Universitat Autònoma de Barcelona

2020/2021

Chemistry in Industry

Code: 42426
ECTS Credits: 15

Degree	Type	Year	Semester
4313385 Industrial Chemistry and Introduction to Chemical Research	OT	0	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: english (eng)

Teachers

Joan Carles Bayón Rueda
Jordi Marquet Cortés
Rosa Maria Ortuño Mingarro
Manuel Valiente Malmagro
Manel del Valle Zafra
Joan Pau Bayón Rueda
Pau Ferrer Alegre
Juan Sangüesa
Juan Antonio Baeza Labat
Gonzalo Guirado López
Albert Guisasola Canudas
Sergio Ponsa Salas

Prerequisites

No previous requirements needed.

Objectives and Contextualisation

The student will acquire the knowledge of the main important aspects that are at play in a General Chemistry Industry.That will involve the main topics related to *the creation and expansion of a Chemical Company, the description of a selection of the main types of chemical activities that are currently developed in the world of the industrial chemistry, and some complementary issues that, although they are not directly related to the chemical aspects of the production process itself, are needed to efficiently run a chemical facility. The level of Knowledge obtained will range, depending on the particular topics, from a general introduction to a medium level of details and complexities.*

Competences

- Correctly apply new information capture and organisation technologies to solve problems in professional activity.
- Correctly evaluate the risks and environmental and socio-economic impact associated to special chemical substances.
- Define specialised concepts, principles, theories and facts in the different areas of Chemistry.
- Design processes that imply the treatment or elimination of dangerous chemical products.
- Evaluate responsibility in the management of information and knowledge in the field of Industrial Chemistry and Chemical Research.
- Evaluate the human, economic, legal and ethical dimension of professional practice, as well as the environmental implications of one's work.
- Foster innovation and entrepreneurship in chemical industry and research.
- Innovate in the spaces and environments of the field of work, showing initiative and an entrepreneurial spirit.
- Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
- Propose alternatives for the solving of complex chemical problems in different chemical specialities.
- Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
- Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Learning Outcomes

1. Correctly apply new information capture and organisation technologies to solve problems in professional activity.
2. Describe and analyse monographic themes of chemical products of major industrial relevance.
3. Describe the different types of sustainable energy and its applications
4. Evaluate responsibility in the management of information and knowledge in the field of Industrial Chemistry and Chemical Research.
5. Evaluate risks related with industrial products.
6. Evaluate the human, economic, legal and ethical dimension of professional practice, as well as the environmental implications of one's work.
7. Explain waste treatment procedures.
8. Identify technological applications based on biological systems and living organisms for the creation and modification of products or processes.
9. Innovate in the spaces and environments of the field of work, showing initiative and an entrepreneurial spirit.
10. Manage projects, evaluate production costs and demonstrate entrepreneurial activity.
11. Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
12. Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
13. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
14. Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Content

Chemistry in Industry

The creation and expansion of a Chemical Company

Entrepeneurship

Prof.: Jordi Marquet. Evaluation: Homework

1. Introduction. From Research to Innovation

2. The entrepreneurial cycle: Innovation and creativity, risk, initiative, confidence and control.

3. Diagnosis: Culture, training and financing.

4. The tool box: Opportunity window, feasibility analysis, and business plan.

5. Funding: From "FFF" to "business angels" and "venture capital".

6. Managing and growing the venture.

Practical exercise: Each student will have to propose a business idea and assess its feasibility using the tools provided in the course.

Project Management

Prof.: Juan Sangüesa. Evaluation: Group Homework.

Overview of project management concepts:

1. Project initiation.

2. Setting objectives.

3. Planning.

4. The human factor.

5. Project execution and evaluation.

Skills and technical tools of the Project Manager:

1. Specification of appropriate objectives for the project.

2. Techniques of management by objectives.

3. Roles and responsibilities of the Project Manager.

4. Preparation of Project Plan and development.

5. Evaluation and implementation.

Selected topics on Chemical Industry activities

Bullk Chemicals:

Prof.: Joan Carles Bayón (Chemistry Dept, UAB), Jesus Santamaría (Lubrizol Corporation) and Jordi Marquet (Chemistry Dept, UAB). Evaluation: Homework and public presentation.

1. Brief history of the chemical industry (JCB)
2. The chemical industry today: facts and figures (JCB)
3. Bulk chemicals, fine chemicals and specialties (JCB)
4. The waste problem (JCB)
5. *5.* Raw materials for the chemical industry:

- Hydrosphere, atmosphere and biosphere(JCB)

1. Lithosphere: minerals, oil and gas (JCB). The shale revolution (JS)
2. Selected inorganic bulk chemicals (JCB):

- Sulfuric acid

- Phosphoric acid and phosphates

- Ammonia and derivatives

1. Organic Chemicals (JM)

- Basic products for organic industrial synthesis. C1 products

- Synthesis gas. Hydroformilation

- Methanol, Formaldehyde, Acetic Acid

- Hydrogen Cyanide

- Olefins and Acetylene

- Ethylene, Ethylene Oxide, Ethylene Glycol

- Propilene, Acetone

- 1,3-Butadiene, Isobutene, Methyl *tert*-Butyl Ether

- Lower alcohols and higher alcohols

- Aromatics

- Benzene, Phenol, Aniline, Styrene

- Xilenes, Phthalic Anhydride, Terephthalic Acid

- Components for Polyamides

- Adipic acid, Hexamethylenediamine, and e-Caprolactam

Polymers

Prof.: Joan Carles Bayón (Chemistry Dept, UAB), Jesús Santamaria (Lubrizol Corporation), Romina Marín (Lubrizol Corporation) i Josep Gimeno (Honeywell). Evaluation: Homework and examination.

1. Basic concepts (JCB)
2. Polymer classifications (JCB)
3. Polymerization reactions (JCB)
4. Polymer structure and properties (JCB)
5. Biobased monomer for the polymer industry (JS)
6. Techniques for polymer characterization (RM)
7. A survey of some important polymers (JCB)
8. A closer insight into the most important polymers (JCB)

a) Polyolefins (JCB)

b) Polyesters (JCB)

c) Polyamides (JCB)

d) Polyurethanes: basic concepts (JG)

- Polyurethane foams (JG)

- Polyurethane thermoplastics (RM)

9. Open discussion (JCB)

Pharmaceuticals

Prof.: Rosa M. Ortuño, Antoni Torrens, Montserrat Closa. Evaluation: Exam.

1. Historical introduction:

- Active principles in folk medicine.

- Drug development in the early twentieth century: from aspirin to antibiotics.

- Some main hits in the last 50 years: anti-tumour and antiviral drugs.

2. Drug discovery from natural products. Pain killers: from morphine to tapentadol.

3. Pharmaceutical Industry overview.

4. Research & Innovation: breakthroughs and blockbusters.

5. Drug discovery anddevelopment. From the original idea to the marketplace.

6. Analytical development of active pharmaceutical ingredients (APIs).

7. Good manufacturing practices (GMPs) and regulations.

Surfactants

Prof.: Miquel Osset. Evaluation: Exam.

1. Applied chemistry of surfactants:

- Industrial sectors.

- Applications.

- Suppliers and formulations.

2. Surfactants as key ingredients in a wide variety of uses and intermediate solutions to provide consumer relevant products.

Dyes

Prof.: Fernando Carrillo. Evaluation: Exam.

1. Introduction.

2. Clasification of Dyes and chemical structures.

3. Dyeing of textile materials.

4. Quality control of dyed textiles.

5. Environmental aspects of textile dyeing.

Food Chemistry

Prof.: Jordi Saldo. Evaluation: Homework.

1. Food main components and chemical properties:

- Amino acids, peptides and proteins

- Hydrocarbons.

- Oils and fats.

2. Food technology, modifications during storage and industrial processes:

- Water activity (Sorption isotherms, water binding, effect on food stability).

- Processing methods related with changes in water activity, oils and fats, proteins and hydrocarbons.

Functional Foods

Prof.: Manuel Valiente. Evaluation: Exam.

1. General Overview of Functional Foods.

2. Regulatory Rules.

3. Chemical Aspects of Functional Foods.

4. Case Studies.

Biotechnology processes

Prof.: Pau Ferrer. Evaluation: Homework and Oral Presentation of a Case Study.

1. Introduction. Historic perspective. Bio-based products and processes: fields of application.

2. Industrial biotechnology in practice. Case studies of bio-based products and processes:

a. Biofuels: ethanol and others.

b. Organic acids and amino acids.

c. Antibiotics: penicillin.

d. Biopharmaceuticals.

Asymmetric Synthesis and Catalysis in Industrial Processes

Prof.: Pau Bayón. Evaluation: Exam.

Industrial Applications of Nanotechnology

Prof.: Claudio Roscini. Evaluation: Homework.

Complementary issues in the Chemical Industry

Chemical Diagnostics

Prof.: Manel del Valle. Evaluation: Exam.

1. Automation concepts in chemical analysis.

2. Digital and analogue signal acquisition.

3. Diagnostic kits.

4. Use of biological reagents.

5. Omics technologies.

6. Case applications in the clinical, food & beverage sectors.

Chemical and Biochemical process control

Prof.: Juan Antonio Baeza. Evaluation: Exam

- Instrumentation for control of chemical and biochemical processes.

- Basic control schemes. Feedback. Tuning of PID controllers. Feedforward.

- Other control schemes. Cascade, ratio, override, auctioneering, split-range…

Wastewater treatment

Prof.: Albert Guisasola. Evaluation: Exam.

1. Wastewater treatment.

- Wastewater characterisation: wastewater distribution, analytical parameters of conventional wastewaters.

- Biological, physical and chemical processes occurring during urban wastewater treatment in WWTP.

- Possibilites for industrial wastewater treatment.

- Potabilisation techniques for drinking water.

Solid and gas waste treatment

Prof.: Sergio Ponsá. Evaluation: Exam.

Green Chemistry

Prof.: Gonzalo Guirado and José Peral. Evaluation: Exam.

1. The problem of non-biodegradable industrial wastewaters: Advanced Oxidation Processes for water and air treatment:

- Heterogeneous photocatalysis.

- Fenton and photo-Fenton.

- Chemical reactors for AOPs.

2. Green solvents.

3. Electrochemistry for greener processes.

Methodology

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Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises classes	100	4	1, 5, 2, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4
Seminars	30	1.2	1, 5, 2, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4
Theoretical classes	170	6.8	1, 5, 2, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4
Type: Supervised			
Project Development	20	0.8	2, 10, 14

Assessment

- Every professor decides the number and typology of evaluation activities: oral presentations, written exams, delivery of discussed articles, small tests...

- The final mark of the module will be the sum of the mark of every professor multiplied by the percentage of his classes in the total teaching of the module.

- The marks of the written exams must be above 3.5 in order to average with other marks of the professor and/or the module.

- There will be a period in January to repeat written exams with marks under 5. In the case of exams under 3.5 will be mandatory to the student, in case of exams between 3.5 and 5 would be optional to the student. Only students that have attended to 2/3 of the evaluation activities can retake the exams in January.

- In the case that a student will not arrive to a 3.5 mark after the retaking exam in January, the coordinator of the module could decide to average this mark with the rest of the module. However, this option can only be considered for two written exams in the whole master.

- The marks of other evaluations activities (i. e. oral presentations) will average with the rest of the marks of the professor/module independently of the value. There will not be option of repeating these other evaluation activities.

- An average mark of 5.0 is mandatory in order to pass a module.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Homeworks	25%	10	0.4	1, 5, 2, 3, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4
Oral Presentations	15%	15	0.6	1, 5, 2, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4
Written Exams	60%	30	1.2	1, 5, 2, 7, 10, 8, 9, 13, 12, 11, 14, 6, 4

Bibliography

Each Lecturer will recommend its particular preference of textbooks.