BACHELOR'S DEGREE IN INDUSTRIAL DESIGN ENGINEERING

SYLLABUS
MATERIALS PHYSICS

ACADEMIC YEAR: 2026-27
COURSE: 1st
SUBJECT TYPE: Compulsory Training
SEMESTER: 2nd
ECTS: 6
TEACHING HOURS: 49
AUTONOMOUS WORKING HOURS: 101
TOTAL HOURS: 150
LANGUAGE/S: Spanish/Catalan
CODE: 17044

TEACHING TEAM: Francesc Mestres fmestres@elisava.net / Judit González jgonzalez@elisava.net

PRESENTATION OF SUBJECT / GOALS

Students will learn the physical properties of the different types of materials we know. Knowledge of physical properties, and especially mechanical properties, will be a fundamental aspect to develop in this course. Sensory properties will also be introduced, most of which are not reflected in the technical data sheets but are an important factor for the selection of materials. The main objective is to learn about the properties of materials and their importance for the selection of the ideal material for an application.
In the internship block, students will carry out practices in the school's laboratory where they will work and experiment with metallic, ceramic, polymeric and composite materials. Above all, they will become familiar with the behaviour of these materials under tensile and bending.
A research work is carried out that incorporates not only the selection of a material, but also an analysis of its life cycle. Understanding the environmental properties of materials and their life cycle will make the subject acquire a fundamental dimension with respect to a key concept: circularity. This circularity of the materials that our world needs depend to a large extent on the materials we use. Students will learn to recognise the factors that condition the design process in relation to the sustainability and circularity of materials, and the life cycle of products.

SUSTAINABLE DEVELOPMENT GOALS (SDGS)

This subject specifically incorporates the following SDG and its target:
Goal 13: Climate action.13.3 Improve education, awareness, and human and institutional capacity for climate change mitigation, adaptation, impact reduction and early warning

In Materials Physics, the analysis of the life cycle of products is carried out using GRANTA Edupack. The tool to be able to estimate the environmental impact in the design phase is important to be able to create new products with a minimized environmental impact and thus help to reduce emissions that affect climate change.

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CONTENTS

Block I: Physical properties of materials

1. Mechanical properties:
    1.1. Fracture
    1.2. Fracture experimentation in tensile and flexural
    1.3. Fatigue
2. Thermal properties
    Heat capacity, thermal expansion, thermal conductivity
3. Electrical properties
    Electrical conduction, semiconductors, dielectric behaviour
4. Magnetic properties
    Diamagnetism and paramagnetism, ferromagnetism, domains and hysteresis, soft and hard magnets, superconductivity

Block II: Selection of materials based on their properties

1. Databases
2. Material selection based on material properties and the intended environment
3. Selection indices according to Ashby

TEACHING METHODOLOGIES

- PA-Work sessions with the whole group class with the teacher
- PF-Autonomous group work sessions
- Laboratory Practices

COMPETENCIES

- Developing a creative attitude of experimentation, under scientific and humanistic criteria, which favours the exploration of relevant and innovative contributions (G1)
- Configuring new realities based on the interpretation of the historical, social, cultural, economic and technological context (G2)
- Students must have the ability to gather and interpret relevant data (usually within their area of study) in order to make judgments that include reflection on relevant social, scientific or ethical issues (CB3)
- Students must have developed those learning skills necessary to undertake further studies with a high degree of autonomy (CB5)
- Acting with a spirit and critical reflection in the face of knowledge in all its dimensions, showing intellectual, cultural and scientific concern and commitment to rigour and quality in professional demand (T1)
- Exercising active citizenship and individual responsibility with a commitment to democratic values, sustainability and universal design, based on practices based on learning, service and social inclusion (T5)
- Becoming the main actor in the training process itself with a view to personal and professional improvement and the acquisition of a comprehensive training that allows learning and coexist in a context that respects linguistic diversity, with diverse social, cultural, gender and economic realities (T7)
- Defining a personal positioning of the design based on a political, social, environmental, ethical and aesthetic vision of the context (E1)

– Solving technical problems in a creative way in the fields of industrial design engineering to respond to new situations (E8)
– Using and generating research tools appropriate to the needs of each project (E9)

Competences specific to the subject
– Analysis of the life cycle of products and the environmental impact of materials.
– Reasoning the physical behaviour of the materials and/or identifying the characteristics of the materials in the products they conform.

LEARNING OUTCOMES
– Collecting and interpreting data and information on which to base their conclusions, including reflections on social, scientific or ethical issues in the field of materials.
– Globally evaluating the learning processes carried out according to the plans and objectives set, and establishing individual improvement measures.
– Showing skills for the analysis of situations from a global and comprehensive perspective, relating social, cultural, economic, and gender elements, as appropriate.
– Correctly selecting and characterising the materials to design with technological criteria.
– Appropriately applying knowledge of materials, technologies, and transformation processes to product development.
– Integrating research sources into decision-making

TRAINING ACTIVITIES
Each subject will present at the beginning of the course its WORK PLAN where the didactic activities per week / session / autonomous work are recorded.

EXAMINATION
EXAMINATION SYSTEMS
The evaluation of the subject will be based on continuous monitoring of the student's academic work throughout the course.

EXAMINATION SYSTEM	FINAL WEIGHTING
P2-Follow-up of the work done	10%
P4-Specific assessment tests: exams	40%
P5-Completion of required work or projects	50%

EXAMINATION CRITERIA
The final grade of the subject will be the weighted average of the grades of the assessable activities according to the following table:

EXAMINATION ACTIVITY	WEIGHT	RECOVERABLE (up to 50%)	EXAMINATION SYSTEM
Midterm exam (contents of Block-I and Laboratories)	20%	YES*	P-4**

EXAMINATION ACTIVITY	WEIGHT	RECOVERABLE (up to 50%)	EXAMINATION SYSTEM
Final exam (Block-II contents)	20%	YES*	P-4**
Research paper (Part-I: LCA of two products)	25%	NO	P-5
Research paper (Part-II: Selection of materials)	15%	NO	P-5
Transversal forum	10%	NO	P-5
Activity submissions made during class	10%	NO	P-2

Students will have the option of retaking the retake tests. The retake tests will be carried out in the period of the semester allocated to this function, not being able to recover more than 50% of the subject.
* In the event that the Recoverable Assessable Activities exceed 50%, the student body may choose, up to a limit of 50%.
The unjustified non-submission of any assessable activity implies a grade of 0, even if the activity has been classified as Recoverable.
Recoverable Activities can only be recovered when they have been submitted by the student body on the indicated date and with a grade equal to or greater than 3.
** In order to calculate the final grade of the subject, it will be necessary to obtain a minimum grade of 4 in the weighted average of the exams (P-4 evaluation system).
If access to the retake test is waived, the grade achieved in the first instance will be maintained. In case of taking the recovery, the grade obtained will be the last, even if it is lower than the first.
Plagiarism or copying of other people's work is penalised in all universities and, according to the Rules of Coexistence of the University of Vic-Central University of Catalonia, they constitute serious or very serious offences. That is why in the course of this subject any indication of plagiarism or misappropriation of texts or ideas other people (What is considered plagiarism?) as well as the improper or undeclared use of Artificial Intelligence in an activity, automatically translates into a suspension and/or other disciplinary measures (Normes de Convivencia de la Universitat de Vic-Universitat Central de Catalunya).
For any questions or queries, see the (Academic Regulations of the Bachelor's Degree of the Faculty of Design and Engineering Elisava UVic-UCC).

BIBLIOGRAPHY AND TEACHING RESOURCES

Basic

- Ashby, M.F. 2009. *Materiales para Ingeniería 1 y 2*. Ed. Reverté.
- Callister, W.D. 2012. *Introducción a la Ciencia e Ingeniería de materiales.* Barcelona: Reverté.
- Peña, J. 2010. *Selección de materiales en el proceso de diseño.* 2ª Edición, Barcelona: CPG.
- Smith, W.F., Hasheim, J. 2014. *Fundamentos de la ciencia de e ingeniería de materiales*. Mc Graw Hill.
- Thompson, R., Thompson, M. 2017. *The Materials Sourcebook for Design Professionals*. Ed. Thames & Hudson.
- Kula, D., Ternaux, E. 2013. *Materiology*. Ed. matéria.

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Supplementary

– Ashby, M.F. 2012. *Materials and the environment. Eco-Informed Material Choice*. Oxford: Butterworth-Heinemann.
– Karana, E., Pedgley, O., Rognoli, V. 2013. *Materials Experience: Fundamentals of Materials & Design.* Elsevier Science & Technology. ·
– Karana, E., Hekkert, P., Kandacher, P. 2009. Meanings of materials through sensorial properties and manufacturing processes. *Materials & Design* (30):2778–2784.
– Selecció de Materials p.4 · González, M. 2018. Dynamic experiences generated by sensory features through smart materials driven design. *Temes de Disseny* 34. ·
– Ramalhete, P.S., Senos, A.M.R., Aguiar, C. 2010. Digital tools for material selection in product design. *Materials & Design* (31):2275-2287.
– Dent, A.H., Sherr L. 2014. *Material Innovation: Product Design*. New York: Thames & Hudson.

Teaching resources and teaching material

The teaching staff will deliver the teaching material to the students as needed. This material will consist of scientific articles, problem collections, practice scripts, and academic paper scripts.

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