

## 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: 2017  
 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 enroled 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

Total learning time: 125h	Hours large group:	26h	20.80%
	Hours small group:	13h	10.40%
	Self study:	86h	68.80%

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### Content

Basic semiconductor device characterization: the crystalline silicon diode

Learning time: 44h

Theory classes: 8h  
Laboratory classes: 4h  
Self study : 32h

#### 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,  $R_s$ , lifetime, etc.

Organic semiconductor devices and technologies

Learning time: 44h

Theory classes: 8h  
Laboratory classes: 4h  
Self study : 32h

#### 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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<p>Fabrication and characterization of nanostructured devices</p>	<p>Learning time: 43h Theory classes: 8h Laboratory classes: 4h Self study : 31h</p>
<p>Description:</p> <p>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.</p> <p>Related activities: Lab: (4 h) 1 session: electrospray deposition. 1 session: SEM characterization and optical characterization.</p>	

### Qualification system

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

### Bibliography

Basic:

Muller, Richard S; Kamins, Theodore I; Chan, Mansun. Device electronics for integrated circuits. 3rd ed. New York: John Wiley and Sons, 2003. ISBN 9780471593980.