Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** .

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Second year

COURSE

27681 - Materials Science **Credits, ECTS:** 6

COURSE DESCRIPTION

"Materials Science" is one of the technological subjects of the 2nd year, common to the Mechanical Engineering, Electrical Engineering and Industrial Electronic and Automatic Engineering Degrees. It is part of the technological module.

This subject develops the basis to know the materials that are commonly used in industrial engineering, the processes with which they can be manufactured and the most relevant physical and mechanical properties of each family and subfamily of materials. Students will learn to measure conventional mechanical properties and to observe and quantify their microstructure. Moreover, how the manufacturing process affects the properties of the materials and how to relate it to their internal structure will be studied.

This knowledge will allow the selection of the most suitable material for manufacturing specific products, taking into account the performance and service requirements of the product. In the selection of materials, environmental criteria are taken into account by carrying out life cycle studies.

In order to be able to carry out "Materials Science" subject without excessive difficulty, it is necessary to have a basic knowledge of the basic subjects of the degrees.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific competences of the subject:

-CRI3: Knowledge of the fundamentals of science, technology and materials chemistry. Understand the relationship between microstructure, synthesis or processing and material properties.

Transversal competences:

C.12. To adopt a responsible and organized attitude at work and to show a willingness to learn, considering the need for continuous training that the exercise of the profession will undoubtedly require.

C.13 To apply the strategies of scientific methodology: to analyze the problem qualitatively and quantitatively; to rise hypotheses and propose solutions using engineering models.

C.14 To work efficiently in groups integrating skills and knowledge to take decisions in the development of the technological subjects.

Learning outcomes:

To properly use the specific terminology of the subject, expressing the basic fundamentals of Materials Science through the correct use of verbal, mathematical and graphic language.

To distinguish the main types of materials and relate their different characteristics with their different applications.

To relate the internal structure of materials with their specific physicochemical and mechanical properties, establishing the impact that these properties have on the practical performance of each material.

To understand the concept of the equilibrium state of a material and to reason in what way a mechanical or thermal treatment can change this state and, therefore, the properties of the material.

To work cooperatively in tasks framed in the field of Materials Science, doing teamwork by analyzing and discussing ideas among team members.

In addition, the possibility of implementing new learning methodologies will be considered, including the flipped classroom, according to the criteria of the lecturer in charge of the subject.

Theoretical and Practical Contents

Lesson 1. Structure of condensed matter.
Crystalline and amorphous structure. Types of materials. Defects of the crystalline structure. Diffusion phenomena.

Lesson 2. Solidification
Solidification mechanisms. Phase diagrams.

Lesson 3. Manufacturing of materials
Obtaining and processing metallic, polymeric, ceramic and composite materials. Natural resources, synthesis, recycling.

Lesson 4. Properties of materials
Mechanical, electrical and magnetic properties of materials and their relationship with the structure. Material testing. Other physical and chemical properties.

Lesson 5. Modification of the structure of materials.
Thermal, thermochemical and thermomechanical treatments. Effect on the properties of materials.

Lesson 6. Materials for engineering
Metallic, polymeric, ceramic and composite materials. Properties, classification and applications. New materials for new applications.

Lesson 7. Service conditions and failure diagnosis
Corrosion, fatigue, creep, wear and aging conditions. Failure analysis.

Lesson 8. Materials selection
Criteria for materials selection: service requirements and economic criteria.

Laboratory practices:

-Thermal treatment (Quenching and tempering of metal probes).
-Mechanical tests (charpy, tensile test, hardness test).
-Metallography (sample obtaining and preparation).
-Characterization of polymers (Fluidity index)
-Electrical and magnetic properties of materials
-Non-destructive testing

TEACHING METHODS

In theoretical lectures, conceptual contents of the subject will be explained with the participation of the students in occasional discussions.

In the laboratory practices experimental works will be developed to acquire knowledge and skills of experimental techniques used in Materials Science, showing the students progress in a laboratory notebook or other type of tool.

In order to facilitate and ensure the students learning, the laboratory practices will be monitored. Feedback will be provided based on previously established evaluation criteria, so that students have the opportunity to be aware of their learning, as well as ways to improve it.

In case of small groups, the lecturer may propose modifications in the methodology by introducing autonomous learning activities (PBL, cases, etc.). The methodology will be detailed exhaustively in a student's notebook that will be included in the guide of the subject.

The student must consult and follow the indications that the lecturers of the subject publish in eGela according to the calendar of the subject, as well as the modifications that can be made due to unforeseen causes.

To the extent of the possibilities of each group-lecturer, work on issues related to sustainability could be introduced along the lines proposed by the IKD-i3 model of the university. Activities that address Sustainable Development (SD) through the Sustainable Development Goals (SDGs) of the United Nations could be implemented.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30			30					
Horas de Actividad No Presencial del Alumno/a	45			45					

Legend: M: Lecture-based | S: Seminar | GA: Applied classroom-based groups | GL: Applied laboratory-based groups | GO: Applied computer-based groups | GCL: Applied clinical-based groups | TA: Workshop | TI: Industrial workshop | GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Multiple choice test 30%
- Exercises, cases or problem sets 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The students assessed by the CONTINUOUS EVALUATION SYSTEM shall demonstrate that they have passed all the planned evaluation tests. Otherwise, it will not exceed the subject and will involve the consumption of a call.

To pass the tests you will need to reach in 75% of the questions in each test, a minimum rating of 3 out of 10. The final note shall be calculated arithmetically taking into account the weight of each assessment test as shown below.

The evaluation tests are as follows:
- Theoretical content test (30%)
- Laboratory practice deliverables (30%)
- Written test (40%)

THEORETICAL CONTENT TEST
The theoretical content will be evaluated through three tests through e-gela successfully completed within the deadlines established by the teacher of the subject. Each test has a weight of 10% in the total score, therefore, the evaluation of the theoretical agenda will be 30% of the total score of the subject. The final note shall be calculated by applying the arithmetic mean of the three tests. To pass this test, students must obtain a minimum grade of 5 out of 10.Failure to answer test questions within the set deadlines will amount to 0.
The final grade of approved tests shall be kept only until the extraordinary call of the same academic year.

DELIVERABLES FOR LABORATORY PRACTICE
Continuous evaluation of laboratory practices will be carried out through the delivery of reports, works, projects and/or presentations made throughout the academic year, as defined by the teacher at the beginning of the academic year.The total weight of laboratory practices will be 30% of the total score of the subject. To overcome laboratory practices it is mandatory to perform all practices in person, and obtain a minimum rating of 5 out of 10.
The note of approved laboratory practice reports, works, projects and/or presentations shall only be kept until the extraordinary call of the same academic year.

WRITTEN TEST
The test will evaluate all contents of the subject taught in master classes and in laboratory practices. The test shall be conducted on the official date of the test schedule and may contain both theoretical/conceptual questions and exercises to be resolved. The total weight of the written test shall be 40% of the total score of the subject. To pass this test, students must obtain a minimum grade of 5 out of 10.

WAIVER OF THE CONTINUOUS EVALUATION SYSTEM:
Students wishing to give up the continuous evaluation system must submit their resignation in writing to the responsible faculty in accordance with the procedure and deadlines set (Article 8.3). For the Material Science subject, given that it is a quadrimonthly subject, the maximum period will be 9 weeks from the beginning of the course, according to the academic calendar of the center.

In cases in which the students are not able to attend the laboratory as stated in the regulations and/or perform the laboratory deliverables and/or perform the tests of theoretical content, they must demonstrate in the final test the achievement of competencies and knowledge of the subject. In this case, the students will be evaluated through the final evaluation system. This written test shall be conducted on the official date of the examination schedule and shall consist of two written assessment tests; one examination of the theoretical agenda (master classes) and one examination of the practical course (laboratory practices).

The weight of each party in the written test shall be 70 % and 30 % of the total score of the subject, respectively. To overcome the subject, students must obtain a minimum grade of 5 out of 10 in each of the evaluated parts. The final note shall be calculated arithmetically taking into account the weight of each assessment test.

WAIVER OF THE INVITATION:
According to the regulations governing the evaluation of students in official degrees in Article 12:
The waiver of the call shall mean the qualification of not submitted or not submitted. As the weight of the written test is 40% of the total score of the subject, the student may give up the call within a period that, at least, will be up to one month before the end of the teaching period of the subject. This renunciation must be presented in writing to the faculty responsible for the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY CALL
For students who have not passed the written test in the ordinary call, but if they have obtained a final grade greater than 5 in the theoretical content tests and/or in the deliverables of the laboratory practices, they will have the possibility to be kept the notes for the EXTRAORDINARY CALL of the approved evaluation tests, taking into account that each test (theoretical content test and laboratory practices) has a weight of such a total of 30 %.

Students who have not passed the written test in the ordinary call and have not obtained a final grade higher than 5 in the tests of theoretical content and/or in the deliverables of the laboratory practices, or choose to submit for the first time to the extraordinary call, must submit to two written evaluation tests; one examination of the theoretical agenda (master classes) and the other of the practical (laboratory practices).The weight of each party to the written test shall be 70 % and 30 % respectively. To overcome the subject, the students must obtain 5 out of 10 in each of the evaluated parts.

Notes of the test of theoretical content and/or deliverables of laboratory practices that are approved throughout the course shall only be kept until the extraordinary call of the same academic year.

WAIVER OF SPECIAL NOTICE
In order to give up the extraordinary call, it will be enough not to submit to it.

*If health conditions prevent the performance of a teaching activity and/or in-person evaluation, a non-in-person modality will be activated, from which the students will be informed promptly.

MANDATORY MATERIALS

Materials testing standards.
Laboratory practice guides.

BIBLIOGRAPHY

Basic bibliography

Fundamentals of Materials Science and Engineering. W.F. Smith (McGraw-Hill Ed.)
Introduction to Materials Engineering. W.D. Callister Jr. (Ed. Reverté)
Materials Science. Theory - Tests - Treatments. P. Coca Rebollero, J. Rosique Jiménez (Ediciones Pirámide S.A.)
Course Notes.
Electronic resources (available from the library): ASM HAndbook.

Detailed bibliography

Materials for Engineering. M.F. Ashby, D.R.H. Jones, Ed. Reverté,
Metals and Alloys: their constitution, structure, properties and treatments. R. Calvo Rodes, Ed. INTA,
Introduction to Physical Metallurgy. S.H Avner, McGraw-Hill, Mexico, 1988.
Science and engineering of materials: physical metallurgy, structure and properties. J.A. Pero Sanz, Ed. Cie Dossat 2000, Madrid, 2004.

Journals

Metalurgia y Electricidad
Fundidores
Plásticos universales
Journal of Materials Science
Materials Science and Engineering

Web sites of interest

Materials Science & Engineering Educational Software: http://www.matter.org.uk
MatWeb - Online Materials Information Resource: http://www.matweb.com
ASM Handbook: http://products.asminternational.org/hbk/index.jsp

OBSERVATIONS

FORMATIVE NATURE OF THE EVALUATION

The evaluation will be formative and will provide adequate information and guidance to students on the level of skills acquisition and the suggested improvements in their learning process. After each evaluation test, the faculty of the department will give the correct answers to the questions raised, so that the students extract the maximum performance of the tests performed.