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230484 - NTECH - Nanotechnology

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering
713 - EQ - Department of Chemical Engineering

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: - JOAQUIM PUIGDOLLERS GONZALEZ

Others: - JORDI LLORCA PIQUÉ

Degree competences to which the subject contributes

Specific:

4. Knowledge of matter properties at the nanoscale. Knowledge of nanomaterials synthesis methods and nanodevices production. Ability to use technology manipulation of matter at the nanoscale. Knowledge of nanotechnology applications.

Generical:

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

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Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

Introduction to Nanotechnology

Learning time: 4h 40m

Theory classes: 1h 15m
Practical classes: 0h 45m
Self study : 2h 40m

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

Nanomaterials

Learning time: 11h 40m

Theory classes: 3h 05m
Practical classes: 1h 55m
Self study : 6h 40m

Description:
- Carbon nanotubes. Graphene.
- Nanoparticles.
- Colloids.
- Porous materials.

Characterization Techniques

Learning time: 11h 40m

Theory classes: 3h 05m
Practical classes: 1h 55m
Self study : 6h 40m

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

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Reactivity of surfaces

Learning time: 23h 20m

Theory classes: 6h 10m
Practical classes: 3h 50m
Self study : 13h 20m

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

Fabrication and preparation

Learning time: 17h 30m

Theory classes: 4h 35m
Practical classes: 2h 55m
Self study : 10h

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

Molecular devices

Learning time: 29h 10m

Theory classes: 7h 40m
Practical classes: 4h 50m
Self study : 16h 40m

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

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Nanoelectronics	Learning time: 49h 40m Theory classes: 12h 15m Practical classes: 7h 45m Guided activities: 3h Self study : 26h 40m

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

Qualification 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 (+0.35 0.35EF EP; 0.7EF) +0.3 Report (PT)

Bibliography

Basic:

Somorjai, G.A. Introduction to Surface Chemistry and Catalysis. 2nd.ed. Wiley Interscience, 2010. ISBN 9780470508237.

Kelsall, R.; Hamley, I.; Geoghegan, M. Nanoscale science and technology [on line]. Chichester: John Wiley & Sons, 2005 [Consultation: 22/01/2015]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/0470020873>. ISBN 9780470020876.