VNIVERSITAT DE VALÈNCIA

Course Guide
36460 Environmental Analytical Chemistry

COURSE DATA

Data Subject	
Code	36460
Name	Environmental Analytical Chemistry
Cycle	Grade
ECTS Credits	4.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	Second term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	14 - Analytic Chemistry Applied	Optional

Coordination

Name	Department
	310 - Analytical Chemistry

SUMMARY

The Analytical Environmental Chemistry course has been structured in twelve lessons that aim to provide an integrated view of the parameters of interest and contaminants present in the atmospheric, aquatic environment and in solid samples.

The first four lessons of the subject are an introduction to the basic aspects of analytical chemistry in environmental analysis, with special emphasis on the most dangerous organic and inorganic compounds and their effects on the environment.

The following 8 lessons focus on pollutants and their analysis depending on the environment in which they are located: i) Analysis of gases and aerosols in the atmosphere, ii) Physical-chemical characterization of waters and determination of specific compounds and iii) Analysis of solid samples, both soil and sediment and biota.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Although enrollment restrictions have not been specified with other subjects of the curriculum, to successfully address the subject, it is necessary that the student knows, both the basis of the Analytical Chemistry courses and associated laboratories, and general concepts such as: i) Nomenclature and chemical formulation, ii) Adjustment of chemical reactions, iii) Elementary stoichiometric calculations, iv) Mathematical and statistical algebra applied to chemical analysis.

OUTCOMES

1110 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Solve problems effectively.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.

- Learn autonomously.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.
- Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
- Show knowledge of the metrology of chemical processes including quality management.
- Recognise and analyse new problems and plan strategies to solve them.
- Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems.
- Handle the instrumentation used in the different areas of chemistry.
- Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them.
- Evaluate the risks in the use of chemicals and laboratory procedures.
- Relate theory and experimentation.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.
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- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter ENVIRONMENTAL ANALYTICAL CHEMISTRY that allow to acquire specific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject ENVIRONMENTAL ANALYTICAL CHEMISTRY related to the competences of the degree in Chemistry.

SPECIFIC KNOWLEDGE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject ENVIRONMENTAL ANALYTICAL CHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
The principles and procedures used in chemical analysis and the characterisation of chemical compounds.	Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8) Show knowledge of the metrology of chemical processes including quality management..(CE10) Handle the instrumentation used in the different areas of chemistry.(CE19). Understand the qualitative and quantitative aspects of chemical problems..(CE24). Develop sustainable and environmentally friendly methods.(CE25)

The principal techniques of structural investigations, including spectroscopy	Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications..(CE7). Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12). Handle the instrumentation used in the different areas of chemistry.(CE19). Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8)
COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject ENVIRONMENTAL ANALYTICAL CHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
Ability to apply this knowledge and understanding to the solution of	Solve qualitative and

common qualitative and quantitative problems.	quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Competences to present and argue scientific issues orally and in writing to a specialized audience.	Relate chemistry with other disciplines.(CE26). Prepare reports, surveys and industrial and environmental projects in the field of chemistry..(CE27). Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate. (CG6). Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4).
Ability to calculate and process data, related to information and chemistry data.	Solve qualitative and quantitative problems following previously developed

	models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15).
GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject ENVIRONMENTAL ANALYTICAL CHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	Solve problems effectively..(CG4). Solve qualitative and quantitative problems following previously developed models..(CE14). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Competences in information management, in relation to primary and secondary sources, including information retrieval through on-line	Demonstrate ability to communicate

searches.	information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Ability to analyse materials and synthesize concepts.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2). Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration..(CB3).
Ethical commitment to the European Code of Conduct: http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf	Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.(CG10). Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a

	professional. (CG7). Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration. (CB3).

These learning outcomes must allow students, upon completion of the course CHEMICAL ANALYTICAL ENVIRONMENTAL, be able to:

To know the theory and skills needed to plan, implement and manage the most suitable analytical method for addressing problems of an industrial and environmental nature.

To understand and use bibliographical and technical information related to Analytical Chemistry. Take decisions with rigour.

To know the tools and principles of sustainable chemistry.

To understand the chemical parameters of environmental quality. To reason critically.

To demonstrate the ability to manage information.

To demonstrate a commitment to ethics and an understanding of the gender perspective. To develop experimental procedures for analysing industrial and environmental samples.

Regarding the Sustainable Development Goals (SDGs), it is expected that students will be able to know in this subject how to apply the knowledge learned to guarantee an inclusive, equitable, and quality education and promote learning opportunities for everyone (SDG 4), to acquire a special sensitivity for sustainable management of water (SDG 6), raw materials and energy sources (SDG 7), as well as for an environmentally friendly and sustainable development (SDGs 11 , 12, 13, 14 and 15), in addition to being able to design, select and/or develop efficient chemical products, processes and/or analytical methodologies (SDG 7) that minimize their impact on the environment (SDGs 14 and 15), using alternative raw materials and reducing wastes (SDG 11).

DESCRIPTION OF CONTENTS

1. Analytical Chemistry and environment.

Contamination. Environmental patterns Environmental analysis: Objectives. Types of analysis, problems in environmental analysis, global analytical procedure. Sampling and storage. Sample treatment Analysis methods. Analytical results

2. Environmental pollution.

Sources of contamination: Air pollution, water, soil and living beings. Classification of pollutants. Biogeochemical cycles. Bioaccumulation and biomagnification. Bioindicators of contamination and biomarkers.

3. Organic microcontaminants.

Introduction. Insecticides: organo-chlorinated, -phosphorus, carbamates. Herbicides: triazinics, phenoxy and others. Phenols Dioxins, PCBs and Furans. Polynuclear aromatic hydrocarbons (PAH's).

4. Inorganic contaminants. Metals

Introduction. Essential and toxic elements. Micronutrients: presence, sources, uses, levels, essentiality and toxicity. Trace elements: presence, sources, uses, levels, essentiality and toxicity.

5. The atmosphere.

Composition and characteristics of the atmosphere. Units of concentration. Types of atmospheric pollutants. Passive and active samplers. Determination of instantaneous concentrations and average concentrations.

6. Analysis of atmospheric gases.

Determination of CO, CO2, oxides of nitrogen, oxides of sulfur, ozone, ammonia, volatile organic compounds (hydrocarbons, CFC, ...).

7. Analysis of atmospheric aerosols.

Sources of contamination and sampling. Particle size (PM2.5, PM10). Determination of heavy metals. Determination of asbestos.

8. The hydrosphere.

Hydrological cycle and contamination. Types of waters. Quality parameters. Sample taking, storage and conservation.

9. Physical-chemical characterization I.

Organoleptic properties. Decantable and suspended material. Turbidity Redox potential. Electric conductivity. pH. Salinity. Hardness. Acidity. Alkalinity. Determination of major cationic (Na, K, Ca and Mg) and anionic compounds (Cl-, SO42-, NO3-, HCO3-)

10. Physical-chemical characterization II.

Determination of dissolved gases (Cl2, NH3, O2, Cl2). Determination of non-specific organic compounds: Total organic carbon (TOC), chemical oxygen demand (COD), biochemical oxygen demand (BOD), total oxygen demand (DOT).

11. Determination of specific compounds.

Non-toxic metals (Fe, Mn, Cu, Zn). Toxic metals (Cd, Cr, Pb, Hg, As). Organic compounds (Hydrocarbons, PAHs, pesticides, phenols, halomethanes, ...).

12. Analysis of solid samples.

Profile and classification of soils. Sources of contamination. Sample taking and preparation. Dissolution and extraction. Physical parameters. Nutrients Pollutants Analysis of plants. Analysis of animal tissues.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Tutorials	7,00	100
Development of individual work	19,00	0
Study and independent work	16,00	0
Preparation of evaluation activities	14,00	0
Preparing lectures	9,00	0
Preparation of practical classes and problem	9,50	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

In theory classes the teacher will teach the key concepts of each subject and solve problems type in those subjects that require it. Students will have the necessary material previously in the virtual classroom.

In the seminars students will solve exercises and questions representative of each topic.

In the tutorials a personalized follow-up of the work and the progress of each student will be carried out.

The exercises and questions proposed to be carried out in a non-contact manner will be reviewed and resolved doubts about the subject taught or the preparation of group or individual work.

Non-contact activities may include the resolution of problems and issues that require search of bibliographic information about issues / aspects / topics related to the subject..

EVALUATION

The evaluation of student learning will take into account all the aspects exposed in the methodology section of this teaching guide.

FIRST CALL

Final score:

Part 1 - Activities proposed in the seminars: 20%

(Active participation: 10%, critical reports 5%, solving case studies: 5%)

Part 2 - Activities proposed in the tutorials: 15%

(Issues and problems proposed will be evaluated)

Part 3 - Written exam: 65%

(Theoretical questions and numerical exercises similar to those made in class)

The final grade will be the weighted average of the three parts. To be able to average, the minimum qualification in each of these three parts must be equal to or greater than 4.5. The minimum global grade to pass the subject is 5.0.

NOTE: The student may request in writing to be evaluated only with an exam.

This examination will be composed, in this case, of three parts. One of them will be identical to the exam that the rest of the students will take, it will be carried out simultaneously and will contribute 65% to the overall mark. The other two parts will be composed of a series of questions with which the competences that the rest of the students will have demonstrated will be evaluated through the realization of the activities proposed in seminars and tutorials.

SECOND CALL

In the second call the qualification will be obtained applying the same criteria as in the first call.

Students who failed any of the three parts of the evaluation in the first call must complete an examination of the part (s) not passed.

REFERENCES

Basic

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- BAIRD C. y CANN M. Química Ambiental, segunda edición, Ed. Reverté, 2014, ISBN 978-84-291-7915-6

Additional

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- Guía técnica para la evaluacion y prevención de los riesgos relacionados con los agentes químicos presentes en los lugares de trabajo [Recurs electrònic] : Real Decreto 374/2001, de 6 de abril BOE nº104, de 1 de mayo 2001 / Gobierno de España Ministerio de empleo y seguridad social. Instituto Nacional de Seguridad e Higiene en el Trabajo. ISBN 9788474258103

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