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

<table>
<thead>
<tr>
<th>1. Field effect transistors and advanced devices</th>
<th>Learning time: 29h</th>
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<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td>- Review of Metal-oxide-semiconductor field effect transistor (MOSFET) standard model</td>
<td>Guided activities: 6h</td>
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<td>- MOSFET downscaling</td>
<td>Self study: 14h</td>
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<tr>
<td>- Thin film transistors (TFT)</td>
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<tr>
<td>- Junction (JFET) and Metal-semiconductor (MESFET) field effect transistors</td>
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<tr>
<td>- Devices based on heterojunctions: High Electron Mobility Transistors (HEMT) and Heterojunction Bipolar Transistors (HBT)</td>
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<td>- Advanced topics</td>
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<tr>
<th>2. Power devices</th>
<th>Learning time: 33h 30m</th>
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<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 10h 30m</td>
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<tr>
<td>- Diodes</td>
<td>Guided activities: 7h</td>
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<tr>
<td>- Bipolar transistors</td>
<td>Self study: 16h</td>
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<td>- Thyristors (SCR, DIAC, TRIAC, etc.)</td>
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<tr>
<td>- Metal-oxide-semiconductor field effect transistor (MOSFET)</td>
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<tr>
<td>- Insulated gate bipolar transistor (IGBT)</td>
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<tr>
<th>3. Fabrication technology</th>
<th>Learning time: 19h</th>
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<tbody>
<tr>
<td>Description:</td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>- Semiconductor materials</td>
<td>Guided activities: 4h</td>
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<tr>
<td>- Doping techniques</td>
<td>Self study: 9h</td>
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<tr>
<td>- Layer growth</td>
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<tr>
<td>- Lithography</td>
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<td>- Epitaxy</td>
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<td>- Process integration</td>
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### 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.

### 4. Sensors

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

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

### 5. Advanced Materials

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

**Description:**
- Carbon nanotubes
- Polymers
- Porous silicon
## Qualification system

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

## Bibliography

**Basic:**


**Complementary:**


