Universidad Europea

1. OVERVIEW

Subject area	Materials for Energy Storage and Transformation
Degree	Bachelor's Degree in Physics
School/Faculty	Architecture, Engineering and Design
Year	4º
ECTS	6
Type	Optional
Language(s)	Spanish
Delivery mode	On campus
Semester	First semester

2. INTRODUCTION

This subject area is part of the group of subject areas that constitute the Materials speciality, and it is compulsory for all students wishing to obtain this speciality.

3. SKILLS AND LEARNING OUTCOMES

General skills (CG, by the acronym in Spanish):

- 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.

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

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: To be able 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 analyse the different materials used for energy storage.
- RA2. To understand the different ways that materials are modified to increase their energy efficiency.
- RA3. To design new energy storage systems.

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

Skills	Learning outcomes
CG2, CG3, CG4, CG5, CB2, CB5, CT2, CT3, CT5, CT7, CE06, CE09	RA1
CG2, CG3, CG4, CG5, CB2, CB5, CT2, CT3, CT5, CT7, CE06, CE09	RA2
CG2, CG3, CG4, CG5, CB2, CB5, CT2, CT3, CT5, CT7, CE06, CE09	RA3

4. CONTENTS

1. Advanced batteries
2. Photovoltaic materials: inorganic semiconductors, organic materials
3. Fuel cells
4. Superconductors
5. Heat accumulators
6. Hydrogen

5. TEACHING/LEARNING METHODS

- 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. Simulation environments

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
Oral presentations of projects and debates	6
Report writing	21
Lectures	22
Asynchronous lectures	4
Practical activities (problems, written work, projects, workshops and/or lab work)	21
Group tutorials	16
Independent working	54
Assessment	6
Total hours	150

7. ASSESSMENT

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

On campus:

ASSESSMENT SYSTEMS	Min%	Max. %
Individual on-campus knowledge tests (theory and/or practice)	50%	50%
Oral defence	5%	10%

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Submission of group and/or individual reports, written work, projects or exercises	15%	40%
Performance observation	10%	20%

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 recommended bibliography is indicated below:

- Alkali-activated and hybrid materials: Alternative to Portland cement as a storage media for solar thermal energy, Elsevier España, S.L.U., 2021.
- Thermal Energy Storage: Storage Techniques, Advanced Materials, Thermophysical Properties and Applications, Singapore Springer International Publishing, 2021.
- Energy Materials, Inorganic materials series, 2011.
- Advanced energy Materials, Hoboken, New Jersey John Wiley & Sons, 2014.