Course guide
295570 - 295EQ242 - Design of Equipment Coating Technologies

Last modified: 29/01/2025

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).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Maria del Mar Pérez Madrigal

Others: Jordi Sans
Elaine Armelin
Maria del Mar Pérez Madrigal

PRIOR SKILLS

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

REQUIREMENTS

Basic knowledge in chemistry and chemical engineering

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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

Master classes based on the material available in Athena and cooperative learning in practical classes. Group project related to the content of the course.

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

Type	Hours	Percentage
Self study	108,0	72.00
Hours large group	42,0	28.00

Total learning time: 150 h

CONTENTS

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: 4h 30m
Laboratory classes: 4h 30m
Self study : 20h

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: 14h
Theory classes: 1h 30m
Laboratory classes: 1h 30m
Self study : 11h

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: 14h
Theory classes: 1h 30m
Laboratory classes: 1h 30m
Self study : 11h

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: 16h
Theory classes: 3h
Laboratory classes: 3h
Self study : 10h

Paint formulation and application

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: 62h
Theory classes: 9h
Laboratory classes: 9h
Self study : 44h

Equipment design and coatings application in relevants sectors.

Description:
Chemical Industry:
6.1 Factors that cause corrosion in the chemical industry
6.2 Design of equipment and types of corrosion failures in the chemical sector
6.3 Selection of materials
6.4 Economic aspects: costs of corrosion
6.5 Corrosion coatings.

Automotive Industry:
6.6. Corrosion in the car. Differential aspects.
6.7. Corrosion in the body and design.
6.8 Metal coatings: hot dip galvanized and electrolytic zinc
6.9 Zincrometall and aluminized.
6.10 Phosphating and cataphoresis

Specific objectives:
Bring the student to the knowledge of the peculiarities of corrosion, its economic costs and solutions in the chemical sector. Know the main peculiarities of corrosion and protective solutions in the automotive industry

Related activities:
Sharing and / or work on the characteristics of corrosion in the chemical sector. Sharing and / or work on corrosion and body protection in the car.

Full-or-part-time: 15h
Theory classes: 1h 30m
Laboratory classes: 1h 30m
Self study : 12h

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. Specifically, in the first part, problems/activities will be evaluated with 15% (deliverables); the other 35% will correspond to a partial exam (theory and problems from topics 1 to 6). In the second part, again, problems/activities/test will be evaluated with 15% (deliverables); the other 35% will correspond to a project to be carried out in group. This project is based on an oral presentation (40% individual mark) and a project report (60% group mark) for a specific coating formulation, guided by the professor. Carrying out and presenting the deliverable activities stipulated by the teacher are a necessary condition to pass the course.

EXAMINATION RULES.

Complementary material may be used in case the teacher deems it appropriate. No re-evaluation exam.

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|.
- 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.
- Calvo Carbonell, Jordi. Pinturas y recubrimientos : introducción a su tecnología. Madrid: Díaz de Santos, cop. 2009. ISBN 9788479788834.
- 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.
- Müller, Bodo; Poth, Ulrich. Coatings formulation : an international book . 2nd rev. ed. Hannover : Vincentz Network, 2011. ISBN 978-3-86630-872-5.
- Sander, Jörg. Anticorrosive coatings : fundamentals and new concepts . Hanover : Vincentz Network, 2010. ISBN 3866309112.