Course guide

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).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2023 ECTS Credits: 5.0 Languages: English

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

Basic knowledge of semiconductor physics and technology
MEE students must have passed or being simultaneously enrolled to Nanotechnologies and Electron Devices (NED, 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>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>10.40</td>
</tr>
<tr>
<td>Hours large group</td>
<td>26,0</td>
<td>20.80</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

Total learning time: 125 h
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.

Related activities:
Lab: (4h)
1 session: Dielectric thickness characterization by ellipsometry and profilometry, lifetime measurements, measurements of device area through calibrated microscope.
1 session: c-Si diode characterization: I-V-T. Fitting with two diode and two resistor model. Calculation of activation energy of diffusion current. Impedance measurement of the diode up to 1 MHz. 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 (4h)
- 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. Theory and Lab visit.

## Related activities:
Lab (8 h):
- 1 session: colloidal crystal formation by different methods: electrospray, drop casting and thermal assistance.
- 1 session: SEM and optical colloidal crystal characterisation.

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

## GRADING SYSTEM
Laboratory assessments: 66 %
Small project: 33 %

## BIBLIOGRAPHY
### Basic: