in Spanish):

- To describe the structure of semiconductor bands and their electronic properties.
- To explain the physical structure of electronic devices and how this structure affects their properties.
- To identify the electronic devices used in micro- and nanoelectronics.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB4, CG5, CT5, CE01, CE02, CE04	• To describe the structure of semiconductor bands and their electronic properties.
CB4, CG5, CT5, CE01, CE02, CE04	• To explain the physical structure of electronic devices and how this structure affects their properties.
CB4, CG5, CT5, CE04, CE09	• To identify the electronic devices used in micro- and nanoelectronics.

4. CONTENTS

1. Basic concepts of band structure.
2. Physics of semiconductors.
3. Properties of electronic transport.
4. Heterojunctions and nanostructures 5. Introduction to micro- and nanoelectronics.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Collaborative learning: Students learn to collaborate with other people (classmates and professors) in order to find creative, comprehensive and constructive solutions to questions and problems that arise from the given case studies, using all relevant knowledge and material resources available.
- Problem-based learning: Students are given problems and asked to solve them, working individually or in groups.
- Lectures: Presentations by the professor with the necessary technological tools to maximise comprehension of the learning content.
- Guided academic activities: Individual and group work that is more independent, including information searches, written summaries, debates and the public defence of projects.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity	Number of hours
Lectures	18
Asynchronous lectures	12
Oral presentations of projects and debates	6
Report writing	18
Assessment	6
Practical activities (problems, written work, projects, workshops and/or lab work)	30
Group tutorials	10
Independent working	50
TOTAL	**150**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
Individual on-campus knowledge tests (theory and/or practice)	50%
Oral defence	5%–10%
Submission of group and/or individual reports, written work, projects or exercises	15%-40%
Performance observation	10%–20%

On the Virtual Campus, when you open the subject area, you'll find details of your assessable tasks, including the submission dates and assessment procedures for each task.

8. BIBLIOGRAPHY

The reference material for the subject area is as follows:

• Sze, S. M. (1996). *Modern semiconductor device physics.* New York: John Wiley & Sons.

The recommended bibliography is indicated below:

- Campbell, S. A. (2001). *The Science and Engineering of microelectronic fabrication.* New York: Oxford University Press.
- Grove, A. S. (1967). *Physics and technology of semiconductor devices.* New York: John wiley, cop.
- Rudan, M. (2015). *Physics of Semiconductor Devices.* New York: Springer International Publishing.
- Shalímova, K. V. (1975). *Física de los semiconductores.* Moscú: Mir.
- Streetman, B. G., & Banerjee, S. (2015). *Solid State Electronic Devices.* Columbia MD: Pearson.
- Sze, S. M. (1981). *Physics of semiconductor devices.* New York: John Wiley & Son.
- Sze, S. M. (1996). *Modern semiconductor device physics.* New York: John Wiley & Sons.