Course guides
230484 - NTECH - Nanotechnology

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.
713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Optional subject).

Academic year: 2020 ECTS Credits: 6.0 Languages: Catalan, English, Spanish

LECTURER

Coordinating lecturer: - JOAQUIM PUIGDOLLERS GONZALEZ
Others: - JORDI LLORCA PIQUÉ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

General:
3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:
1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

Course is divided into two components: lectures and tutorials.

Lectures are provided by the course professors, who presents the essential course contents to the students. Not all course contents will be taught in the lecture sessions, so autonomous study is required. Tutorials will be conducted by external faculty members.

LEARNING OBJECTIVES OF THE SUBJECT

Introduction to Principles, Fabrication Methods, and Applications of Nanotechnology
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>65.0</td>
<td>43.33</td>
</tr>
<tr>
<td>Self study</td>
<td>85.0</td>
<td>56.67</td>
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</tbody>
</table>

Total learning time: 150 h

CONTENTS

### Introduction to Nanotechnology

**Description:**
- What is it?
- Size dependent properties.
- Surface effects: Surface energies and surface tensions. Surface reactivity and catalysis.
- Quantum effects: Tunneling, quantum confinement.

**Full-or-part-time:** 4h 40m
- Theory classes: 1h 15m
- Practical classes: 0h 45m
- Self study: 2h 40m

### Nanomaterials

**Description:**
- Nanoparticles.
- Colloids.
- Porous materials.

**Full-or-part-time:** 11h 40m
- Theory classes: 3h 05m
- Practical classes: 1h 55m
- Self study: 6h 40m

### Characterization Techniques

**Description:**
- Optical Microscopy, IR, Raman, UV-VIS, Fluorescence, Confocal, DRX, Ellipsometry, XPS, Synchrotron.
- SEM, TEM, EDX.
- Tunnel effect techniques, AFM and related techniques.

**Full-or-part-time:** 11h 40m
- Theory classes: 3h 05m
- Practical classes: 1h 55m
- Self study: 6h 40m
Reactivity of surfaces

**Description:**
- Gas-solid reactions.
- Infrared Spectroscopy with probe molecules and HREELS.
- Sensors and catalysis.
- Surface reconstruction.

**Full-or-part-time:** 23h 20m
- Theory classes: 6h 10m
- Practical classes: 3h 50m
- Self study: 13h 20m

Fabrication and preparation

**Description:**
- Top-down and bottom-up.
- Lithographies: Optical (UV, DUV), e-beam litho, AFM based litho, Nanoimprint.
- Growth of films.

**Full-or-part-time:** 17h 30m
- Theory classes: 4h 35m
- Practical classes: 2h 55m
- Self study: 10h

Molecular devices

**Description:**
- Organic LED.
- Organic PV.
- Organic FET.

**Full-or-part-time:** 29h 10m
- Theory classes: 7h 40m
- Practical classes: 4h 50m
- Self study: 16h 40m

Nanoelectronics

**Description:**
- Confinement; Density of states.
- MOS revisited and scaling down
- UTB and FINFET
- Quantum conductance
- Resonant Tunneling and devices.
- High performance lasers

**Full-or-part-time:** 49h 40m
- Theory classes: 12h 15m
- Practical classes: 7h 45m
- Guided activities: 3h
- Self study: 26h 40m
**GRADING SYSTEM**

Written exam  
Work-term reports on specific topics

Partial exam (EP) (35%) + Final Exam (EF) (35%) + Presentation of the report (PT) (30%)

In case you need to recover the partial exam, the grade will be Max (+0.35EF; 0.7EF) +0.3 Report (PT)

**BIBLIOGRAPHY**

**Basic:**