# Environmental Chemistry and Sustainability

Code: 102497
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| Chemistry | OT | 4 |

## Contact

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## Teaching groups languages

You can view this information at the end of this document.

## 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.

## Competences

- 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 one's own language.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Have numerical calculation skills.
- Lead and coordinate work groups.
- Learn autonomously.
- Manage, analyse and synthesise information.
- Manage the organisation and planning of tasks.
- 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 one's 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. Describe the principles of green chemistry and its implications.
9. Evaluate the appropriateness of a product or chemical process regarding the principles of green chemistry.
10. Evaluate the changes in chemical production processes designed to reduce environmental impact and its economic implications.
11. Have numerical calculation skills.
12. Lead and coordinate work groups.
13. Learn autonomously.
14. Manage, analyse and synthesise information.
15. Manage the organisation and planning of tasks.
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. Summarise an article written in English in a reasonable time.
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 IT to treat and present information.
30. Use risk analysis to determine the environmental impact of chemical pollutants in simple systems.
31. 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. Phyisisorption 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.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Type: Directed | | | |
| Exercise Classes | 11 | 0.44 | 1, 2, 4, 24, 25, 18, 19, 20, 17, 22, 23, 11, 29, 28, 27 |
| Theoretical classes | 36 | 1.44 | 1, 2, 10, 4, 6, 7, 8, 30, 14, 3, 25, 18, 20, 17, 21, 23, 28, 27, 9 |
| Type: Supervised | | | |
| Tutorials | 5 | 0.2 | 10, 24, 14, 15, 12, 3, 25, 16, 18, 19, 20, 22, 31, 9 |
| Type: Autonomous | | | |
| Study, Exercise Resolution, Reading, and Data Gathering | 90 | 3.6 | 1, 2, 13, 10, 5, 6, 7, 8, 30, 14, 15, 12, 3, 16, 18, 19, 20, 17, 21, 22, 23, 26, 11, 31, 29, 27, 9 |

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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.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Last Chance Exam | 90% | 2 | 0.08 | 2, 4, 6, 8, 30, 14, 25, 18, 19, 20, 17, 22, 23, 11, 28, 27, 9 |
| 1 Midterm exam | 45% | 2 | 0.08 | 2, 4, 6, 8, 30, 3, 25, 18, 19, 20, 17, 23, 28, 27, 9 |
| 2 Individual Homeworks | 10% | 2 | 0.08 | 1, 2, 13, 10, 4, 5, 24, 7, 14, 15, 12, 25, 16, 18, 19, 20, 21, 22, 23, 26, 11, 31, 29, 28, 27 |
| 2 Midterm exam | 45% | 2 | 0.08 | 2, 4, 6, 7, 8, 30, 25, 18, 19, 20, 17, 22, 23, 11, 28, 27, 9 |

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 60% of the total course (one of the midterm exams and the two individual homeworks, or the two midterm exams). When the student has not been evaluated of that minimum 60% of the subject the final mark will ne* Not Evaluated.

Single Assessment

The student who choose the "Single Assessment" procedure will have to make a final test containing a theory exam with 25 multiple choice questions an several short questions. Then, he/she will have to solve a number of exercises similar to the ones solved in class.

The final mark of the student will be the weighted average of the above mentioned activities (theory exam 70% and exercises exam 30%).

If the final mark is below 5, the student will have another opportunity to pass the subject through a second chance exam that will take place in a day decided by the Degree Coordination Committee. That second chance exam will allow the student to pass 100% of the total mark (theory and exercises).

## 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.


## Software

No specific software is used

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 1 | English | second semester | morning-mixed |
| (TE) Theory | 1 | English | second semester | morning-mixed |