1. OVERVIEW

Subject area	Introduction to Nanotechnology
Degree	Bachelor's Degree in Physics
School/Faculty	School of Architecture, Engineering and Design
Year	Third
ECTS	6 ECTS
Type	Optional
Language(s)	Spanish
Delivery mode	On campus
Semester	Second semester

2. INTRODUCTION

Introduction to Nanotechnology is a 6 ECTS subject area taught in the third year, second semester, of the Bachelor's Degree in Physics. The aim is to introduce the basic concepts of nanotechnology that students will need in their future careers. The subject area is divided into three areas. The first part of the subject area focuses on the modification of physical properties when reducing the size of materials and working in nanometres. The second part explores the synthesis and morphological characterisation of nanostructured materials. The third and final part looks at current applications and potential future applications of nanometric systems.

3. SKILLS AND LEARNING OUTCOMES

Key skills (CB, by the acronym in Spanish):

- CB2: Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.
- CB3: Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.
- CB4: Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

Transversal skills (CT, by the acronym in Spanish):

- CT3: Ability to adapt to new circumstances: Being able to evaluate and understand different points of view, taking different approaches to suit the situation.
- CT4: Ability to analyse and synthesise: be able to break down complex problems into manageable blocks; evaluate other options and perspectives to find the ideal solution. Synthesising to reduce the complexity and better understand the situation and/or solve problems.

Specific skills (CE, by the acronym in Spanish):

- CE26: To understand the laws and principles of physicochemical processes. To master chemical formulation and the balancing of chemical reactions. To be aware of the importance of inorganic elements in biological systems. To understand the nature and reactivity of organic compounds.
- CE09: To understand the processes for obtaining materials and the physical fundamentals and uses of materials.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: To complete exercises and solve problems by applying the acquired knowledge.
- RA2: To participate in collaborative projects, demonstrating the ability to work as part of a team, to communicate orally and in writing and to apply the subject area content to form critical judgements.
- RA3: To pass a theoretical knowledge test, demonstrating an understanding of the physical principles and structure of nanomaterials, describing their synthesis and morphological characterisation.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CG3, CB1, CT5, CE3 RA1	RA1. To complete exercises and solve problems by applying the acquired knowledge.
CG3, CT5, CE3	RA2. To participate in collaborative projects, demonstrating the ability to work as part of a team, to communicate orally and in writing and to apply the subject area content to form critical judgements.
CB2, CB4, CT3, CT4, CE26	RA3. To pass a theoretical knowledge test, demonstrating an understanding of the physical principles and structure of nanomaterials, describing their synthesis and morphological characterisation.

4. CONTENTS

The content is as follows:

1. Physical principles and structure of nanomaterials.
2. Fundamental properties of individual nanoparticles and nanostructured materials.
3. Nanoparticle synthesis and methods of obtaining nanomaterials.
4. Key characterisation techniques for nanostructured materials.
5. Basic applications of nanotechnology.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Case studies: Discussion of real cases that allow for practical application of the acquired theoretical knowledge.

- Collaborative learning: Students learn to collaborate with other people (classmates and professors) in order to find creative, comprehensive and constructive solutions to questions and problems that arise from the given case studies, using all relevant knowledge and material resources available.
- Problem-based learning: Students are given problems and asked to solve them, working individually or in groups.
- Lectures: Presentations by the professor with the necessary technological tools to maximise comprehension of the learning content.
- Workshop-based learning: Students acquire knowledge through learning to use the tools and equipment needed in their profession. In other words, "learning by doing".
- Guided academic activities: Individual and group work that is more independent, including information searches, written summaries, debates and the public defence of projects.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity	Number of hours
AF1: Lectures, reading of key topics and supplementary material, individual and collaborative applied activities.	45
AF2: Integrative group work, including participation in debates and seminars and the group completion of integrative applied activities.	20
AF3: Independent working	50
AF4: Tutorials, academic monitoring and assessment	23
AF5: Assessments	12
TOTAL	**150**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
Midterm exam	20
Individual activities (questionnaires)	10
Individual activity (report + presentation)	20

Group activity (report + presentation/debate)	20
Final exam	30

On the Virtual Campus, when you open the subject area, you'll find details of your assessable tasks, including the submission dates and assessment procedures for each task.

8. BIBLIOGRAPHY

The reference material for the subject area is as follows:

- Introducción a la nanotecnología. Charles P. Poole, Frank J. Owens. Barcelona: Reverté, D.L. 2007.

The recommended bibliography is indicated below:

- Handbook of Nanotechnology. Bharat Bhushan. Springer.