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

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, which it appears to be the largest industry in the world.
In particular we go in depth in the physical foundations, then we will present in detail diodes, MOS and bipolar transistors. Additionally, a brief description and analysis of fundamental properties of optoelectronic devices and MEMS (Micro Electro Mechanical Systems) will be given.

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

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Total learning time:</td>
<td>125h</td>
<td>39h</td>
<td>31.20%</td>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
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<td></td>
<td>Hours small group:</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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</tbody>
</table>
## Content

### 1. Fundamentals

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

**Learning time:** 30h  
Theory classes: 10h  
Self study: 20h

### 2. P/N junctions

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

**Learning time:** 31h  
Theory classes: 9h  
Self study: 22h

### 3. Bipolar junction transistor.

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

**Learning time:** 26h  
Theory classes: 8h  
Self study: 18h
## 4. MOS transistor

**Learning time:** 32h  
Theory classes: 10h  
Self study: 22h

**Description:**  
- MOS transistor structure  
- MOS capacitor  
- I-V characteristics  
- Small signal model  
- Non idealities

## 5. MEMS and optoelectronic devices

**Learning time:** 6h  
Theory classes: 2h  
Self study: 4h

**Description:**  
- Description and analysis of basic MEMS devices: piezoelectrics, accelerometers and MEMS gyroscopes.  
- Description and analysis of basic optoelectronic devices: photoconductors, photodiodes, solar cells, LED's, and lasers.

### Planning of activities

#### SHORT ANSWER TEST (CONTROL)

**Description:**  
Mid term control.

#### EXTENDED ANSWER TEST (FINAL EXAMINATION)

**Description:**  
Final examination.

### Qualification system

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

**Basic:**
