Universitat Autònoma de Barcelona

2023/2024

Industrial Inorganic Chemistry

Code: 102496
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OT	4	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

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 one's 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 altertatives proposed to solve problems.
3. Be ethically committed.
4. Communicate orally and in writing in one's own language.
5. Correlate analytical information obtained with one's 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, superv
1) Directed activities: Attendance is compulsory and is carried out in the
a) Theoretical classes: The teacher exposes the contents of the sub
b) Seminars: Students present a written report and make the oral pr

c) Visits to industries

2) Autonomous activities: Within this activity they find the study, the read
3) Supervised activities. The student can ask the teacher of the subject f

Additionally, the teacher will allocate approximately 15 minutes of a class to allow the students to answer the eva

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

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	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,

presentations			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 3 blocks.
1) two partial exams (NP1 and NP2) throughout the course that will count for 60% of the final grade (30% + 30%)
2) A written report and its oral defense of a topic proposed by the teacher (HL, 25%)
3) Evidence on topics discussed and proposed (NE, 15%)
The final grade (NF) of the subject will be obtained according to the formula:
NF = 0.60 [(NP1 + NP2) / 2] + 0.25 NS + 0.15 NE

Requirements:
To make an average, the minimum mark for the NP1 and NP2 partial exams must be $\geq$ 3.5
To pass the course, the NF must be $\geq$ 5.0
Students who do not pass the subject by course will be able to recover the subject by taking a final exam (EF).
In order to take the make-up exam, it is necessary to have attended at least 2/3 of the evaluation activities.
The notes corresponding to the seminars (NS) and the evidence (NE) are not recoverable.
In this case, the final grade will be calculated according to:
NF = 0.60 EF + 0.25 NS + 0.15 NE

Requirements:
To make the average, the minimum grade of the EF must be $\geq$ 3.5
To pass the course, the NF must be $\geq$ 5.0
A student will be considered non-evaluable if he has completed less than 25% of the evaluation activities.

The final marks of the students who pass the subject may be distributed between 5 and 10, always maintaining the order of the students according to the NF mark obtained, in order to achieve the distribution between approved, notable, excel · lenses and MHs, which teachers consider ideal.

Single evaluation

Students who have taken advantage of the single assessment modality must take a final test that will consist of a single exam (EF, 75% total grade) corresponding to the entire theoretical syllabus of the subject (60% equivalent to partial exams and 15% of the evidence). This test will be carried out on the day that the students of the continuous evaluation take the second partial exam.

It will also be necessary to send, through the CV, a presentation of a topic chosen by the teacher and a summary (following the requirements published in the CV) before the day of the final exam. This seminar grade (NS) will count 25% of the final grade. This part of the note will not be recoverable.

The student's final grade (NF) will be:

NF = 0.75 EF + 0.25 NS

Requirements:

To average, the minimum grade of the EF must be ≥ 3.5

To pass the course, the NF must be ≥ 5.0

A student will be considered non-assessable if they have completed less than 25% of the assessment activities.

IMPORTANT NOTE:
In the event that the activity is not totally face-to-face (that is, in scenarios of total confinement or semi-presence), the evaluation activities will not change in percentage, but only in the way they are done. In any case, the requirements indicated above are maintained (minimum marks, recovery, not assessable).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evidences	15%	2	0.08	1, 10, 5, 11, 12, 8, 7, 3, 13, 15, 17, 16, 18
Exams	60%	4	0.16	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:

Industrial Inorganic Chemistry. M. A. Benvenuto. De Guryter, 2015. https://doi.org/10.1515/9783110330335

Industrial Inorganic Chemicals: Productions and Uses. R. Thompson. The Royal Society of Chemistry. 1995. https://doi.org/10.1021/ja955345+

Industrial Chemistry. D. Harvey, N. Rutledge. ED-TECH PRESS, 2018.

Software

The programs that will be used to carry out virtual activities will be:

- Teams

- Zoom

- UAB Virtual Campus

Likewise, some of the activities may require the use of basic office automation tools (word and graphics processor, etc.)