Course guide
340097 - CIMA-D - Materials Science

Last modified: 03/07/2026

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Joan Vicent Castell

Others: Joan Vicent Castell
David Gutiérrez

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
2. CE25. Knowledge and ability to apply material engineering.

Transversal:
3. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
5. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
6. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

In the theory classes the basic concepts of the subject will be explained. In the classes of problems the basic techniques for the resolution of problems will be explained and the proposed problems will be discussed, from the student's contributions. In the practical exercises will explain the basic knowledge to perform the different proposed tests and the obtained results will be interpreted and discussed.
In the out-class activities the professor supervises the student's work by means of the analysis of his evolution through the evaluation activity and the guided activities.

LEARNING OBJECTIVES OF THE SUBJECT

1. Understand and contrast the fundamental concepts of crystalline structure and microstructure of the different types of materials
2. Select the chemical/physical/mechanical magnitudes of the materials necessaries in accordance with the specifications of a product.
3. Understand the relation between the microstructure, the processing and the materials properties.
4. Know the effect the material microstructure in its mechanical, electrical and magnetic behavior.
5. Select of materials based on their chemical, thermal, electrical, magnetic and mechanical properties
6. Applies the standards of tests.
7. Be able to adapt to the new technologies and new materials.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	30,0	20.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

1. Introduction to Science and Engineering of Materials

Description:
1.1 Science, Technology and Engineering of materials
1.2 Types of materials. Structural materials. Functional materials.
1.3 Materials characterization. Mechanical properties. (At the laboratory)

Specific objectives:
Introduce to the student in the science and engineering of materials
Understand the types of materials and their classification.
Know the historical evolution of materials.
Main destructive tests. First contact.

Related activities:
Activity 1: Expositive class.
Activity 2: Visit to laboratories.
Activity 3: Bibliographical research
Activity 16. Partial test
Activity 17: Final test

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
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Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

2. Types of Materials

Description:
2.1 Atomic bond and depending properties. Types of materials.
2.2 Metallic materials. Inherent properties. Main industrial metals and metallic alloys.
2.3 Ceramic materials: Inherent properties. Technical ceramics. Processes of conformation.
2.4 Polymeric materials: Types of polymers (thermoplastics, thermostables and elastomers).
2.4 Composites: General characteristics; Types of composites.

Specific objectives:
Know the different types of materials, their atomic constitution and their main properties.
Know the available options and classes in every case.

Related activities:
Activity 1 Master class
Activity 3 Bibliographic search
Activity 4 Self-learning test

Related competencies :
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Full-or-part-time: 18h
Theory classes: 3h
Laboratory classes: 2h
Guided activities: 1h
Self study : 12h

2. Crystalline structure of materials

Description:
2.1 Crystalline structure. Crystallographic parameters and Bravais lattices
2.2 Main crystalline structures. Factor of packing.
2.3 Polymorphism and Allotropy.
2.4 Density: linear, planar and volumetric
2.5 X-ray diffraction: Bragg law
2.6 Crystal defects: punctual, linear or dislocations and superficial.

Specific objectives:
Know the concept of crystal
Learn the crystallographic parameters
Know the concept of density of a crystal.

Related activities:
Activity 1: master class
Activity 12. Crystallography applied problems.
Activity 16: Midterm Assessment
Activity 17: Final Assessment

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 12h
Theory classes: 4h
Laboratory classes: 2h
Self study : 6h

3. Diffusion

Description:
3.1 Diffusion mechanisms.
3.2 Fick's laws
3.3 Diffusion and treatments of materials (applications)

Specific objectives:
Know the concept of diffusion.
Analyze and understand the solution of the Fick's laws and its application to real cases.

Related activities:
Activity 1: expositive class
Activity 13. Problems of diffusion. Applications of the Fick's laws to practical examples.
Activity 16: Partial test
Activity 17: Final test

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

4. Mechanic properties of materials

Description:
4.1 Plastic deformation Mechanisms. Hardening mechanisms.
4.2 Testing and characterization of mechanical properties.
4.3 Analysis and selection of structural materials.

Specific objectives:
Know the main structural properties of materials. Know its physical origins and the available techniques to modify them.
Know how to analyze and design structural elements, regarding the mechanical properties of the material its made.

Related activities:
Activity 1. expositive class
Activity 6. Problems related to the tensile test and the design of structural elements.
Activity 7. Practice of laboratory: Tensile test
Activity 8. Practice of laboratory: Hardness tests
Activity 9. Practice of laboratory: Charpy impact test.
Activity 17: Final assessment.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 28h
Theory classes: 4h
Laboratory classes: 8h
Self study : 16h

5. Solidification and equilibrium (or phase) diagrams.

Description:
5.1 Solidification of a pure metal.
5.2 Equilibrium diagrams.
5.3 Invariant reactions.
5.4 Types of diagrams and interpretation.

Specific objectives:
Know the process of solidification of a pure metal.
Know what an equilibrium o phase diagram is.
Know how to work with an equilibrium diagram and get information about the characteristics of a binary alloy.

Related activities:
Activity 1: Expositive class
Activity 4: Challenge problems
Activity 14. Problems of equilibrium diagrams.
Activity 5. Metal·lography laboratory.
Activity 15: Practice of laboratory: equilibrium diagrams (software)
Activity 17: Final test

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 27h
Theory classes: 4h
Laboratory classes: 6h
Guided activities: 1h
Self study : 16h

6. Heat treatments of metallic materials

Description:
7.1 Types of heat treatments
7.2 Heat treatments of quenching and tempering
7.3 Heat treatments of solution and aging.

Specific objectives:
Know what a heat treatment is.
Learn the effect of a heat treatment on the material properties.

Related activities:
Activity 1: expositive class
Activity 17: Final test

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
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Full-or-part-time: 10h
Theory classes: 2h
Self study : 8h

ACTIVITIES

ACTIVITY 1: EXPOSITIVE CLASS

Description:
Expositive class with some solved practical exercises by the professor.

Specific objectives:
Fundamental knowledge acquisition that it would be used in the other activities.

Material:
Provided material by the professor via Digital Campus, bibliography and specific software.

Delivery:
The acquired knowledge would be evaluated in the first and the second exams (activities 16 and 17).

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.

Full-or-part-time: 52h
Theory classes: 26h
Self study: 26h

ACTIVITY 2: WELCOME PLAN

Description:
Welcome to the new students. To inform about the Department and about the facilities that will be used. To inform about the general and specific risks of the Laboratories where the Department conducts specific teaching. Inform about the emergency plan.
Present the processes and mechanisms of the destructive tests that constitute the laboratory part of the subject. Make a demonstration essay for each.

Specific objectives:
See the equipment used in the EPSEVG to the material characterization.

Material:
Nothing

Delivery:
Questionnaire

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.

Full-or-part-time: 2h
Laboratory classes: 2h

ACTIVITY 3: PRACTICE OF LABORATORY: BIBLIOGRAPHICAL RESEARCH

Description:
The student will learn how looking for information related to the subject, both in the library of the EPSEVG or by Internet search in specialized journals, data bases, etc.

Specific objectives:
Know where it is the recommended bibliography in the library of the EPSVG.
Learn to look for information in bases of the UPC.
Learn to look for information in data bases external to the UPC or in specialized journals.

Material:
Practice dossier (available in the digital campus), bibliography.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 4: CHALLENGE PROBLEMS IN CLASS

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 5: PRACTICE OF LABORATORY: METALLOGRAPHY

Description:
The student will have to learn prepare a metallographic sample and use an optical microscope.

Specific objectives:
Learn to prepare metallographic samples for its observation.
Observation of the microstructure of different materials.

Material:
Practice dossier (available in the digital campus), bibliography.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 6: PROBLEMS RELATED TO THE TENSILE TEST.

Description:
The student will have to solve the problems proposed by the professor.

Specific objectives:
Acquire ability in the use of stress ¿ strain graphics.
Calculate the mechanical properties that are derived from a tensile test: maximum resistance, elastic limit, elastic module and elongation.
Determine the coefficient of hardening of a metal from the data of a tensile test.

Material:
List of problems, bibliography and specific software.

Delivery:
The students will have to present by oral or written form some of the resolute problems. The acquired knowledge would be evaluated in the first and second exams that among others evaluate this subject (Activities 16 and 17).

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
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07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Full-or-part-time: 8h
Practical classes: 2h
Self study: 6h

ACTIVITAT 7: PRACTICE OF LABORATORY: TENSILE TEST

Description:
The student will perform a tensile test in two different materials: an aluminium alloy and steel.

Specific objectives:
Know the procedure of a tensile test machine
Learn to determine the mechanical properties of a material from a real tensile test.
Interpret and analyze the results.
Apply standards to carry out the test.

Material:
Practice dossier (available in the digital campus), bibliography, standards to carry out the test, specific software.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
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Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 8: PRACTICE OF LABORATORY: HARDNESS TESTS

Description:
The student will perform a hardness test in different materials: an aluminum alloy, a copper alloy and steel.

Specific objectives:
Know the procedure of a hardness equipment
Learn to determine the hardness of a material by means of the different types of hardness.
Interpret and analyze the results.
Apply standards to carry out the test.

Material:
Practice dossier (available in the digital campus), bibliography and standards to carry out the test.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 9: PRACTICE OF LABORATORY: CHARPY IMPACT TEST.

Description:
The student will perform an impact test in steels with and without heat treatment (quenching and tempering).

Specific objectives:
Know the procedure of a Charpy pendulum
Learn to determine the Resilience of a material.
Learn the concepts of toughness and fragility
Interpret and analyze the results.
Apply standards to carry out the test.

Material:
Practice dossier (available in the digital campus), bibliography and standards to carry out the test.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
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07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 12: CRYSTALLOGRAPHY PROBLEMS.

Description:
CRYSTALLOGRAPHY PROBLEMS

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 13: PROBLEMS OF DIFFUSION. APPLICATIONS OF THE FICK'S LAWS TO PRACTICAL EXAMPLES.

Description:
The student will have to solve the problems proposed by the professor.

Specific objectives:
Know the main diffusion concepts.
Determine the diffusivity and evaluate the temperature effect.
Analyze and understand the solution of the Fick's laws and its application to real situations.

Material:
List of problems, bibliography and specific software.

Delivery:
The students will have to present by oral or written form some of the resolute problems. The acquired knowledge would be evaluated in the first and second exams that among others evaluate this subject (Activities 16 and 17).

Related competencies :
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. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
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Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 14: PROBLEMS OF EQUILIBRIUM DIAGRAMS.

Description:
The student will have to solve the problems proposed by the professor.

Specific objectives:
Acquire ability in the use of binary equilibrium diagrams.
Calculate the chemical composition of phases (Rule of the horizontal)
Determine the proportion of phases (Rule of the Handle or the inverse segment)
Understand the invariant reactions.
Know the solidification process and cooling until room temperature of a metallic alloy and understand its microstructural evolution.

Material:
List of problems, bibliography and specific software.

Delivery:
The students will have to present by oral or written form some of the resolute problems. The acquired knowledge would be evaluated in the second exam that among others evaluate this subject (Activity 17).

Related competencies :
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
. CE25. Knowledge and ability to apply material engineering.
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Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

ACTIVITY 15: PRACTICE OF LABORATORY: EQUILIBRIUM DIAGRAMS.

Description:
The student will acquire the knowledge necessary to work and to obtain data of simple equilibrium diagrams.

Specific objectives:
Acquire ability in the use of binary equilibrium diagrams.
Calculate the chemical composition of phases (Rule of the horizontal)
Determine the proportion of phases (Rule of the Handle or the inverse segment)
Understand the invariant reactions.
Know the solidification process and cooling until room temperature of a metallic alloy and understand its microstructural evolution.

Material:
Practice dossier (available in the digital campus), bibliography and specific software.

Delivery:
When the student finishes the practice he/she will have to give the corresponding report. The evaluation of the task will contribute to a 20% of the final mark.

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Full-or-part-time: 10h
Laboratory classes: 6h
Self study: 4h

ACTIVITY 16: PARTIAL TEST

Description:
The student will have to do a written test on contents 1, 2, 3 and 4, in which he/she will have to solve some exercises and questions.

Specific objectives:
Consolidation of the knowledge acquired until the moment

Material:
Exam.

Delivery:
Individual resolution of the proposed questions and exercises

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 17: FINAL TEST

Description:
Written test in which the student will have to demonstrate the degree of acquisition of the knowledge acquired on the subjects explained during the course. In this test acquired knowledge about different subjects will be interrelated.

Specific objectives:
Consolidation of the knowledge acquired during the course and their interrelation.

Material:
Exam.

Delivery:
Individual resolution of the proposed questions and exercises

Related competencies :
. CE25. Knowledge and ability to apply material engineering.
. CE9. Baisc knowledge of science, technology and material chemistry. Understand relation between microstructure, synthesis or processing and material properties.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

Individual written tests (T): 70%. There will be a partial exam (EP1), a second partial (EP2) and/or a final exam (EF).
Laboratory practice development reports (L): 20%
Presentation and evaluation of the resolution of problems or individual questionnaires (Q): 10%
The subject will be evaluated according to the following indicators:

If EP1 > 5, then the student will have the option to examine only the second part of the subject (EP2). In this case the assessment will be:

If EP2 > EP1

70% EP2 + 20% L + 10% Q

If EP2 < EP1

30% EP1 + 40% EP2 + 20% L + 10% Q

If EP1< 5, the student will have to take a final exam (EF) for the entire subject. In this case the assessment will be:

70% EF + 20% L + 10% Q

Completion and presentation of the corresponding reports for at least 75% of the laboratory practices will be a necessary condition for the approval of the subject. Otherwise, the maximum mark for the subject will be failing, with a 4.9 (UPC, Academic regulations for Bachelor and Master studies).
The student who gets a course grade > 2 and < 5 will be able to take the re-evaluation exam (ER). Laboratory practices, tests carried out via Campus Digital or activities carried out in the classroom during the regular class period (problems and/or work presentations) will not be re-evaluable. Only the theory part is considered re-evaluable. In this case the assessment will be:

70% ER + 20% L + 10% Q

According to the regulations, the maximum grade for the course, through re-evaluation, will be 7.

EXAMINATION RULES.

All the planned activities in this subject have a part in which the students have to attend in person and another part in which the students have to do an independent learning. Before the classes of problems, the students will individually discuss individually or in small groups the proposed problems and will have to present their solution. The evaluation of this task will influence in the evaluation.
For the practical exercises in the laboratory, the students have to previously know the fundamentals of each test and knowledge that results are expected for each test. A pre-test may be required to access the laboratory for certain practices. The practice of the Welcome Plan is mandatory, its non-implementation implies the prohibition of access to the laboratories.
The accomplishment of the individual tests will be carrie4d out in accordance with the course timetable.

BIBLIOGRAPHY

Basic:
- Callister, William D; Rethwisch, David G. Materials science and engineering : an introduction. 10th ed. Hoboken: John Wiley & Sons, 2020. ISBN 9781119453918.
- Ashby, Michael F. Engineering materials. Vol. 1, An introduction to properties, applications and design [on line]. 5th ed. Oxford: Butterworth-Heinemann, 2019 [Consultation: 20/02/2024]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780081020517/engineering-materials-1. ISBN 9780081020524.
- Ashby, Michael F. Engineering materials. Vol. 2, An introduction to microstructures and processing [on line]. 4th ed. Oxford: Elsevier Butterworth-Heinemann, 2012-2013 [Consultation: 20/02/2024]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780080966687/engineering-materials-2. ISBN 9780080966687.
- Smith, William F.; Hashemi, Javad. Fundamentos de la ciencia e ingenieria de los materiales [on line]. 7a ed. Ciudad de México: McGraw-Hill, 2023 [Consultation: 19/02/2025]. Available on: https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=18989. ISBN 9781456294878.
- Askeland, Donald .R.; Wright, Wendelin J. Ciencia e ingeniería de materiales. 7a ed. México D.F: Cengage Learning, 2017. ISBN 9786075260624.
- Shackelford, James F. Introducción a la ciencia de materiales para ingenieros [on line]. 7a ed. Madrid [etc.]: Pearson Educación, 2010 [Consultation: 16/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1258. ISBN 9788483226599.

Complementary:
- Pero-Sanz Elorz, José Antonio. Ciencia e ingeniería de materiales : estructura, transformaciones, propiedades y selección. 5a ed. Madrid: Dossat 2000, 2006. ISBN 8496437442.