340052 - MAES-M5O02 - Structural Materials

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy
Academic year: 2015
Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

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 necessarily in accordance with the specifications of a product.
- Understand the relation between the microstructure, the processing and the materials properties.
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- 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

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>20.00%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</tbody>
</table>
Content

**Content 1: Ferrous alloys: Aliatges Fe-C**

**Learning time:** 28h 40m
- Theory classes: 3h
- Practical classes: 2h
- Laboratory classes: 8h
- Guided activities: 0h 40m
- Self study : 15h

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

**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 metallography
- Activity 11: Test of steel knowledge
- Activity 18: Final test

**Specific objectives:**
Fundamental knowledge acquisition on the Faith alloys
## Content 2: Heat treatments ferrous alloys

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

### Description:
- Heat treatments
- Surface treatments

### Related activities:
- Activity 1: Expositive class
- Activity 5: Exercises of content 2
- Actividad3: Steel diagram 2ª part (computer program)
- Actividad6: Practice of micro-hardnesses
- Actividad7: Practice of hardenability: Jominy test
- Actividad8: Practice of pyrometry
- Actividad11: Test of steel knowledge
- Actividad18: Final test

### Specific objectives:
- Fundamental knowledge acquisition of the heat treatments of ferric alloys
Content 3: Classification of steels

Description:
Plain carbon steels.
Low-alloy steels
Alloy steels and super-alloy steels.
Special steels.

Related activities:
Activity 9: Seminary of steel classification
Actividad10: Works in small group of content 3
Actividad11: Test of steel knowledge
Actividad18: Final test

Specific objectives:
It relates the microstructure, the processing and the properties of steel
It selects materials based on his physical, chemical, thermal and mechanical properties
# Content 4: Cast Irons

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>17h 40m</th>
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</thead>
<tbody>
<tr>
<td>Theory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Practical classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h 40m</td>
</tr>
<tr>
<td>Self study:</td>
<td>11h</td>
</tr>
</tbody>
</table>

## Description:
Properties of Cast Irons
- White Cast Irons
- Gray Cast Irons
- Nodular Cast Irons
- Heat treatments of Cast Irons

## Related activities:
- Actividad1: Expositive class
- Actividad12: Exercises of content 4
- Actividad13: Practice of metallography of Cast Irons
- Actividad18: Final test

## Specific objectives:
- Know ferrous materials
## Content 5: Non ferric alloys

### Learning time: **24h 40m**
- Theory classes: **4h**
- Practical classes: **3h**
- Laboratory classes: **4h**
- Guided activities: **0h 40m**
- Self study: **13h**

### Description:
- Aluminum and its alloys
- Magnesium and its alloys
- Titanium and its alloys
- Copper and brasses

### Related activities:
- Actividad1: Expositive class
- Actividad14: Exercises of content 5
- Actividad15: Practice of non ferric alloy characterization
- Actividad18: Final test

### Specific objectives:
- Know non ferrous materials
### Content 6: Materials non metallic

**Learning time:** 21h 40m  
Theory classes: 3h  
Practical classes: 2h  
Laboratory classes: 2h  
Guided activities: 1h 40m  
Self study: 13h

**Description:**  
Ceramic and glasses. Mechanical ceramic properties and glasses  
Polymers. Thermo-mechanical polymer properties  
Composites.

**Related activities:**  
Actividad1: Expositive class  
Actividad16: Exercises of content 6  
Actividad17: Practice ceramic  
Actividad18: Final test

**Specific objectives:**  
Know non metallic materials
Qualification 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 note
   Labs, L: 20% of the final note
   Final score T = 0.7T +0.2P +0.1 L

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 = 0.7 F +0.1 P +0.2 L

Regulations for carrying out activities

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.
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Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

http://www.matter.org.uk/steelmatter/

http://aluminium.matter.org.uk/content/html/eng/default.asp?catid=&pageid=1

http://aluminium.matter.org.uk/aluselect/

http://www.matter.org.uk/steelmatter/


Computer material

Materials Science on CD-ROM version 2.1