



## Course guides

# 295570 - 295EQ242 - Design of Equipment Coating Technologies

Last modified: 04/06/2021

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).  
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Optional subject).

**Academic year:** 2021    **ECTS Credits:** 6.0    **Languages:** Spanish

### LECTURER

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**Coordinating lecturer:** José Ignacio Iribarren Laco

**Others:** José Ignacio Iribarren Laco  
Elaine Armelin Digroc  
Georgina Fabregat

### PRIOR SKILLS

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Availability for teamwork, investigation of solutions to corrosion problems and cost evaluation at the company level

### REQUIREMENTS

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Basic knowledge in chemistry and chemical engineering

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Generical:**

CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental

CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

**Transversal:**

02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

### TEACHING METHODOLOGY

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



## LEARNING OBJECTIVES OF THE SUBJECT

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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

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Type	Hours	Percentage
Self study	102,0	68.00
Guided activities	6,0	4.00
Hours large group	28,0	18.67
Hours small group	14,0	9.33

**Total learning time:** 150 h

## CONTENTS

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### Basics of Corrosion

#### 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.

#### Specific objectives:

Introduce the student to the basics concepts related to corrosion processes and their thermodynamic and kinetic implications.

#### Related activities:

Laboratory sessions on determining the corrosion rate and electrochemical tests.

#### Full-or-part-time: 29h

Theory classes: 6h

Laboratory classes: 6h

Self study : 17h



### Corrosion types

**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

**Specific objectives:**

Bring the student to the different types of corrosion that occur in the real world

**Related activities:**

Application exercises and seminar on the evaluation of the types of corrosion in real cases.

**Full-or-part-time:** 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

### Cathodic protection

**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

**Specific objectives:**

Bring the student to the knowledge of how cathodic protection is applied in real cases.

**Related activities:**

Application exercises on cathodic protection in pipes, tanks and other equipment.

**Full-or-part-time:** 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

### Metallic coatings

**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

**Specific objectives:**

Know the main types of metal coatings and their application in the protection against corrosion

**Related activities:**

Application exercises and electrodeposition laboratory session

**Full-or-part-time:** 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h



### 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

**Specific objectives:**

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

**Related activities:**

Discussion on the different coatings applied as plates

**Full-or-part-time:** 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

### 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

**Specific objectives:**

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

**Related activities:**

Discussion on the applications of paints in different industrial sectors

**Full-or-part-time:** 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

### 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 Selecton of materilas
- 7.4 Economic aspects: costs of corrosion

**Specific objectives:**

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

**Related activities:**

Sharing and / or work on the characteristics of corrosion in the chemical sector

**Full-or-part-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

### Specific objectives:

Know the main peculiarities of corrosion and protective solutions in the automotive industry

### Related activities:

Sharing and / or work on corrosion and body protection in the car

### Full-or-part-time: 11h

Theory classes: 2h

Laboratory classes: 2h

Self study : 7h

## GRADING SYSTEM

The contents imparted by each teacher will be evaluated separately, usually based on deliveries of exercises, works, expositions, etc. Each part will contribute by 50% in final qualification.

## EXAMINATION RULES.

Complementary material may be used in case the teacher deems it appropriate

## BIBLIOGRAPHY

### Basic:

- Bilurbina, Luis; Liesa Mestres, Francisco; Iribarren Laco, José Ignacio. Corrosión y protección [on line]. Barcelona: Edicions UPC, 2003 [Consultation: 06/05/2020]. Available on: <http://hdl.handle.net/2099.3/36748>. ISBN 9788498800609].
- Calvo Carbonell, Jordi. Pinturas y recubrimientos : introducción a su tecnología. Madrid: Díaz de Santos, cop. 2009. ISBN 9788479788834.
- Revie, R. Winston; Uhlig, Herbert Henry. Corrosion and corrosion control : an introduction to corrosion science and engineering. 4th ed. New York [etc.]: Wiley-Interscience, cop. 2008. ISBN 9780471732792.
- Giudice, Carlos Alberto; Pereyra, Andrea Marisa. Tecnología de pinturas y recubrimientos : componentes, formulación, manufactura y control de calidad. Buenos Aires: Edutecne, 2009. ISBN 9789872536022.
- McArthur, Hugh. Corrosion prediction and prevention in motor vehicles. Chichester [etc.]: E. Horwood, cop. 1988. ISBN 0745803571.