

## 60645 - Electrochemistry and Photochemistry for Industry

### Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	540 - Master's in Industrial Chemistry
ECTS	6.0
Course	1
Period	Second semester
Subject Type	Compulsory
Module	---

### 1. Basic info

#### 1.1. Recommendations to take this course

#### 1.2. Activities and key dates for the course

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

#### 2.2. Introduction

### 3. Context and competences

#### 3.1. Goals

#### 3.2. Context and meaning of the subject in the degree

#### 3.3. Competences

#### 3.4. Importance of learning outcomes

### 4. Evaluation

### 5. Activities and resources

#### 5.1. General methodological presentation

#### 5.2. Learning activities

#### 5.3. Program

##### 1 . - Fundamentals of the Electrochemical Synthesis.

Basic concepts in electrochemical synthesis. Thermodynamic aspects. The electrical double layer. The kinetics of the

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electrode processes. Transport phenomena. Electrochemical adsorption. Interpreting the components of the cell potential.

### 2.- Electrochemical Reactors . Components and Operation.

Basic components in an electrochemical reactor. Physicochemical properties of common solvents and solvent selection. The supporting electrolyte. Types of electrodes and the selection criteria. Main materials for anodes and cathodes. Counter electrodes. Recent developments on electrode materials.

Mass transport in the electrochemical reactors. Current and potential distributions. Geometry of reactors. Electric connections. Hydraulic distribution. Heat removal. Types of reactors and selection criteria.

### 3.- Industrial Traditional Applications of the Electrochemical Synthesis .

The chlor-alkali industry. Fluorine production. Hall-Heroult process of aluminium. Sodium chlorate manufacturing.

### 4.&#8208; Modern Industrial Applications of the Electrochemical Synthesis.

Production of adiponitrile, a key ingredient for nylon 6,6. Anisaldehyde production (perfume industry). Production of L-cysteine. Maltol production. Electrosynthesis in the pharmaceutical industry.

### 5.&#8208; Electrochemical Synthesis and Environment .

Intrinsic advantages of the electrochemical synthesis for the environment. Green electrochemical processes. Electrochemical decontamination.

### 6.- Electroplating and Other Related Electrochemical Applications.

General Aspects of electrodeposition. The various steps in the process of electrodeposition of metals. Crystal structure of the metallic electrodeposits. Parameters affecting the process. Additives (brighteners, levelers, surfactants and ductilizers).

Industrial electroplating of Zn, Sn, latón, Cu, Ni y Cr. Modern electro-coatings with gold and silver.

Other electrochemical applications: electroforming, electrowinning and electrorefining of metals; electromachining and electropolishing.

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### 7.- Corrosion and Corrosion Prevention .

The effects and economic impact of corrosion. Types of corrosion.

Electrochemical and non-electrochemical methods for the corrosion rate measurement.

The corrosion prevention; actions concerning the metal and actions concerning the corrosive medium (inorganic and organic coatings, pH control, corrosion inhibitors, cathodic and anodic protection). Practical applications in industry.

### 8.- Electrochemical Energy Conversion and Storage .

Types of electrochemical converters: primary cells, rechargeable batteries and fuel cells. Electrochemical behaviour of primary cells. Leclanché dry cell, alkaline batteries, silver oxide batteries (Zn-Ag<sub>2</sub>O). Characteristics of commonly used rechargeable batteries (lead-acid, Ni-Cd, Ni-metal hydride, Li-ion batteries). New developments in fuel cell technology.

### 9.- Fundamentals of Industrial Photochemistry .

Photochemical activation of molecules and atoms. Primary and secondary photochemical processes. Mechanisms of deactivation. Quantum yield. The rate of the photochemical reactions. Effect of solvent. Sensitization. Experimental techniques.

Photochemical synthesis. Photochemical reactors. Photochemistry in industrial synthesis.

### 10.- Other Applications and Effects of Light . Photochemistry and Environment.

Photoinitiators in the polymerization processes. Photochemical depolymerisation of plastics. Sunscreen and sun protection. Photochromism.

Environmental photochemistry. Photochemical origin of some chemicals in the troposphere. Kinetics and mechanism of the main tropospheric reactions. Estimating the rate constants and half-lives for the reactions of organic molecules with HO· radicals in the troposphere. Photochemical processes for water treatment.

### 5.4.Planning and scheduling

### 5.5.Bibliography and recommended resources