Course guide
240EQ211 - 240EQ211 - Equipment and Facilities Design

Last modified: 27/05/2024

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

Degree: **Academic year:** 2024 **ECTS Credits:** 6.0
Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE IGNACIO IRIBARREN LACO

Others: ELAINE ARMELIN DIGGROC

PRIOR SKILLS

Basics knowledges in chemical and chemical engineering

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Designing products, processes, systems and services for the chemical industry as well as the optimization of other already developed technology based on various areas of chemical engineering, understanding of processes and transport phenomena, separation operations and engineering chemical reactions, nuclear, electrochemical and biochemical.
2. The student will be able to analyze the economic feasibility of a chemical engineering project.

Generical:
3. Communicate and discuss proposals and conclusions in forums multilingual, skilled and unskilled, in a clear and unambiguous.
4. Lead and define multidisciplinary teams capable of solving technical and management needs changes in national and international contexts.
5. Possess independent learning skills to maintain and enhance the competencies of chemical engineering to enable the continued development of their profession.

TEACHING METHODOLOGY

Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

LEARNING OBJECTIVES OF THE SUBJECT

Apply the knowledge of mathematics and electrochemistry to study the phenomenon of corrosion.
Comparison of different types of corrosion with the existent in chemical industry
Design equipment and installations with efficiency and economy criteria

STUDY LOAD

Type	Hours	Percentage
Self study	96,0	64.00
Hours large group	45,0	30.00
Hours small group	9,0	6.00

Total learning time: 150 h

CONTENTS

1. Basis of corrosion.Thermodynamic of corrosion processes. Pourbaix diagrams and applications

Description:
Corrosion basis. Electrochemical cells. Nernst equation. Galvanic, concentration and differential aeration cells. Examples. Pourbaix diagram of water. Pourbaix diagram of metals. Applications and limitations. Examples.

Specific objectives:
To obtain thermodynamic basis of corrosion processes and predicting the possibility of corrosion by using the Pourbaix diagrams.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 14h
Theory classes: 4h
Practical classes: 4h
Self study : 6h

2. Electrochemical kinetics. Corrosion rate. Polarization and types. Passivity.

Description:
Corrosion rate. Activation polarization. Tafel equations and Evans diagrams. Concentration and resistance polarization. Factors affecting to corrosion rate. Passivity. Fkade potential. Examples

Specific objectives:
To obtain the electrochemical kinetics basis in order to understand the kinetics implications and the different factors affecting to corrosion rate.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 2h
Self study : 6h

3. Types of corrosion

Description:
Corrosion types classification. Environmental, water, soils, stray current and microbiological corrosion. Galvanic, homogeneous, located (pitting), intergranular corrosion. Stress corrosion cracking.

Specific objectives:
To differentiate the different types of corrosion in basis to the knowledge of precedents units and additional contributions of materials science.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

4. Cathodic protection

Description:
Cathodic protection by sacrificial anodes. Characteristics and materials of the anodes. Cathodic protection by impressed current. Cathodic protection with coatings combination. Anodic protection. Applications. Examples.

Specific objectives:
To apply correctly the cathodic protection against corrosion and calculate number of anodes o current necessary to overall protection.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

5. Metallic coatings

Description:
Electrolytic processes. Thermodynamic tendencies and overpotential. Chlor alkali process. Electrolytic processes of industrial interest: electrolytic affine, electrosynthesis and metallic coatings. Equipment and installations for the metallic electrodeposition. Alloys electrodeposition. Hot immersion galvanizing. Aluminum anodizing. Examples.

Specific objectives:
Study the characteristics of electrolytic processes and metallic coatings by electrodeposition and immersion and additional processes in chemical industry.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

6. Organic coatings

Description:
Sheet coatings. Surface preparation. Sheet coatings based on polyolefins, vinyl plastics, fluorinated plastics and elastomers. Paints. Characteristics and classification. Paints formulation. Vehicles and pigments. Application of paints. Paints fabrication. Quality control. Examples.

Specific objectives:
Study the characteristics, properties and applications of different types of organic coatings.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 2h
Self study : 6h

7. High temperature corrosion

Description:
High temperature corrosion. High temperature oxidation kinetics. Pilling-Bedworth ratio. Protective and no protective oxides. Catastrophic corrosion.

Specific objectives:
Study the characteristics of high temperature corrosion processes and the differences with electrochemical corrosion.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

8. Materials selection for the chemical industry

Description:
Materials properties. Metals and alloys. Carbon steels and stainless steels. Non ferrous metals: aluminum, cooper, magnesium. Special alloys and refractory metals. Plastics materials. Physical properties. Plastic for general purpose. Elastomers and termoshettings. Special and reinforced plastics. Applications. Materials selection criteria. Exemples.

Specific objectives:
Study properties of metallic and plastic materials and their application in chemical industry and the appropriated criteria in the selection processes.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 2h
Self study : 6h

9. Costing and project evaluation

Description:
Investment analysis. Economic evaluation of projects. Factorial methods of cost estimation and application to chemical industry. Bombes and compressors, heat exchangers, vessels, packing and plates, furnace and boilers, other equipment of the chemical industry. Exemples.

Specific objectives:
Study preliminarily the investment analysis and associated costing in chemical industry.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

10. Mechanical dessign

Description:
Mechanical design of pressure vessels under internal and external pressure. Parameters adjustment: design stress, pressure stress, welded joint efficiency. Head and closures design. Piping and instrumentation. Wind loads. Liquid storage tanks. Exemples.

Specific objectives:
Study of the mechanical design bases in pressure vessels under pressure and liquid storage tanks.

Related activities:
Exercises session based in cooperative work and evaluation. Laboratory session.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

ACTIVITIES

LABORATORY SESSION Nº 1

Description:
Corrosion rate determination

Specific objectives:
Application of the gravimetric method to obtain the corrosion rate in galvanized steel.

Material:
Laboratory notebook

Delivery:
The results must be delivered when the session is finished

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

LABORATORY SESIÓN Nº 2.

Description:
Rheological properties of paints and lubricants

Specific objectives:
Study the rheological behavior in quality control for pains and lubricants

Material:
Laboratory notebook

Delivery:
The results must be delivered when the session is finished

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

LABORATORY SESIÓN Nº 3.

Description:
Corrosion inhibitors

Specific objectives:
Study the influence of inhibitors in corrosion rate

Material:
Laboratory notebook

Delivery:
The results must be delivered when the session is finished

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

LABORATORY SESIÓN Nº 4.

Description:
Metal electrodeposition

Specific objectives:
Study the Faraday laws in electrochemical deposition

Material:
Laboratory notebook

Delivery:
Study the Faraday laws in electrochemical deposition

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

LABORATORY SESIÓN Nº 5.

Description:
Batteries properties

Specific objectives:
Study the composition and basis of batteries running

Material:
Laboratory notebook

Delivery:
Study the composition and basis of batteries running

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

LABORATORY SESIÓN Nº 6.

Description:
Acid and iodine index in paints and oils

Specific objectives:
Calculate the acid and iodine index as quality parameter in paints and oils

Material:
Laboratory notebook

Delivery:
The results must be delivered when the session is finished

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

VISIT TO INDUSTRIAL SOLVAY PLANT

Full-or-part-time: 5h
Theory classes: 5h

VISIT TO INDUSTRIAL GALVANIZADOS TENAS PLANT

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.

EXAMINATION RULES.

Additional material is allowed in examination in accordance with the criteria of the professor.

BIBLIOGRAPHY

Basic:
- Bilurbina, L. ; Liesa, F. ; Iribarren, J. I. Corrosión y protección [on line]. 2ª ed. Barcelona: Edicions UPC, 2003 [Consultation: 22/05/2020]. Available on: http://hdl.handle.net/2099.3/36748. ISBN 9788498800609.
- Uhlig, Herbert H. Corrosión y control de la corrosión. Bilbao: Urmo, 1970. ISBN 8431401494.
- Winston Revie, R. ; Uhlig, Herbert H. Corrosion and corrosion control : an introduction to corrosion science and engineering. 4th ed. New York: Wiley & Sons, 2008. ISBN 9780471732792.
- Champion, F.A. Ensayos de corrosión. Bilbao: Urmo, 1970. ISBN 8431401486.
- Sinnot, R.K. ; J.M. Coulson ; J.F. Richardson. Chemical Engineering. Volume 6 : Chemical engineering design. 5th ed. Oxford: Elsevier : Butterworth-Heinemann, 2009. ISBN 9780750685511.

Complementary:
- Talbot, David ; Talbot, James. Corrosion science and technology. Boca Raton, FLA: CRC Press, 1998. ISBN 0849382246.
- Dillon, C. P. Materials selection for the chemical process industries. New York: Mc Graw Hill, 1992. ISBN 0970169845.
- Greene, Richard W. The chemical engineering guide to corrosion. New York: Mc Graw Hill Chemical engineering, 1986. ISBN 0070243093.

- Couper, James R. [et al]. Chemical process equipment. Selection and design [on line]. 3rd ed. Oxford: Elsevier, 2009 [Consultation: 22/05/2020]. Available on: http://www.sciencedirect.com/science/book/9780123725066. ISBN 9780080919720.
- Peters, Max Stone ; Timmerhaus, Klaus D. Plant design and economics for chemical enginers. 5th ed. New York: Mc Graw Hill, 2003. ISBN 9780071240444.