

Industrial Inorganic Chemistry

Code: 102496
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Gloria Garcia Ortega
Mario García-Risco Aguado

Prerequisites

Prerequisites:

In order to study the Industrial Inorganic Chemistry course, it is highly rec

Objectives and Contextualisation

Goals:

The main objective of this subject is to show the main characteristics of t

Competences

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Adapt to new situations.
- Be ethically committed.
- Communicate orally and in writing in ones own language.
- Lead and coordinate work groups.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.

- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show motivation for quality.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Analyse texts related to real situations in the context of industrial chemistry and understand the different alternatives proposed to solve problems.
3. Be ethically committed.
4. Communicate orally and in writing in ones own language.
5. Correlate analytical information obtained with ones own information on the studied environmental industrial/process.
6. Explain the origins and main characteristics of the chemicals industry as an economic sector.
7. Identify the production methods of the main sectors of the chemicals industry with different production levels: commodities and fine chemicals.
8. Identify the relevant aspects of organic and inorganic chemistry in related industrial sectors.
9. Lead and coordinate work groups.
10. Learn autonomously.
11. Manage the organisation and planning of tasks.
12. Manage, analyse and synthesise information.
13. Obtain information, including by digital means.
14. Propose creative ideas and solutions.
15. Reason in a critical manner
16. Recognise the applications of the main organic and inorganic products, and the economic and environmental implications related with their production and distribution.
17. Recognise the industrial methods for obtaining basic products of the chemicals industry.
18. Resolve problems and make decisions.
19. Show initiative and an enterprising spirit.
20. Show motivation for quality.
21. Show sensitivity for environmental issues.
22. Summarise an article written in English in a reasonable time.
23. Use IT to treat and present information.
24. Use common English terminology for industrial chemistry, electrochemistry and corrosion, environmental chemistry, green chemistry, quality management, monitoring systems, and financial and business management.
25. Work in a team and show concern for interpersonal relations at work.
26. Work with the main databases available on the Internet dealing with the physical and chemical properties of pollutants and chemical compounds in general, and learn to select specifically useful data.

Content

1) The Chemical Industry. Origins. Features. The first 50 products. The first 50 companies. The Chemical Industry in Spain and Catalonia. Scale of production of inorganic products. Main sectors.

2) Sulfuric acid and other products with sulfur. Introduction. Manufacture of sulfuric acid: contact and double contact methods. Environmental aspects. The sulfuric acid market. Other sulfur products with industrial relevance: sulphites, thiosulfates, dithionite and sulfur chlorides.

3) Industrial gases. Introduction. Atmospheric gases: nitrogen, oxygen and argon. Separation methods: cryogenic and non-cryogenic plants. The markets for oxygen, nitrogen gas, liquid nitrogen and argon. Other atmospheric gases: neon, krypton and xenon. Helium Hydrogen: production and market. Hydrogen as an energy vehicle. Carbon dioxide; supercritical fluids.

4) Ammonia, nitric acid and other products with nitrogen. Introduction. Ammonia production: Preparation and purification of synthesis gas, synthesis by heterogeneous catalysis. Hydrazine and derivatives: applications in very diverse fields. Manufacture of nitric acid: oxidation of ammonia, thermodynamic and catalytic aspects. Ammonium nitrate: problems arising from its use on a large scale. The market for ammonia, nitric acid and ammonium nitrate.

5) Phosphorus, phosphoric acid and derivatives. Introduction. Production of elemental phosphorus. Phosphoric acid: production by thermal and wet process. The market for phosphoric acid and phosphates. Alkaline and alkaline earth metal phosphates: orthophosphates, triphosphates and polyphosphates; applications in cleaning and food products. Environmental impact of phosphates: eutrophication. Products prepared from elemental phosphorus with industrial relevance: sulfides, hypophosphites, halides, phosphorous acid, organophosphorus products.

6) Feeds. Introduction. Nutrients The agricultural land. Its interaction with nutrients. Monary, binary and ternary fertilizers. Main fertilizers: superphosphate, Triple superphosphate, Nitrogen phosphate, ammonium phosphates, sulfate and ammonium nitrate, urea, potassium salts. The market for fertilizers.

7) Sodium carbonate. Introduction. The Solvay Process: reactions, installation, energy, byproducts. The sodium carbonate market: importance of natural sources and influence of sodium hydroxide produced by sodium chloride electrolysis. Sodium bicarbonate and other derivatives. Comparison with the uses and applications of potassium and lithium carbonates.

8) The chlor-alkali industry. Introduction. Chlor-alkaline electrolysis. Mercury, diaphragm and membrane processes. Relations between the market of chlorine and sodium hydroxide. Main sources of hydrochloric acid. Compounds with chlorine and oxygen: chlorine dioxide, hypochlorites, chlorates and perchlorates.

9) Hydrogen peroxide and inorganic peroxides. Introduction. Manufacture of hydrogen peroxide: the anthraquinone method. The market, environmental uses, competition with chlorinated products. Other inorganic peroxides: perborate, percarbonate and peroxodisulfate. Characteristics and applications.

10) Silica and zeolites. Introduction. Methods of preparation of silicas: thermal and wet processes. Properties and applications: thixotropic agents. Zeolites: general characteristics and applications. Zeolites in processes of heterogeneous catalysis.

11) Cements and ceramics. Introduction. An aerial binder: lime. A hydraulic binder: Portland cement. The hardening process. Relations between composition and properties. Manufacturing. The aluminous cement Gypsum. Clays: relationships between structure and properties. Ceramic materials: manufacture and properties. Other non-siliceous ceramic materials.

12) Titanium dioxide. Introduction. Characteristics related to its use in the preparation of pigments. Industrial methods of preparation: The sulfate method and the chloride method. Other applications: protection against UV light.

13) Aluminum, oxide and hydroxide. Introduction. Metallic aluminum: manufacture and applications. Aluminum hydroxide: Properties, preparation and flame retardant applications. Aluminum oxide: Industrial products, applications. Aluminum halides. Other compounds The market for metallic aluminum and aluminum compounds.

Methodology

Methodology:

The 6 ECTS credits of this subject are broken down into directed, supervised

- 1) Directed activities: Attendance is compulsory and is carried out in the following:
 - a) Theoretical classes: The teacher exposes the contents of the subject
 - b) Seminars: Students present a written report and make the oral presentation

c) Visits to industries

- 2) Autonomous activities: Within this activity they find the study, the reading and the synthesis of the subject
- 3) Supervised activities. The student can ask the teacher of the subject for help

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Magistral class	36	1.44	1, 4, 6, 8, 7, 3, 21, 15, 17, 16, 24
Seminaries	2	0.08	1, 2, 10, 4, 5, 19, 20, 6, 11, 12, 8, 7, 9, 3, 21, 13, 14, 15, 16, 18, 22, 26, 25, 23, 24
Visits to industries	4	0.16	8, 7, 17, 16
Type: Supervised			
Tutorials	4	0.16	2, 4, 6, 11, 8, 7, 3, 15, 17, 16
Type: Autonomous			
Bibliography research	10	0.4	1, 2, 10, 5, 19, 20, 6, 11, 12, 8, 7, 3, 21, 13, 15, 17, 16, 18, 22, 26, 25, 24
Preparation of presentations	12	0.48	1, 2, 10, 4, 5, 19, 20, 6, 11, 12, 8, 7, 9, 3, 21, 13, 14, 15, 17, 16, 18, 22, 26, 25, 23, 24
Reading of texts	12	0.48	1, 2, 10, 5, 6, 11, 12, 8, 7, 3, 13, 15, 17, 16, 22, 26, 24
Studing	48	1.92	1, 2, 10, 5, 6, 11, 12, 8, 7, 3, 13, 15, 17, 16, 18, 26, 24
Writting homeworks	14	0.56	1, 2, 10, 4, 5, 19, 20, 6, 11, 12, 8, 7, 9, 3, 21, 13, 14, 15, 17, 16, 18, 22, 26, 25, 23, 24

Assessment

Evaluation

The evaluation of the subject is divided into two blocks.

- 1) Two partial exams (NP1 and NP2) made throughout the semester (75%)
 - 2) A written report and oral defense of a topic proposed by the teacher (25%)
- The final grade (NF) of the subject will be obtained according to the form
$$NF = 0.75 [(NP1 + NP2) / 2] + 0.25 NS$$

Requirements:

To make average, the minimum mark of the partial exams NP1 and NP2

To pass the subject, the NF must be ≥ 5.0

Students who do not pass the subject per course may recover the subject

In order to be able to take the recovery exam, it is necessary to have attended

The notes corresponding to the seminars (NS) are not recoverable.

In this case, the final grade will be calculated according to:

$$NF = 0.75 EF + 0.25 NS$$

Requirements:

To make the average, the minimum score of the EF must be ≥ 3.5

To pass the subject, the NF must be ≥ 5.0

A student will be considered non-evaluable if he has made less than 25%

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exams	75%	6	0.24	1, 2, 4, 5, 6, 12, 8, 7, 3, 14, 15, 17, 16, 18, 24
Seminars	25%	2	0.08	1, 2, 10, 4, 5, 19, 20, 6, 11, 12, 8, 7, 9, 3, 21, 13, 14, 15, 17, 16, 18, 22, 26, 25, 23, 24

Bibliography**Bibliography****Books:**

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Complementary bibliography:

Industrial Chemistry (Volume 1). E. Stocchi. Ellis Horwood. 1990.

Introducción a la Química Industrial. A. Vian Ortuño. Reverte. 1994 (2ª Edición).

Chemistry of the Elements. N.N.Greenwood- A.Earnshaw. Butterworth-Heinemann 1998 (2ª edición)

Survey of Industrial Chemistry. P.J. Chenier. VCH Publishers. 1992 (2ª Edición).

An Introduction to Industrial Chemistry. C.A. Heaton. Blackie. 1989 (2ª Edición).

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