

Environmental Chemistry and Sustainability

Code: 102497
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OT	4	2

Contact

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Use of languages

Principal working language: english (eng)

Some groups entirely in English: Yes

Some groups entirely in Catalan: No

Some groups entirely in Spanish: No

Prerequisites

No previous requirements

Objectives and Contextualisation

The goal is to get the fundamentals of environmental chemical processes and pollution chemistry. Also, the student will gain skills for the assessment of the behavior and the fate of chemical substances and anthropogenic pollutants in the environment.

Skills

- Adapt to new situations.
- Apply knowledge of chemistry to problem solving of a quantitative or qualitative nature in familiar and professional fields.
- Be ethically committed.
- Communicate clearly in English.
- Communicate orally and in writing in ones own language.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Have numerical calculation skills.
- 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 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. Apply basic physical and chemical concepts to explain the behaviour and destination of pollutants.
3. Be ethically committed.
4. Communicate clearly in English.
5. Communicate orally and in writing in ones own language.
6. Define the use of lifecycle analysis in the environmental evaluation of chemical substances and processes.
7. Describe the basic chemistry techniques for the treatment of contaminated air, water and land.
8. Distinguish the problems associated with the different types of analyte and sample matrices in the industrial and environmental fields (water system, atmosphere, soil).
9. Evaluate the changes in chemical production processes designed to reduce environmental impact and its economic implications.
10. Evaluate the results of the environmental monitoring process to control the evolution of the ecosystem and thus enable effective management of natural resources.
11. Have numerical calculation skills.
12. Identify the main pollutant chemical agents, know their sources, and their distribution and interaction with the natural environment.
13. Learn autonomously.
14. Manage the organisation and planning of tasks.
15. Manage, analyse and synthesise information.
16. Obtain information, including by digital means.
17. Perform an environmental risk analysis of pollutants in simple situations.
18. Plan chemical strategies to resolve problems with the decontamination of contaminated air, water or land.
19. Propose creative ideas and solutions.
20. Reason in a critical manner
21. Relate basic chemical reactivity with the most common reactions in the environment
22. Resolve problems and make decisions.
23. Resolve thermodynamic, kinetic and mass equilibrium problems associated with natural substances and pollutants, in the different environmental aspects.
24. Show motivation for quality.
25. Show sensitivity for environmental issues.
26. Use IT to treat and present information.
27. Use basic models to predict the distribution of pollutants.
28. Use common English terminology for industrial chemistry, electrochemistry and corrosion, environmental chemistry, green chemistry, quality management, monitoring systems, and financial and business management.
29. Use risk analysis to determine the environmental impact of chemical pollutants in simple systems.
30. Work in a team and show concern for interpersonal relations at work.

Content

The hydrosphere

1. Water chemical properties

Water properties. Water cycle. Chemical composition of natural waters. Natural water types. Dissolved gases. Hardness and alkalinity. Main chemical processes in water: redox processes.

2. Sea water chemistry

Salinity. Chemical composition. Minority inorganic elements. Organic compounds. Marine pollution.

3. Polluted water treatment

Toxic substances and bioaccumulation. Types of toxic substances. Heavy metals. Classification of polluted waters. Water quality indexes. Drinking water treatment. Municipal wastewater treatment. Industrial wastewater treatment.

Soil Chemistry

4. Soil chemistry

Soil formation and weathering. Aluminosilicates. Soil texture and properties. Humus. Soil vertical profile. Soil fluid phase. Physisorption and cationic exchange. Soil pH. Soil acidification. Reclamation of acid soils. Soil salinization. Reclamation of salty soils. Soil remediation techniques.

The atmosphere

5. Introduction

Historical precedents. Previous concepts and nomenclature. Measurement units. Earth atmosphere special features. Carbon, oxygen, nitrogen and sulfur closed cycles. Halogens and noble gases in the atmosphere. Atmospheric pressure profile. Atmosphere energy balance. Temperature profile and atmospheric layers.

6. Stratosphere chemistry

The ozone layer. Chapman cycle. Ozone depletion catalytic cycles. Stratosphere study techniques. Anderson's experiments. Perturbations of the ozone layer. Chlorofluorocarbons. Antarctic ozone hole.

7. Troposphere chemistry

Greenhouse effect: the IPCC data. Urban pollution. Hydroxyl radical and photochemical smog. NO₃ radical. Urban pollution consequences. Tropospheric sulfur chemistry: Planetary thermostat hypothesis and Gaia hypothesis. Acid rain. Indoor atmosphere pollution.

8. Atmosphere pollution control

Particle retention. Chemical retention. Car exhaust control. Control of inmission levels (XVPCA).

Sustainability an Green Chemistry

9. Risk assessment.

Risk, hazard and the basic risk assessment equation. Green Chemistry. Life Cycle Assessment (LCA) of chemical reactions. The REACH system.

10. Fugacity models.

Pollutants distribution in the environment. Phase distribution equilibrium constants. Fugacity model level I. Environmental risk characterization. Fugacity model level II. Examples of application. Quantitative structure-activity relationships.

Methodology

Activities

Title	Hours	ECTS	Learning outcomes
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Type: Directed

Exercise Classes	11	0.44	1, 21, 4, 24, 25, 8, 19, 20, 17, 22, 23, 11, 26, 9, 27
Theoretical classes	36	1.44	1, 21, 6, 4, 29, 2, 7, 10, 15, 3, 25, 8, 20, 17, 12, 23, 9, 27, 18
Type: Supervised			
Tutorials	5	0.2	6, 24, 14, 15, 19, 3, 25, 16, 8, 20, 22, 30, 18
Type: Autonomous			
Study, Exercise Resolution, Reading, and Data Gathering	90	3.6	1, 21, 13, 6, 5, 29, 2, 7, 10, 14, 15, 19, 3, 16, 8, 20, 17, 12, 22, 23, 28, 11, 30, 26, 27, 18

Evaluation

The last chance exam includes the whole course. Thus, in the case of students that failed just one of the midterm exams, it will be mandatory to complete the whole final course exam.

In order to take the last chance exam the student need to have been previously evaluated in a set of evaluation activities that amount two thirds of the totals course (one of the midterm exams and the two individual homeworks, or the two midterm exams).

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
1 Midterm exam	45%	2	0.08	21, 4, 29, 7, 10, 3, 25, 8, 19, 20, 17, 23, 9, 27, 18
2 Individual Homeworks	10%	2	0.08	1, 21, 13, 6, 4, 5, 24, 2, 14, 15, 19, 25, 16, 8, 20, 12, 22, 23, 28, 11, 30, 26, 9, 27
2 Midterm exam	45%	2	0.08	21, 4, 29, 2, 7, 10, 25, 8, 19, 20, 17, 22, 23, 11, 9, 27, 18
Last Chance Exam	90%	2	0.08	21, 4, 29, 7, 10, 15, 25, 8, 19, 20, 17, 22, 23, 11, 9, 27, 18

Bibliography

Basic Textbooks

X.Domènech, J. Peral, *Química Ambiental de Sistemas Terrestres*. Reverté. 2006.

Complementary Textbooks

C. Orozco y otros, *Contaminación Ambiental. Una visión desde la Química*. Thomson. 2003.

C. Orozco y otros. *Problemas resueltos de Contaminación Ambiental*. Thomson. 2003.

C. Baird, *Química ambiental*. Reverté. Barcelona. 2001.

R.H. Tan, *Soil Chemistry*. Marcel Dekker. 1993.

R.P Wayne, *Chemistry of theAtmospheres*. Clarendon Press. 1993.