820465 - ESU - Engineering Surfaces

**Degree competences to which the subject contributes**

**Transversal:**
1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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**Teaching methodology**

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

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**Learning objectives of the subject**

1. Get to Know analytical techniques and characterization of the surface.
2. Gaining basic knowledge of surface modification techniques.
3. Learning to select surface modification techniques based on applications.

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**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 60h</th>
<th>40.00%</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: 0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 90h</td>
<td>60.00%</td>
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**Prior skills**

Basic knowledge of materials science and chemistry.

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**Degree:**

- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
- BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
820465 - ESU - Engineering Surfaces
## Content

<table>
<thead>
<tr>
<th>(ENG) Chapter 1. Introduction</th>
<th>Learning time: 5h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td><strong>Theory classes:</strong> 3h</td>
</tr>
<tr>
<td>1.1. Surface engineering goals</td>
<td><strong>Laboratory classes:</strong> 0h</td>
</tr>
<tr>
<td>1.2. Surface description</td>
<td><strong>Self study:</strong> 2h</td>
</tr>
<tr>
<td>1.3. Surface phenomena: corrosión, wear and fatigue</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td><strong>Specific objectives:</strong></td>
</tr>
<tr>
<td>Presentation of case studies</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(ENG) Chapter 2. Surface characterization</th>
<th>Learning time: 18h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td><strong>Theory classes:</strong> 7h</td>
</tr>
<tr>
<td>2.1. Microscopy techniques</td>
<td><strong>Laboratory classes:</strong> 0h</td>
</tr>
<tr>
<td>2.2. Spectroscopy techniques</td>
<td><strong>Self study:</strong> 11h</td>
</tr>
<tr>
<td>2.3. Measurements and tests</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td></td>
</tr>
<tr>
<td>Describe the surface characterization techniques at different scales to determine: microstructure, chemical composition and mechanical properties</td>
<td></td>
</tr>
</tbody>
</table>
(ENG) Chapter 3. Surface cleaning:

**Description:**
- 3.1 Degreasing processes
- 3.2 Removal of organic deposits
- 3.3 Removal of protective layers
- 3.4 Removal of corrosion 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.

Learning time: 14h
- Theory classes: 5h
- Laboratory classes: 0h
- Self study: 9h

(ENG) Chapter 4. Surface modification without changing the material chemically

**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

Learning time: 12h
- Theory classes: 7h
- Laboratory classes: 0h
- Self study: 5h
### (ENG) Chapter 5. Surface modification by altering surface chemistry

**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 working conditions these processes are useful

**Learning time:** 21h
- Theory classes: 12h
- Self study: 9h

### (ENG) Chapter 6. Surface modification by adding a new material onto the surface (coating).

#### Conventional techniques

**Description:**
- 6.1. Introduction to coatings
- 6.2. Electroplating
- 6.3. Electroless
- 6.4. Galvanized

**Related activities:**
Presentation of case studies

**Learning time:** 21h
- Theory classes: 11h
- Self study: 10h

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

#### Advanced techniques

**Description:**
- 7.1. Thermal spray
- 7.2. Chemical vapor deposition
- 7.3. Physical vapor deposition

**Related activities:**
Presentation of case studies

**Learning time:** 16h
- Theory classes: 7h
- Self study: 9h
(ENG) Chapter 8. Surface modification by adding a new material onto the surface (coating):
Organic coatings

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1. Technology and functions</td>
</tr>
<tr>
<td>8.2. Types and selection criteria</td>
</tr>
<tr>
<td>8.3. Application processes</td>
</tr>
<tr>
<td>8.4. Pathological processes</td>
</tr>
</tbody>
</table>

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

Learning time: 16h
- Theory classes: 6h
- Self study: 10h

Chapter 9. Nanotechnology in surfaces

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1. Pulsed laser deposition</td>
</tr>
<tr>
<td>9.2. Litography</td>
</tr>
</tbody>
</table>

Learning time: 7h
- Theory classes: 2h
- Self study: 5h

Qualification system
First partial test: 15%
Second partial test: 25%
Third partial test: 35%
Work: 15%
Laboratory: 10%

In this subject a reassessment test will be scheduled

Regulations for carrying out activities
Autonomous learning evaluation: report and oral presentation
Bibliography

Basic:


Complementary:

