Titulación
Master en Ingeniería de Materiales
Ficha de Asignatura: Materiales y Aplicaciones en Nanotecnología

20-11-2014

Department (Faculty)
Ingeniería Electrónica (ETSI de Telecomunicación)

Module	Code
Materials and Applications in Nanotechnology	43000340

ECTS credits	Type	Year/Semester	Schedule	Language
6	Optativa	1/2	2nd quarter	English

Objectives

Continuation of the module Nanotechnology, in the 3rd year of the Graduate program, the main objectives of this module are two:

- first, the students should achieve advanced knowledge on materials and structures used in nanotechnology, especially for applications in areas like electronics, heat transfer, fluidics, surface coatings, sensors, energy harvesting, information technology, medicine, etc. Both organic and inorganic materials will be considered. Some selected nanofabrication processes will be also presented.

- second, the students should practice the simulation of advanced nanodevices for several of the above applications. Selected cases in scaling MOSFETS, nanowire and and nanotube TRTs will be considered. Students will develop skills for the assessment of critical parameters, representation of results, and their interpretation to extract conclusions.

Prerequirements

None

Previous knowledge recommended

Nanotechnology; Structure of Materials I,II; Quantum Physics; Instrumentation Engineering; Properties of Materials

Coordination with other subjects

Modules of the Graduate of Materials Engineering Program

Modules of the Master of Materials Engineering Program, in particular: Functional Materials at Macro and Micro/Nanometer Scales, New Materials and Emerging Technologies, Materials for Electronic and Optoelectronic Devices, Polymeric Materials for Advanced Applications, Materials and Microfabrication Technologies for Electronic Devices, and Spintronics and Nanomagnetism

Generic Competencies

CG1, Use of english language
CG2, Capacity for teamwork
CG3, Spoken and written communication skills
CG4, Use of communication and Information technologies
CG7, Planning and organizational capacity
CG9, Capacity of interdisciplinary work

Specific Competencies

CE1, Knowledge of the structure of materials and the techniques for their characterization and analysis
CE5, Capacity for autonomous learning
CE6, Capacity for designing, assessment, selection and manufacture of materials

Contents and Schedule

The contents of the course are shown in the following table. Student attendance is divided in theory and practical lessons (LM) and simulation work in the computer laboratory (LB).

The students will make individual reports (TI) or answer to exams and tests, according to the classes. Also, they will present specific reports for each of the simulation practices, according to some forms which include questions, tables, graphs, etc.

Weeks	Description	LM	LB	Assignments/Tests
1-7	**PART 1 – Nanomaterials and applications**			
1 - 3	Review of Nanomaterials - Introduction to Nanotechnology - Nanomaterials and nanostructures based in semiconductors, C-based nanostructures, organic materials - Electronic properties of nanostructures: transport and confinement - Nanofabrication and nanocharacterization	11 h		TI-1, 1h
4 - 7	Devices and applications - Nanotechnology for heat transfer, nanofluidics, surface coatings, energy harvesting, etc. - Nanoelectronics for computation, memories, sensors and actuators. - Nanotechnology in portable systems: inertial systems and displays.	15 h		TI-2, 1 h
8-14	**PART 2 - Practical sessions of device simulation**			
8 - 10	- Physics of Nanoscale MOSFETs: scaling down MOSFET, nanowire FET, CNT/G FET - Basics of simulation. Software FETToy 2.0: device, model, environment, outputs	11 h		TI-3, 1 h
11 - 14	- Simulation 1: Introduction to MOSFET - Simulation 2: Scaling transistors - Simulation 3: Si NanoWire MOSFET - Simulation 4: CNT / Graphene FET		16 h	TI-4 TI-5 TI-6 TI-7

Tutorials, Office hours

A cooperative methodology will be used, favouring student-professor and student-student interactions by means of discussion sessions, team work, and individual sessions for doubt solving.

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

Evaluation

The progress of the students will be monitored through the exams, laboratory sessions and individual assignments.

Exams: 50% (20+20+10)
Simulations: 50%

Bibliography

- B. Rogers, S. Pennathur, J. Adams, “Nanotechnology. Understanding small systems”, 2nd ed. CRC Press (2011).
- R. Kelsall, I.W. Hamley and M. Geoghegan (eds.), “Nanoscale Science and Technology”, Wiley (2005).
- V. Mitin et al., "Introduction to Nanoelectronics", Cambridge University Press (2008).
- R. Wasser (ed.), "Nanoelectronics and Information Technology", Wiley-VCH (2005).
- Bharat Bhushan (ed.), “Springer Handbook of Nanotechnology” 3rd ed., Springer (2010).

Simulations
- M. Lundstrom and J. Guo, “Nanoscale Transistors: Device Physics, Modeling and Simulation”, Springer (2006).
- Mark Lundstrom, “Online Presentations”, https://nanohub.org/resources/5306
- Software: *FETToy 2.0* at https://nanohub.org/resources/107

Teaching Staff

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