Universitat Autònoma de Barcelona

2023/2024

Chemistry of Pollution

Code: 102844
ECTS Credits: 6

Degree	Type	Year	Semester
2501915 Environmental Sciences	OB	3	1

Contact

Name: Jose Peral Perez

Email: jose.peral@uab.cat

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

It is recommended to have taken Química and Equilibri químic i Instrumentació

Objectives and Contextualisation

The objective is to provide tools and knowledge necessary to be able to understand and predict the behaviour of chemical substances in the environment and to asses the environemntal risks. Also the objective is to describe physicochemical procedures for remediation of contaminates environemtal systems.

Specific objectives:

1. Top understand the environmental relevance main physiscochemical properties that define the chemical compunds

2. Use of envirtonmental databases and use them for interpret environmental behaviour.

3. Draw up models that allow the prediction of the behaviour and fate of chemical contaminants.

4. Analyze and evaluate environmental risk of chemicals in the environment.

5. To know the chemical properties of natural environments

6. To know reactivity and persistence of chemicals in natural environments

7. Provide the necessary knowledge for the design of procedures of remediation.

Competences

- Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
- Analyze and use information critically.
- Collect, analyze and represent data and observations, both qualitative and quantitative, using secure adequate classroom, field and laboratory techniques
- Demonstrate adequate knowledge and use the most relevant environmental tools and concepts of biology, geology, chemistry, physics and chemical engineering.
- Demonstrate concern for quality and praxis.
- Demonstrate initiative and adapt to new situations and problems.
- Learn and apply in practice the knowledge acquired and to solve problems.
- Quickly apply the knowledge and skills in the various fields involved in environmental issues, providing innovative proposals.
- Teaming developing personal values regarding social skills and teamwork.
- Work autonomously

Learning Outcomes

1. Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
2. Analyze and use information critically.
3. Apply chemical knowledge to solve problems in a quantitative or qualitative nature relating to the environment.
4. Demonstrate concern for quality and praxis.
5. Demonstrate initiative and adapt to new situations and problems.
6. Develop strategies for analysis and synthesis relating to the environmental implications of industrial processes.
7. Develop work type chemical analysis from previously established procedures.
8. Handle tools and equipment in chemical laboratories standards of environmental control.
9. Identify the chemical processes in the surrounding environment and evaluate them properly and originally.
10. Interpret data from databases or by experimental measures, including the use of computer tools, identify the meaning and relate behavior in environmental systems.
11. Learn and apply in practice the knowledge acquired and to solve problems.
12. Make correct assessments of health risks and environmental and socioeconomic impacts associated with chemicals and the chemical industry.
13. Observe, recognize, analyze, measure, and so properly and safely represent chemical processes applied to environmental sciences.
14. Recognize and analyze chemical problems and plan appropriate responses or work for resolution, including, where necessary, the use of bibliographical sources.
15. Safe handling of chemicals, taking into account their physical and chemical properties.
16. Teaming developing personal values regarding social skills and teamwork.
17. Work autonomously

Content

Environmental Distribution of Pollutants

1. Pollutant destination in the environment

Pollutants Cycle. Transport. Residence Time. Reactivity. Phase Distribution. Vapor Pressure and Solubility. Partition Coeficients. Pollutant distribution in an environmental system: Fugacity Model.

2. Tools for the assesment of a pollutant environmental distribution

Databases with environmental properties. Search of phisico-chemical properties. Spreadsheet making for the assessment of the environmental behaviour of a pollutant.

The hydrosphere

3. 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.

4. Sea water chemistry

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

5. 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

6. 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

7. 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.

8. 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.

9. 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. Indooratmosphere pollution.

10. Atmosphere pollution control

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

Sustainability an Green Chemistry

11. Risk assessment.

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

Methodology

The subject will be developed through master classes, which will be complemented by problem sessions in order to consolidate the acquired knowledge and to develop the quantitative calculation of environmental parameters. Problem sessions will not form a segregated typology,
but they will be integrated into most cases in the
development of theoretical classes.
In the first block of the subject, in addition to theoretical classes and problems, there will be two practical sessions of 3 hours each, in computer room, for the realization of a practice in which the student will have to deliver a report, which will be evaluated.

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			
practical classes	6	0.24	2, 3, 11, 5, 4, 6, 7, 12, 9, 10, 8, 15, 13, 14, 17
problem solving classes	20	0.8	2, 3, 11, 5, 4, 6, 12, 10, 14, 17, 16
theoretical classes	33	1.32	
Type: Supervised			
tutorials	8.5	0.34	2, 3, 11, 5, 4, 13, 16
Type: Autonomous			
Autonomus study	63.5	2.54	3, 11, 4, 7, 12, 10, 8, 15, 13, 14, 17
Practices preparation	4	0.16	12, 10, 8, 15

Assessment

The evaluation will be carried out through two partial written tests that might content multichoice questions (blocks 1 and 2), numerical exam and report of a practice (block 3) and a second chance exam. The final grade will be weighted according to the weight of the three blocks. On the other hand, the second chance exam will consist of a written test of all the subjects included in the three blocks. It must be kept in mind that in order to be able to attend the second chance exam, the student must have been in a total of activities equivalent to 65% of the total grade.

The practice will be on- line and attendance is mandatory.

The minimum to consider the matter exceeded is 5 out of 10.

Single Assessment

The student who chooses 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. Finally, he/she will have to present a report about the practice carried out in the workshop of the subject.

The final mark of the student will be the weighted average of the above mentioned activities (theory exam 50%, exercises exam 30%, and workshop report 20%).

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 account for only the 80% of the total mark (theory and exercises). The part corresponding to the workshop report is not submitted to a second chance assessment.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st Partial Written Exam	35%	3	0.12	2, 3, 11, 5, 4, 6, 12, 9, 10, 13, 14, 1, 17
2nd Written Partial Exam	35%	3	0.12	2, 3, 11, 9, 10, 1, 17
Numerical exam about a practice	15%	2	0.08	2, 3, 11, 4, 12, 9, 10, 14, 1, 17
Practice report	15%	7	0.28	2, 3, 11, 5, 4, 7, 12, 9, 10, 8, 15, 14, 1, 17, 16

Bibliography

The book will be followed during the course:

X. Domènech, "Fundamentos de Química Ambiental" Vol.1 y Vol.2. Ed. Síntesis. Madrid. 2014

Other reference books:

- X.Domènech, J. Peral, "Química Ambiental de Sistemas Terrestres". Ed. Reverté. Barcelona. 2006

- X. Domènech, "Química de la Contaminación". Ed. Miraguano. Madrid. 1999.

- X.Domènech, "Química atmosférica". Ed. Miraguano. Madrid. 2008.

- R.P. Wayne, "Chemistry of the Atmospheres". Oxford University Press. 2000

- C. Baird, Química ambiental. Reverté. Barcelona. 2014.

Software

Excel 2016