

Academic Year/course: 2022/23

## 60640 - Industrial Chemistry

### Syllabus Information

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**Academic Year:** 2022/23

**Subject:** 60640 - Industrial Chemistry

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 540 - Master's in Industrial Chemistry

**ECTS:** 10.0

**Year:** 1

**Semester:** Annual

**Subject Type:** Compulsory

**Module:**

### 1. General information

### 2. Learning goals

### 3. Assessment (1st and 2nd call)

### 4. Methodology, learning tasks, syllabus and resources

#### 4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as:

- Theory sessions
- Guided assignments and seminars
- Visits to chemical companies and/or laboratories

Active participation of the students in the theory sessions and seminars will be encouraged with questions, discussions and presentations of practical cases.

Visits to companies will be previously prepared with an explanation of the processes that will be known in situ.

The conferences by external specialists and related activities will be complemented with bibliographic material. Discussion involving the students will be encouraged.

All the learning tasks will be properly documented with bibliography and learning notes.

#### 4.2. Learning tasks

The course includes the following learning tasks:

Formative activity	Hours	% class attendance
Theory sessions	82	100
Autonomous work and elaboration of assignments / essays	132	0

Assignments	10	100
Visits to companies	8	100
Conferences by external specialists	10	100
Assessment	8	100

### 4.3. Syllabus

The course, **Industrial Chemistry**, will address the following topics:

#### General Aspects of the Chemical Industry

- The chemical industry in Spain. Specific features of the chemical industry production. Environmental aspects.

#### General synthetic approaches to Industrial Chemistry

- Raw materials. Commodities. Industrial catalyst. Chemical solvents. Prevention and safety in the chemical industry.

#### Industrial Inorganic Chemistry

##### The problematics of water

- Requirements regarding waters in relation to their use. The elimination of suspensions from waters. The softening of waters. The removal of cations from waters and demineralization of waters. The desalination of waters. Waters conditioning processes.

##### The industrial utilization of air

- Physical separation of gases from the air: theoretical basis for liquefaction. The Linde process. The Claude process. The production of noble gases from air.

##### The industrial compounds of nitrogen

- The synthesis of ammonia: the Haber-Bosch process. The industrial production of nitric acid: the Ostwald process. Modified processes. Applications. Hydrocyanic acid and cyanides. Hydrazines. Other derivatives.

##### The phosphorus industry

- Phosphate minerals. The preparation of phosphorus. The phosphoric acid industry. Compounds derived from elementary phosphorus. Salts derived from phosphoric acid. The problem of phosphorus in the biosphere.

##### Sulphur and its principal compounds

- The extraction of natural sulphur. The production of sulphur from sulphuriferous gases, sulphides and sulphates. Sulphur dioxide: production and uses. Sulphuric acid: the preparation by heterogeneous catalysis. Other sulphur products of industrial importance.

##### The chlorine-alkali industry

- Chlorine and its industrial inorganic compounds. The inorganic fluorine industry. The minor halogens. Production of sodium and potassium, and related derivatives.

##### Carbon and silicon

- Carbon natural sources. Chemical processes related to carbon monoxide and carbon dioxide. Inorganic carbon compounds for industrial use: carbonates and bicarbonates, the Solvay process. Uses and applications of carbonates. Silicon, silica and silicates. The silicon industry.

##### Aluminium

- Production of alumina: the Bayer process. Production of aluminium: the Hall-Heroult process. Aluminium applications: light alloys. Recovery and recycling of aluminium.

##### Production of iron and steel.

- The raw material of iron and steel making. The production of iron and steels. Corrosion techniques.

##### Other metals of industrial importance

- Copper: properties and production. The metallurgy of lead. The metallurgy of zinc.

## Industrial Organic Chemistry

### Main sources of industrial organic chemical products

- Petrochemistry: Separation of the components of natural gas. Petroleum distillation: fractions. Petroleum refining reactions.
- Carbochemistry: Coal processing as a source of raw materials for chemical industry.
- Biotechnology in organic chemical industry.

### Basic products in Industrial Organic Chemistry

- Basic chemicals derived from natural gas and petroleum. Olefins: ethylene, propylene and C<sub>4</sub> fraction. Aromatics: benzene, toluene and xylenes.
- Chemicals from the C<sub>1</sub> fraction: synthesis gas (CO + H<sub>2</sub>). Methane. Methanol. Formaldehyde. Other C<sub>1</sub> derivatives.
- Chemicals from coal: Acetylene. Aromatic derivatives from coke production.
- Chemicals from renewable sources: Exploitation of biomass. Biofuels. Main chemicals from fats and oils. Main chemicals from carbohydrates. Introduction to fermentation products.

### Industrial sectors of Organic Chemistry

- Large scale production: commodities.
- Fine chemistry.
- One example of large scale production in organic chemical industry: Plastics. Polymer industry. Bioplastics.
- One example of fine chemistry: Pharmaceutical industry. Features. Properties of drugs. Drug design. Future of pharmaceutical products.

### Seminars

- Tensioactive agents.
- Agrochemistry.
- Regulations of industrial chemicals.
- Selection criteria and synthetic routes for industrial products.
- Patents and scientific publications.
- Other topics

## 4.4. Course planning and calendar

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the "Facultad de Ciencias" (Faculty of Science) website: <http://ciencias.unizar.es/>

## 4.5. Bibliography and recommended resources

- Büchel, Karl Heinz. Industrial inorganic chemistry / Karl Heinz Büchel, Hans- Heinrich Moretto, Peter Woditsch ; translated by David R. Terrel . - 2nd ed. rev. Weinheim [etc.] : Wiley-VCH, 2000
- Chenier, Philip J.. Survey of industrial chemistry / Philip J. Chenier . - 3rd ed. New York [etc.] : Kluwer Academic : Plenum, cop. 2002
- Greenwood, Norman Neill. Chemistry of the elements / N.N. Greenwood and A. Earnshaw . - 2nd ed. Oxford : Butterworth-Heinemann, 1997
- Lee, John David. Concise inorganic chemistry / J. D. Lee . - 5th ed., repr. London : Blackwell Science, 2006
- Stocchi, E.. Industrial chemistry. Vol., 1 / E. Stocchi New York [etc.] : Ellis Horwood, 1990
- Swaddle, Tomas Wilson. Inorganic chemistry : an industrial and environmental perspective / T.W. Swaddle San Diego [etc.] : Academic Press, 1997
- Vian Ortuño, Angel. Introducción a la química industrial / Angel Vian Ortuño . - 2ª ed., [reimpr.] Barcelona [etc.] : Reverté, D. L.1999
- Weissermel, Klaus. Industrial Organic Chemistry / Klaus Weissermel, Hans- Jürgen Arpen ; translated by Charlet R. Lindley and Stephen Hawkins . - 4th. completely rev. ed. Weinheim : Wiley-VCH, 2003
- Wittcoff, Harold A.. Productos químicos orgánicos industriales. V.2, Tecnología, formulaciones y usos / Harold A. Wittcoff, Bryan G. Reuben . - [1a ed.] México [etc.] : Limusa, cop. 1996
- Arpen, H.J.. Industrial Organic Chemistry. 5th Wiley-VCH. 2010
- Wittcoff, H.A.. Industrial Organic Chemicals. - 3ªed Wiley. 2013
- Primo Yúfera, Eduardo. Química orgánica básica y aplicada : de la molécula a la industria / Eduardo Primo Yúfera .

- [1ª ed.], reimp. Barcelona [etc.] : Reverté ; Valencia : Universidad Politécnica, 2003
- Grayson, M.. Kirk-Othmer Concise Encyclopedia of Chemical Technology. Wiley. 1985