230692 - TECHDEV - Fabrication and Characterization Technologies for Micro and Nano Devices

**Coordinating unit:** 230 - ETSETB - Barcelona School of Telecommunications Engineering  
**Teaching unit:** 710 - EEL - Department of Electronic Engineering  
**Academic year:** 2018  
**Degree:** MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
**ECTS credits:** 5  
**Teaching languages:** English

### Teaching staff

**Coordinator:** Sandra Bermejo  
**Others:** Joaquim Puigdollers  
Isidro Martin

### Prior skills

Basic knowledge of semiconductor physics and technology

### Requirements

Student must have passed or being simultaneously enrolled to Micro and Nano Technologies (MNT, core subject of the Master)

### Teaching methodology

Face to face classes and laboratory sessions

### Learning objectives of the subject

- Ability to characterize basic semiconductor devices  
- Ability to fabricate and characterize basic organic devices  
- Ability to learn basic nano fabrication and characterization techniques

### Study load

<table>
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<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
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<td>Hours small group: 13h</td>
<td>10.40%</td>
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<td>Self study: 86h</td>
<td>68.80%</td>
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# Basic semiconductor device characterization: the crystalline silicon diode

**Description:**
- Theory: (8 h)
- Review of current flow through energy barriers
- Calculation of recombination current at the space charge region.
- Dependence of current on the temperature.
- Impact of series and shunt resistance
- Analysis of impedance response of c-Si diodes up to 1 MHz. Simplified model with lumped elements and complete model from EDO's solution.

**Related activities:**
- Lab: (4h)
  - 1 session: c-Si diode characterization: I-V-T. Fitting with two diode and two resistor model. Calculation of activation energy of diffusion current.
  - 1 session: impedance measurement of the diode up to 1MHz. Fitting the results and determination of characteristic diode parameters: n, Rs, lifetime, etc.

# Organic semiconductor devices and technologies

**Description:**
- Theory: (8h)
  - Introduction to organic semiconductors
  - Organic devices. Flexible electronics
  - Organic Thin-Film Transistors (OTFTs)
  - Organic Solar cells (OSCs)

**Related activities:**
- Lab: (4h)
  - 1 session. Fabrication of Organic Thin-Film Transistor (OTFT) based on pentacene semiconductor.
  - 1 session. Measurement of the electrical characteristics of a OTFT: output, transfer and saturation characteristics.
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## Fabrication and characterization of nanostructured devices

<table>
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<th>Description:</th>
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| Theory: (8 h)  
Fabricating technology: review basic clean room fabrication techniques  
Nanolithography: Optical lithography, Electron-beam lithography, Nanoimprint lithography, Multiphoton lithography, Scanning probe lithography.  
Characterization: Superficial (SEM, FIB, TEM, AFM), structural (XDR, topography), energy (electrowetting, contact angle), chemical (XPS), mechanical (internal stress/residual stress, microindentation-nanoindentation, adhesion tests), optical (ellipsometry)  
Case study: colloidal crystal fabrication and characterization. |
| Learning time: 43h  
Theory classes: 8h  
Laboratory classes: 4h  
Self study: 31h |

## Related activities:

Lab: (4 h)  
1 session: electrospray deposition.  
1 session: SEM characterization and optical characterization.

## Qualification system

- Short answer exams: 40%
- Laboratory assessments: 40%
- Small Project: 20%

## Bibliography

### Basic: