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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<tbody>
<tr>
<td>Hours small group</td>
<td>13</td>
<td>10.40</td>
</tr>
<tr>
<td>Self study</td>
<td>86</td>
<td>68.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>26</td>
<td>20.80</td>
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</tbody>
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Total learning time: 125 h
CONTENTS

Basic semiconductor device characterization: the crystalline silicon diode

Description:
Theory: (8h) 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 resistances 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 1 MHz. Fitting the results and determination of characteristic diode parameters: n, Rs, lifetime, etc.

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

Fabrication and characterization of nanostructured devices

Description:
Theory: (8h) 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.

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

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

GRADING SYSTEM
Short answer exams: 40% Labopratory assessments: 40% Small Project: 20%
BIBLIOGRAPHY

Basic: