

Course guide

340052 - MAES-M5002 - Structural Materials

Last modified: 03/04/2024

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 ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: M^a Teresa Baile Puig

Others: - M. TERESA BAILE PUIG - JOSEP ANTON PICAS BARRACHINA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE25. Knowledge and ability to apply material engineering.

Transversal:

2. 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.

3. 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.

4. TEAMWORK - Level 2: Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

5. EFFECTIVE USE OF INFORMATION 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 student's work by means of the analysis of his evolution through the evaluation activity and the guided activities. Biblio

LEARNING OBJECTIVES OF THE SUBJECT

- Understand and contrast the fundamental concepts of crystalline structure and microstructure of the different types of materials
- Select the chemical/physical/mechanical magnitudes of the materials necessities in accordance with the specifications of a product.
- Understand the relation between the microstructure, the processing and the materials properties.
- Select of materials based on their chemical, thermal, electrical, magnetic and mechanical properties
- Applies the standards of tests.
- It uses and It interprets the tests and it analyzes the results

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Content 1: Ferrous alloys: Aliatges Fe-C (steel and cast iron)

Description:

Properties of the Fe. Ferrous alloys: diagrams, reactions, structures, steels and cast irons. Transformations of austenite

Specific objectives:

Fundamental knowledge acquisition on the Fe-C alloys

Related activities:

Activity 1: Expositive class

Activity 2: Exercises of content 1

Activity 3: Steel diagram 1ª part (computer program)

Activity 4: Practice of steel and cast iron metallography

Activity 11: Test of steel and cast iron knowledge

Activity 17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.

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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.

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.

Full-or-part-time: 28h 40m

Theory classes: 3h

Practical classes: 2h

Laboratory classes: 8h

Guided activities: 0h 40m

Self study : 15h

Content 2: Classification of steels and cast irons

Description:

Plain carbon steels.

Low-alloy steels

Alloy steels and super-alloy steels.

Special steels.

Cast irons

Specific objectives:

It relates the microstructure, the processing and the properties of steel and cast iron

It selects materials based on his physical, chemical, thermal and mechanical properties

Related activities:

Activity 5: Seminary of steel and cast iron classification

Actividad 6: Works in small group of content 2

Actividad 11: Test of steel and cast iron knowledge

Actividad 17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.

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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.

Full-or-part-time: 24h 40m

Practical classes: 2h

Laboratory classes: 6h

Guided activities: 1h 40m

Self study : 15h

Content 3: Heat treatments of ferrous alloys

Description:

Heat treatments
Surface treatments

Specific objectives:

Fundamental knowledge acquisition of the heat treatments of ferric alloys

Related activities:

Activity 1: Expositive class
Activity 7: Exercises of content 3
Actividad3: Steel diagram 2ª part (computer program)
Actividad 8: Practice of micro-hardnesses
Actividad 9: Practice of hardenability: Jominy test
Actividad 10: Practice of pyrometry
Actividad11: Test of steel and cast iron knowledge
Actividad17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.
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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.

Full-or-part-time: 32h 40m

Theory classes: 3h
Practical classes: 4h
Laboratory classes: 8h
Guided activities: 0h 40m
Self study : 17h

Content 4: Non ferric alloys

Description:

Aluminum and its alloys
Magnesium and its alloys
Titanium and its alloys
Copper and brasses

Specific objectives:

Knowledge of non ferrous materials

Related activities:

Actividad1: Expositive class
Actividad12: Exercises of content 4
Actividad13: Practice of non ferric alloy characterization
Actividad17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.

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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.

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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.

Full-or-part-time: 24h 40m

Theory classes: 4h

Practical classes: 3h

Laboratory classes: 4h

Guided activities: 0h 40m

Self study : 13h

Content 5: Polymers

Description:

Polymers.
Classification of polymers.
Polymer properties

Specific objectives:

Knowledge polymeric materials

Related activities:

Actividad1: Expositive class
Actividad14: Exercises of content 5
Actividad15: Practice polymers
Actividad17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.
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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.
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.

Full-or-part-time: 21h 40m

Theory classes: 3h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 1h 40m
Self study : 13h

Contingut 6: Ceramics and composites

Description:

Ceramics and glasses
Mechanical properties
Composites

Specific objectives:

Knowledge ceramic and composite materials

Related activities:

Actividad1: Expositive class
Actividad16: Exercises of content 6
Actividad17: Final test

Related competencies :

. CE25. Knowledge and ability to apply material engineering.
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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.
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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.

Full-or-part-time: 9h

Theory classes: 4h
Guided activities: 1h
Self study : 4h

GRADING SYSTEM

Individual written tests: 70%

Development of the laboratory practices: 20%

Presentation and evaluation of proposed problems (individual or in group): 10%

The evaluation of the course will be based on the following indicators:

T, Theory,: average midterm 1, PT1, and midterm 2, PT2.

P, Exercises or completed questionnaires: mean of the different performed exercises.

L Labs: weighted average of the different scheduled practices.

F, Final Theory Test.

The qualification of this matter will be obtained by applying the most favorable of the following ratios:

1.

Theory, T: 70% of the final note (average of the two partials)

Solved exercises, P: 10% of the final

Labs, L: 20% of the final

Final score $T = 0.7T + 0.2P + 0.1L$

2.

Theory, F: 70% of the final exam)

Solved exercises, P: 10% of the final note

Labs, L: 20% of the final note

Final Score = $0.7F + 0.1P + 0.2L$

The laboratory practices, the tests carried out via Campus Digital and the activities carried out in the classroom during the regular period of classes (problems and / or presentations of work) will not be re-evaluated.

The qualification of this matter will be obtained by applying

Theory, R: 70% of the reevaluation exam

Solved exercises, P: 10% of the final note

Labs, L: 20% of the final note

Final Score = $0.7R + 0.1P + 0.2L$

The completion and presentation of the corresponding reports of at least 75% of the laboratory practices will be a necessary condition for the approval of the subject.

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.

BIBLIOGRAPHY

Basic:

- Ashby, M. F.; Jones, David R. H. Materiales para ingeniería. Vol. 1, introducción a las propiedades, las aplicaciones y el diseño [on line]. Barcelona: Reverté, 2008-2009 [Consultation: 14/02/2024]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635457>. ISBN 9788429172553.
- Smith, William F.; Hashemi, Javad. Fundamentos de la ciencia e ingeniería 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, 2021. ISBN 9786075260624.
- Callister, William D; Rethwisch, David G. Ciencia e ingeniería de materiales. 2a ed. Barcelona [etc.]: Reverté, 2016. ISBN 9788429172515.
- Ashby, M. F; Jones, David R. H. Materiales para ingeniería, Vol. 2, introducción a la microestructura, el procesamiento y el diseño [on line]. Barcelona [etc.]: Reverté, 2008-2009 [Consultation: 02/06/2020]. Available on: http://www.ingebook.com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7725. ISBN 9788429172577.

Complementary:

- ASM handbook. Vol. 1, Properties and selection: iron, steels, and high-performance alloys. 6th ed. Materials Park, Ohio: ASM International, 1995. ISBN 0871703777.
- Béranger, Gérard. Le Livre de l'acier. Londres [etc.]: Technique & Documentation-Lavoisier, 1994. ISBN 2852069814.
- Polmear, I.J. Light alloys : from traditional alloys to nanocrystals [on line]. 4th ed. Amsterdam [etc.]: Elsevier, 2006 [Consultation: 20/02/2024]. Available on: <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780750663717/light-alloys>. ISBN 0750663715.
- Mangonon, Pat L. Ciencia de materiales : selección y diseño. México [etc.]: Prentice Hall, 2001. ISBN 9702600278.

RESOURCES

Hyperlink:

- <http://www.matweb.com/index.aspx>