Degree competences to which the subject contributes

Specific:
- CEMT-22. Knowledge and application of materials technology in the production, transformation, processing, selection, control, maintenance, recycling and storage of all types of materials.

Transversal:
- 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.

Prior skills
- Basic knowledge of materials science and chemistry

Teaching methodology
- Face-to-face expository classes (Theory)
- Face-to-face directed classes (Problem solving)
- Cooperative learning

Learning objectives of the subject
- Get to Know analytical techniques and characterization of the surface.
- Gaining basic knowledge of surface modification techniques.
- Learning to select surface modification techniques based on applications.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
# Content

## (ENG) Chapter 1. Introduction

**Learning time:** 5h  
Theory classes: 3h  
Self study: 2h

### Description:
- 1.1. Surface engineering goals  
- 1.2. Surface description  
- 1.3. Surface phenomena: corrosión, wear and fatigue

### Specific objectives:
Describe the surface phenomena that limit the useful life of materials and understand the ways that engineering surfaces offers to control and reduce their effects.

## (ENG) Chapter 2. Surface characterization

**Learning time:** 18h  
Theory classes: 7h  
Self study: 11h

### Description:
- 2.1. Microscopy techniques  
- 2.2. Spectroscopy techniques  
- 2.3. Measurements and tests

### Specific objectives:
Describe the surface characterization techniques at different scales to determine: microstructure, chemical composition and mechanical properties

## (ENG) Chapter 3. Surface cleaning:

**Learning time:** 14h  
Theory classes: 5h  
Self study: 9h

### Description:
- 3.1 Degreasing processes  
- 3.2 Removal of organic deposits  
- 3.3 Removal of protective layers  
- 3.4 Removal of corrosión and oxidation products

### Specific objectives:
To understand the importance of cleaning processes prior to surface modification.  
Establish a criterion to select the appropriate cleaning process depending on the initial state of the surface and/or further treatment and/or application.
## (ENG) Chapter 4. Surface modification without changing the material chemically

<table>
<thead>
<tr>
<th>Learning time: 12h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td>Self study: 5h</td>
</tr>
</tbody>
</table>

### Description:
- 4.1. Thermal treatments: Quenching and annealing
- 4.2. Mechanical treatments: Shot peening

### Related activities:
- Presentation of case studies

### Specific objectives:
- Understand basic theory of these processes
- Describe the stages on which these processes are carried out at industrial level
- Understand their effect on the surface regarding microstructure and mechanical properties
- Know under which work conditions these processes are useful

## (ENG) Chapter 5. Surface modification by altering surface chemistry

<table>
<thead>
<tr>
<th>Learning time: 21h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td>Self study: 9h</td>
</tr>
</tbody>
</table>

### Description:
- 5.1. Carburization
- 5.2. Nitruration
- 5.3. Passivation
- 5.4. Phosphatation
- 5.5. Ionic implantation

### Related activities:
- Presentation of case studies

### Specific objectives:
- 1. Understand basic theory of these processes
- 2. Describe the stages on which these processes are carried out at industrial level
- 3. Understand their effect on the surface regarding microstructure and mechanical properties
- 4. Know under which work conditions these processes are useful
## (ENG) Chapter 6. Surface modification by adding a new material onto the surface (coating).
### Conventional techniques

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
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</table>
| 6.1. Introduction to coatings  
6.2. Electroplating  
6.3. Electroless  
6.4. Galvanized |

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation of case studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific objectives:</th>
</tr>
</thead>
</table>
| Understand basic theory of these processes  
Describe the stages on which these processes are carried out at industrial level  
Understand their effect on the surface regarding microstructure and mechanical properties  
Know under which work conditions these processes are useful |

<table>
<thead>
<tr>
<th>Learning time:</th>
</tr>
</thead>
</table>
| 21h  
Theory classes: 11h  
Self study: 10h |

## (ENG) Chapter 7. Surface modification by adding a new material onto the surface (coating).
### Advanced techniques

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
</table>
| 7.1. Thermal spray  
7.2. Chemical vapor deposition  
7.3. Physical vapor deposition |

<table>
<thead>
<tr>
<th>Related activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation of case studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific objectives:</th>
</tr>
</thead>
</table>
| Understand basic theory of these processes  
Describe the stages on which these processes are carried out at industrial level  
Understand their effect on the surface regarding microstructure and mechanical properties  
Know under which work conditions these processes are useful |

<table>
<thead>
<tr>
<th>Learning time:</th>
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</thead>
</table>
| 16h  
Theory classes: 7h  
Self study: 9h |
### Chapter 8. Surface modification by adding a new material onto the surface (coating): Organic coatings

<table>
<thead>
<tr>
<th><strong>Description:</strong></th>
<th><strong>Learning time:</strong> 16h</th>
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<tr>
<td>8.1. Technology and functions</td>
<td>Theory classes: 6h</td>
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<tr>
<td>8.2. Types and selection criteria</td>
<td>Self study: 10h</td>
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<tr>
<td>8.3. Application processes</td>
<td></td>
</tr>
<tr>
<td>8.4. Pathological processes</td>
<td></td>
</tr>
</tbody>
</table>

**Related activities:**
Presentation of case studies

**Specific objectives:**
Understand basic theory of these processes
Describe the stages on which these processes are carried out at industrial level
Understand their effect on the surface regarding microstructure and mechanical properties
Know under which work conditions these processes are useful

### Chapter 9. Nanotechnology in surfaces

<table>
<thead>
<tr>
<th><strong>Description:</strong></th>
<th><strong>Learning time:</strong> 7h</th>
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</thead>
<tbody>
<tr>
<td>content english</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 5h</td>
</tr>
</tbody>
</table>

**Specific objectives:**
Understand basic theory of these processes
Describe the stages on which these processes are carried out at industrial level
Understand their effect on the surface regarding microstructure and mechanical properties
Know under which work conditions these processes are useful

### Qualification system

First partial test: 15%
Second partial test: 25%
Third partial test: 35%
Autonomous learning: 15%
Laboratory: 10%

In this subject a reassessment test will be scheduled. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)
## Bibliography

### Basic:


### Complementary:

