UAB
Universitat Autònoma de Barcelona

Core Enabling Tools in Nanoscience

2026/2027

Code: 45722
Credits: 6

Degree programme	Type	Course
Applied Nanoscience: From Materials to Devices	OP	1

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the end of the document.

Prerequisites

This is an elective course with no prerequisites, which is strongly recommended for all the students of the Master's Degree who do not have previous solid knowledge in Nanoscience and Nanotechnology.

Objectives

This course aims at providing basic knowledge in Nanoscience & Nanotechnology, which will be required for taking the compulsory course "From Materials to Devices: Advanced Synthetic and Integration Methods" and most of the elective courses of the Master's Degree. To this end, essential physical, chemical and technological concepts in Nanoscience & Nanotechnology will be covered:

1) Physical properties of nanomaterials

2) Chemical methods for the synthesis of nanomaterials

3) Introduction to planar technology for device fabrication

4) Basic techniques for the characterization of nanomaterials

Learning outcomes

- CA06 (Propose methods for the preparation of nanomaterials and nanodevices considering their toxicity and impact on the environment.) Propose methods for the preparation of nanomaterials and

nanodevices considering their toxicity and impact on the environment.
- CA07 (Propose the appropriate characterisation technique according to the nanomaterial and the property to be characterised.) Propose the appropriate characterisation technique according to the nanomaterial and the property to be characterised.
- KA06 (Describe the main technological processes involved in planar technology, nanolithography and in the synthesis of nanoparticles, 1D nanostructures and self-assembled monolayers.) Describe the main technological processes involved in planar technology, nanolithography and in the synthesis of nanoparticles, 1D nanostructures and self-assembled monolayers.
- KA07 (Select the appropriate characterisation technique according to the property to be characterised and the type of nanomaterial.) Select the appropriate characterisation technique according to the property to be characterised and the type of nanomaterial.
- KA08 (Identify the physical and chemical properties of different types of nanomaterials.) Identify the physical and chemical properties of different types of nanomaterials.
- SA07 (Identify the processes involved in the manufacture of nanodevices using planar technology and nanolithography methods.) Identify the processes involved in the manufacture of nanodevices using planar technology and nanolithography methods.
- SA08 (Interpret the role of reagents and substrates used in the upstream synthesis of nanoparticles, 1D nanostructures, and self-assembled monolayers.) Interpret the role of reagents and substrates used in the upstream synthesis of nanoparticles, 1D nanostructures, and self-assembled monolayers.
- SA09 (Investigate the physical and chemical properties of different types of nanomaterials.) Investigate the physical and chemical properties of different types of nanomaterials.

Contents

Physical principles of nanoscience

Schrödinger's equation and its application to the study of nanoscale systems. Physical chemistry of nanomaterials: phonons and thermal properties, energy bands in semiconductors, optical and transport properties, density of states, and size effects on physical properties.

Nanochemistry

Surface reactivity and its implications for catalytic processes. Main methods for the synthesis of nanomaterials: nanoparticles, one-dimensional nanostructures, and self-assembled monolayers, also considering their environmental aspects.

Nanotechnology

Fundamental processes in planar technology and nanolithography. Characterization techniques for morphology, composition, and structure, using electron microscopy and scanning probe microscopy. Evaluation of magnetic, electrical, thermal, optical, and mechanical properties of nanomaterials.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Autonomous study	98	3.92	CA06, CA07, KA06, KA07, KA08, SA07, SA08, SA09
Lectures	38	1.52	CA06, CA07, KA06, KA07, KA08, SA07, SA08, SA09

The course will consist of theory lectures (38 h), during which the lecturer will present the course content using both blackboard explanations and multimedia materials, as well as performing selected demonstrative experiments.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Exams	66%	4	0.16	CA06, CA07, KA08, SA08, SA09
Exercise solving	34%	10	0.4	CA07, KA06, KA07, SA07

The overall mark will be broken down as follows: Exam 1 (33%) + Exam 2 (33%) + Exercises (34%)

The evaluation of the students will comprise the following items:

1) Exams: Two exams will be conducted covering the contents of "Physical Principles of Nanoscience" (Exam 1, 33% of the final grade) and "Nanochemistry" (Exam 2, 33% of the final grade).

2) Exercises: A series of in-class exercises related to "Nanotechnology" will be carried out and will contribute 34% of the final grade.

To pass the course, the weighted average of the exams and exercises must be $\geq$ 5.0. Students who do not meet this requirement will be offered the opportunity to take resit exams for Exam 1 and Exam 2.

Students taking less than 1/3 of the evaluation items will be graded as "no avaluable".

Use of artificial intelligence: Restricted use - In this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as bibliographic or information searches, or translations. The student must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final outcome of the activity. Lack of transparency in the use of AI in this assessable activity will be considered a breach of academic integrity and may result in a partial or total penalty in the activity grade, or more severe sanctions in serious cases.

Academic fraud: The commission of any irregularity in an assessment activity (academic fraud, plagiarism, or improper use of AI) that may lead to a significant change in the grade will result in that activity being graded as 0. If the course guide establishes that, in order to pass the course, it is an essential requirement to obtain a minimum grade in this assessment activity, or if multiple irregularities occur in the assessment activities of the same course, the final grade for the course will be 0. In addition, disciplinary proceedings may be initiated against any student who commits one of these irregularities.

Bibliography

G. Cao, Nanostructures and nanomaterials: synthesis, properties and applications, Imperial College Press, London, 2004. Link.

G. A. Ozin, , A. C. Arsenault, , L. Cademartiri, Nanochemistry : a chemical approach to nanomaterials, 2009, Royal Society of Chemistry. Link

Software

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Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TEm) Theory (master)	1	English	first semester	afternoon