

Course guide

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

Last modified: 17/06/2023

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

Type	Hours	Percentage
Hours small group	13,0	10.40
Hours large group	26,0	20.80
Self study	86,0	68.80

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.

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 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 (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:

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