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

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
Academic year: 2019  ECTS Credits: 5.0  Languages: English

LECTURER

Coordinating lecturer: 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>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>10.40</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>26,0</td>
<td>20.80</td>
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</table>

Total learning time: 125 h
## CONTENTS

### 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?o’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.

**Full-or-part-time:** 44h
- Theory classes: 8h
- Laboratory classes: 4h
- Self study : 32h

### 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.

**Full-or-part-time:** 44h
- Theory classes: 8h
- Laboratory classes: 4h
- Self study : 32h
Fabrication and characterization of nanostructured devices

Description:

Theory: (8 h)
Fabricating technology: review basic clean room fabrication techniques
Nanolitography: 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.

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

Full-or-part-time: 43h
Theory classes: 8h
Laboratory classes: 4h
Self study: 31h

GRADING SYSTEM

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

BIBLIOGRAPHY

Basic: