### Department (School) / Departamento (Escuela)
Ingeniería Electrónica (ETSI de Telecomunicación)

### Nombre de la Asignatura / Name of the Subject
Materiales y Aplicaciones en Nanotecnología  
Materials and Applications in Nanotechnology

### ECTS  |  Type  |  Year / Semester  |  Language  |  Syllabus code  |  Subject code
--- | --- | --- | --- | --- | ---
6  |  Optional  |  1/2  |  EN  |  04AF  |  43000340

### Lecturers (Name)  |  Contact email  |  Office hours (Tutorials)
Fernando Calle Gómez  |  calle@die.upm.es  |  By appointment
Jorge Pedrós Ayala  |  j.pedros@upm.es  |  By appointment
Fátima Romero Rojo  |  fatima.romero@upm.es  |  By appointment

### Assessment criteria
The progress of the students will be monitored through the exams, laboratory sessions and individual assignments.
- Exam: 20%
- Simulations: 80%
- Final exam: 20% (exam) + 80% (simulations)

### Justification and 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.

### Prerequisites
There are no prerequisites

### Previous knowledge of the student
Nanotechnology; Structure of Materials I,II; Quantum Physics; Instrumentation Engineering; Properties of Materials

### Contents in coordination with other subjects
Modules of the Graduate of Materials Engineering Program

### Generic competencies
CG1, CG3, CG8, CG9, CG10
### Specific competencies

CE1, CE2, CE3, CE4, CE5, CE7

### Bibliography


### Subject contents and time distribution

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<th>Weeks</th>
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<td>1-3</td>
<td>PART 1 – Nanomaterials and applications</td>
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| 1-2   | . 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 | LM (6h) |
| 2-3   | 2. 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. | LM (5h) TI-1 (1h) |
| 4-15  | PART 2 - Practical sessions of device simulation | |
| 4-5   | 3. Simulations  
- Physics of Nanoscale MOSFETs: scaling down MOSFET, nanowire FET, CNT/G FET  
- Basics of simulation. Software FETToy 2.0: device, model, environment, outputs | LM (8h) |
| 6-15  | - Simulation 1: Introduction to MOSFET  
- Simulation 2: Scaling transistors  
- Simulation 3: Si NanoWire MOSFET  
- Simulation 4: CNT / Graphene FET  
- Discussion and reports | TI-2  
TI-3  
TI-4  
TI-5  (40h) |

### 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.