230645 - MNT - Micro and Nanotechnologies

**Coordinating unit:** 230 - ETSETB - Barcelona School of Telecommunications Engineering  
**Teaching unit:** 710 - EEL - Department of Electronic Engineering  
**Academic year:** 2019  
**Degree:**  
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019).  
(Teaching unit Optional)  
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
**ECTS credits:** 5  
**Teaching languages:** English

### Teaching staff

**Coordinator:** JOSEP CALDERER CARDONA  
**Others:** ÁNGEL RODRÍGUEZ MARTÍNEZ

### Degree competences to which the subject contributes

#### Specific:
1. Ability to use semiconductor devices taking into account their physical characteristics and limitations.
2. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.  
3. Ability to establish a relationship between an electronic device and its fabrication technology, and to understand its design process.

#### Transversal:
4. 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.  
5. 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.  
6. 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  
- Group work (distance)  
- Individual work (distance)  
- Exercises  
- Oral presentations  
- Other activities: visit to laboratories  
- Short answer test (Control)  
- Short answer test (Test)  
- Extended answer test (Final Exam)

### Learning objectives of the subject

Learning objectives of the subject:
The aim of this course is the understanding of physical and technological basis of electronic devices in order to use innovative solutions to electronic design problems. Emphasis is on MOS field-effect transistors and their behaviors (Fin FET, TFT, etc), Power devices, Nano devices and sensors.

Learning results of the subject:
- Ability to use modelling tools of semiconductor devices.
- Ability to define basic fabrication processes.
- Ability to decide between technological alternatives.

### Study load

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

## 1. Field effect transistors and advanced devices

**Learning time:** 29h  
Theory classes: 9h  
Guided activities: 6h  
Self study: 14h

**Description:**
- Review of Metal-oxide-semiconductor field effect transistor (MOSFET) standard model  
- MOSFET downscaling  
- Thin film transistors (TFT)  
- Junction (JFET) and Metal-semiconductor (MESFET) field effect transistors  
- Devices based on heterojunctions: High Electron Mobility Transistors (HEMT) and Heterojunction Bipolar Transistors (HBT)  
- Advanced topics

## 2. Power devices

**Learning time:** 33h 30m  
Theory classes: 10h 30m  
Guided activities: 7h  
Self study: 16h

**Description:**
- Diodes  
- Bipolar transistors  
- Thyristors (SCR, DIAC, TRIAC, etc.)  
- Metal-oxide-semiconductor field effect transistor (MOSFET)  
- Insulated gate bipolar transistor (IGBT)

## 3. Fabrication technology

**Learning time:** 19h  
Theory classes: 6h  
Guided activities: 4h  
Self study: 9h

**Description:**
- Semiconductor materials  
- Doping techniques  
- Layer growth  
- Lithography  
- Epitaxy  
- Process integration
### 4. Sensors

**Description:**
- Mechanical
- Chemical
- Electromagnetic
- Optical
- Thermal

**Learning time:** 29h
- Theory classes: 9h
- Guided activities: 6h
- Self study: 14h

### 5. Advanced Materials

**Description:**
- Carbon nanotubes
- Polymers
- Porous silicon

**Learning time:** 14h 30m
- Theory classes: 4h 30m
- Guided activities: 3h
- Self study: 7h

### Planning of activities

**EXERCISES**

**Description:**
Exercises to strengthen the theoretical knowledge.

**MIDTERM EXAMINATION**

**Description:**
Test on the evolution of students by half semester.

**EXTENDED ANSWER TEST (FINAL EXAMINATION)**

**Description:**
Final examination.
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**Qualification system**

Final examination: from 60%
Individual assessments: from 40%

**Bibliography**

**Basic:**


**Complementary:**


