Degree competences to which the subject contributes

Specific:
- CEMUEQ-09. (ENG) Gestionar la Investigación, Desarrollo e Innovación Tecnológica, atendiendo a la transferencia de tecnología y los derechos de propiedad y de patentes
- CEMUEQ-11. (ENG) Dirigir y realizar la verificación, el control de instalaciones, procesos y productos, así como certificaciones, auditorias, verificaciones, ensayos e informes
- CEMUEQ-06. (ENG) Diseñar, construir e implementar métodos, procesos e instalaciones para la gestión integral de suministros y residuos, sólidos, líquidos y gaseosos, en las industrias, con capacidad de evaluación de sus impactos y de sus riesgos

Transversal:
- 05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
- 07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

Teaching methodology

Master classes based on the material available in Athena and cooperative learning in practical classes

Learning objectives of the subject

Obtain the electrochemical bases of corrosion phenomena
Know and compare different types of corrosion
Know the different types of coatings, their properties and applications to the different industrial sectors
Know the industrial methods of application of the coatings and their quality control

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 28h</th>
<th>18.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<tr>
<td></td>
<td>Hours small group: 14h</td>
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<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 102h</td>
<td>68.00%</td>
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</table>
## Content

### Basics of Corrosion

<table>
<thead>
<tr>
<th>Learning time: 29h</th>
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<tbody>
<tr>
<td>Theory classes: 6h</td>
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<tr>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>Self study: 17h</td>
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</tbody>
</table>

**Description:**
1.1. Thermodynamics of corrosion.
1.2. Pourbaix diagrams.
1.3. Kinetics of corrosion. Polarization by activation, concentration and resistance.
1.4. Factors that affect the corrosion rate.

**Related activities:**
Laboratory sessions on determining the corrosion rate and electrochemical tests.

**Specific objectives:**
Introduce the student to the basics concepts related to corrosion processes and their thermodynamic and kinetic implications.

### Corrosion types

<table>
<thead>
<tr>
<th>Learning time: 11h</th>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study: 7h</td>
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</tbody>
</table>

**Description:**
2.1. Classification of the types of corrosion.
2.2. Environmental corrosion, by water, soil, microbiological and erratic currents
2.3. Galvanic corrosion, generalized, pitting, intergranular and metallurgical conditions.
2.4. Inspection techniques in corrosion studies

**Related activities:**
Application exercises and seminar on the evaluation of the types of corrosion in real cases.

**Specific objectives:**
Bring the student to the different types of corrosion that occur in the real world.
### Cathodic protection

**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 7h

**Description:**  
3.1 Fundamentals of cathodic protection.  
3.2 Cathodic protection by sacrificial anodes  
3.3 Cathodic protection by impressed current  
3.4 Cathodic protection applied with coatings

**Related activities:**  
Application exercises on cathodic protection in pipes, tanks and other equipment.

**Specific objectives:**  
Bring the student to the knowledge of how cathodic protection is applied in real cases.

### Metallic coatings

**Learning time:** 11h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 7h

**Description:**  
4.1 Characteristics of the electrolytic processes.  
4.2 Electrolytic processes on an industrial scale.  
4.3 Metallic coatings by electrodeposition.  
4.4 Coating of alloys.  
4.5 Coatings by immersion and projection

**Related activities:**  
Application exercises and electrodeposition laboratory session

**Specific objectives:**  
Know the main types of metal coatings and their application in the protection against corrosion
Polymer coatings

Description:
5.1. Coatings in the form of plates
5.2. Preparation of surfaces
5.3. Thermoplastics. PVC, polyethylene, PTFE
5.4. Natural and synthetic elastomers

Related activities:
Discussion on the different coatings applied as plates

Specific objectives:
Know the characteristics of the coatings in the form of plates and their main applications in different industrial sectors

<table>
<thead>
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<tbody>
<tr>
<td>Theory classes: 2h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study: 7h</td>
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Paints

Description:
5.1. Classification of paintings
5.2. Components of the paints. Binders, vehicle and additives.
5.3. Application of paints.
5.4. Manufacture and formulation of paints. Quality control
5.5 Application examples

Related activities:
Discussion on the applications of paints in different industrial sectors

Specific objectives:
Know the characteristics of the pintures, their formulation, components, applications and manufacturing.

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<tr>
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<tr>
<td>Laboratory classes: 2h</td>
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<tr>
<td>Self study: 7h</td>
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</tbody>
</table>
295570 - 295EQ242 - Design of Equipment Coating Technologies

**Equipment design and coatings application in chemical industry**

**Description:**
7.1 Factors that cause corrosion in the chemical industry
7.2 Design of equipment and types of corrosion failures in the chemical sector
7.3 Selection of materials
7.4 Economic aspects: costs of corrosion

**Related activities:**
Sharing and / or work on the characteristics of corrosion in the chemical sector

**Specific objectives:**
Bring the student to the knowledge of the peculiarities of corrosion, its economic costs and solutions in the chemical sector

**Learning time:** 11h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 7h

**Automotive coatings**

**Description:**
8.1 Corrosion in the car. Differential aspects.
8.2 Corrosion in the body and design.
8.3 Metal coatings: hot dip galvanized and electrolytic zinc
8.4 Zincrometall and aluminized.
8.5 Phosphating and cataphoresis

**Related activities:**
Sharing and / or work on corrosion and body protection in the car

**Specific objectives:**
Know the main peculiarities of corrosion and protective solutions in the automotive industry

**Learning time:** 11h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 7h

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**Qualification system**
Resolution of exercises individually or in groups through cooperative learning (40%) and final exam (60%)

**Regulations for carrying out activities**
Complementary material may be used in case the teacher deems it appropriate
Bibliography

Basic:


