1. OVERVIEW

Subject area	Materials Physics
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	First semester

2. INTRODUCTION

The study of material properties has been, since the start of human evolution, one of the main routes of evolutionary progress. All technological and evolutionary development has stemmed from a breakthrough in this area, from the use of stone or metal to make different tools thousands of years ago to new technologies based on improved materials for microchips or semiconductors, which lead to progress and developments in the technological era in which we live.

As such, the study of the physical and chemical properties of different materials is one of the most important branches of research in today's world, resulting in significant advances in both characterisation systems and the search for new materials or properties.

The main aim of this subject area is for students to gain a solid theoretical understanding of the structure of different materials and of how different structures can produce different physical properties, causing, for example, one material to be harder than another. It is worth noting that, given the complexity of this subject area, students will need relatively advanced knowledge of previous subject areas

on the degree programme, such as Chemistry, Fundamentals of Physics

I, Fundamentals of Physics II, Electromagnetism and Optics.

The purpose of this subject area is for students to understand and identify the different structures of a material and to understand and explain what type of material it is, what physical properties it might have based on its structure and if the material could potentially contribute to scientific development in the required field.

3. SKILLS AND LEARNING OUTCOMES

Basic skills and general skills (CB and CG, respectively, by their 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.

- CB5 - Students have developed the learning skills necessary to undertake further study in a much more independent manner.

- CG2 - Ability to plan and perform independent work when managing projects associated with different areas of physics.

- CG3 - To understand and express oneself in a language of science other than Spanish in a professional setting.

- CG4 - To convey knowledge, procedures, results and scientific ideas in the field of physics, both orally and in writing.

- CG5. To understand diverse phenomena that, despite being physically different, share certain similarities, allowing known solutions to be applied to new problems.

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

- CT2 - Independent learning: A range of skills in order to choose research, analysis, evaluation and information management strategies from different sources, as well as to learn and put into practice what has been learnt independently.
- CT3 - Teamwork: Ability to integrate and collaborate actively with other people, areas and/or organisations to reach common goals.
- CT5: Problem solving: Be able to critically evaluate information, separate complex situations into their constituent parts, recognise patterns, and consider alternatives, different approaches and perspectives in order to find optimal solutions and negotiate efficiently.
- CT7 - Leadership: The ability to direct, motivate and guide others, recognising their skills and abilities in order to effectively manage their development and common interests.

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

- CE06 - To understand key experimental models and to perform experiments independently, describing, analysing and critically assessing experimental data.
- 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 understand the structure of different types of materials and their defects. To describe the processes for obtaining different types of materials.
- RA2: To analyse the connection between structure and different types of materials.

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

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Skills	Learning outcomes
CB2, CB5, CG2, CG3, CG4, CG5, CT2, CT3, CT7, CE06, CE09	RA1
CB2, CB5, CG2, CG3, CG4, CG5, CT2, CT3, CT5, CT7, CE09	RA2

4. CONTENTS

1. **Background:**

   A brief historical description of the evolution of materials. Types of materials.
2. **The structure of materials**

   Fundamental concepts. Bonds: types of bonds. Crystalline structure: Crystalline and non-crystalline materials.
3. **Defects and imperfections in solid materials**

   Point, line and mass defects. Communication: Diffusion mechanisms. Deformation, dislocation, recrystallization. Breakage. Phase diagrams and transitions.
4. **Structure, properties and uses of metals** Ferrous alloys. Non-ferrous alloys.
5. **Structure, properties and uses of ceramics**

Phase diagrams for ceramic materials. Mechanical properties. Uses of ceramic materials.

6. **Structures, properties and uses of polymers**

   Mechanical behaviour of polymers. Deformation and hardening mechanisms. Crystallization and glass transition in polymers. Types of polymers.

7. **Composite materials**

   Particle reinforcement. Fibre reinforcement. Structural composite materials.

8. **Electrical, magnetic, thermal and optical properties of materials**

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) 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
Lectures	22
Asynchronous lectures	4

Oral presentations of projects and debates	6
Report writing	21
Assessment	6
Practical activities (problems, written work, projects, workshops and/or lab work)	21
Tutorials	16
Independent working	54
TOTAL	150
TOTAL	

7. ASSESSMENT

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

On campus:

Assessment system	Weighting
SE1. Individual on-campus knowledge tests (theory and/or practice)	50%
SE2. Oral defence	10%
SE3. Submission of group and/or individual reports, written work, projects or exercises	30%
SE4. Performance observation	10%

The following table shows the assessable tasks for the course, the assessment criteria and the weighting of each task in the final grade.

Assessable task (module)	Assessment criteria	Weighting (%)	Assessable elements
Final integrative test	• The student understands relevant physical concepts and knows how to apply them properly. • The student correctly uses mathematical and physical tools to solve the given problems. • The student organises results in a logical way and communicates with precision.	30%	30% SE1
Midterm test		20%	20% SE1

PBS laboratory	• The student actively participates in the task or experience together with the other members of their team. • The student demonstrates teamwork skills. • The activity is completed correctly and includes explanations and conclusions that make the work easy to read and understand. • The student participates effectively in the oral defence of the activity (if applicable).	20%	5% SE2 10% SE3 5% SE4
Activities (individual/group)	• The results of the activity are submitted on time. • The results of the activity are presented clearly, either orally or in writing. • The techniques studied in the unit to which the activity belongs are applied correctly. • The problem solving is correct and includes explanations and conclusions that make the work easy to read and understand.	30%	20% SE3 10% SE4

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.

BIBLIOGRAPHY

The main bibliography for the subject area is as follows:

- Introducción a la ciencia de materiales para ingenieros, J.F. Stackford. Pearson.
- Ciencia e Ingeniería de los Materiales, Donald Askeland, Paraninfo
- Ciencia e Ingeniería de los Materiales, J.M. Montes, F.G. Cuevas y J. Cintas Ed. Paraninfo
- Ciencia e Ingeniería de los Materiales William D. Callister / David G. Rethwisch, Ed. Reverté