COURSE DATA

Data Subject	
Code	36458
Name	Chemical Industrial Analysis
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

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

Subject-matter

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

Coordination

Name	Department
SIMO ALFONSO, ERNESTO	310 - Analytical Chemistry

SUMMARY

The subject Chemical Industrial Analysis has been structured in thirteen lessons that aim to give a joint vision of the descriptors of the subject: i) Analytical control of raw materials, ii) the productive process and iii) finished products.

The first three lessons of the subject are an introduction to the basic aspects of industrial analysis from the point of view of the analytical chemist, with special emphasis on sampling and preparation of samples and analysis methods based on the matrix and the concentration of the species of interest.

The following 9 lessons are focused on the main production sectors: i) Agri-food analysis I, ii) Agri-food analysis II, iii) Agri-food analysis III, iv) Pharmaceutical analysis, v) Analysis of plastics, vi) Analysis of paints and varnishes, vii) Analysis of aggregates, viii) Analysis of metals and alloys, ix) Energy sector. In each lesson, the most important samples and analytes of each sector and the analytical techniques used to control the quality of raw materials and finished products will be introduced. The last lesson focuses on green chemistry, where the student is expected to acquire a global awareness of the analytical processes, from the origin of raw materials, production process, manufactured product and final waste generated after the product's useful life .

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.

- Handle chemicals safely.
- 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.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- 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.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- 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 Chemical Industrial Analysis 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 Chemical Industrial Analysis 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 Chemical Industrial Analysis 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 Chemical Industrial Analysis that contemplate the learning outcomes EUROBACHELOR®

Ability to apply this knowledge and understanding to the solution of common qualitative and quantitative problems.	Solve qualitative and 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).
COMPETENCES AND COGNITIVE SKILLS RELATED TO THE PRACTICE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Chemical Industrial Analysis that contemplate the learning outcomes EUROBACHELOR®
Ability to interpret data derived from observations and laboratory measurements in terms of their relevance, and relate them to the appropriate theory.	Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24). Relate chemistry with other disciplines.(CE26).

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Chemical Industrial Analysis 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).
Calculation and arithmetic capabilities, including aspects such as analysis error, estimates of orders of magnitude, and correct use of the units.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2). Solve problems effectively..CG4).

Competences in information management, in relation to primary and secondary sources, including information retrieval through on-line searches.	Demonstrate ability to communicate 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).
Skills related to information technology such as word processing, spreadsheet, recording and storage of data, internet use related to the subjects.	Demonstrate ability to communicate 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).
Planning and time management skills.	Develop capacity for analysis, synthesis and critical thinking. (CG1). Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation..(CG3). Solve problems effectively..CG4).
Interpersonal skills to interact with other people and get involved in team work.	Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7). Demonstrate the ability to adapt to new situations..(CG9).
Study skills necessary for professional development. These will include the ability to work autonomously.	Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership,

	decision making and negotiation..(CG3). Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). Learn autonomously.(CG8). Demonstrate the ability to adapt to new situations..(CG9). Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.(CB5).
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 should ensure that on successful completion of “Chemical Industrial Analysis” students will be able to:

1 to know the necessary theoretical and practical aspects to plan, to apply and to manage the analytical methodology most adapted to tackle problems of industrial and environmental nature

2 to explain in an understandable way phenomena and processes related to the analysis of chemicals used in the industry

3 to understand and use the bibliographical and technical information referred to the analytical chemical processes.

4 to take decisions with rigor

5 to know the hardware and the principles of sustainable chemistry 6 to know the chemical parameters of environmental quality

7 to reason critically.

8 to demonstrate capacity of management of the information

9 to demonstrate ethical commitment and with perspective of genre

10 to develop experimental procedures for the analysis of industrial products and environmental samples

11 to develop skills on bioanalysis

12 to know the necessary theoretical and practical aspects to tackle the quality systems of a chemical company

13 to know the necessary hardware to realize an audit in a chemical company

14 to value the risks for the use of chemical substances and procedures in the chemical company

Regarding the Sustainable Development Goals (SDG's) in this course, students are expected to be able to apply the knowledge learned to help ensure inclusive, equitable and quality education and promote learning opportunities throughout life. for all (SDG4), to acquire a special sensitivity for the sustainable management of water (SDG 6), raw materials and energy sources (SDG 7) as well as for sustainable development compatible with the environment (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) and that minimize their impact on the environment (SDG 14 and 15), take advantage of alternative raw materials and generate less waste (SDG 11).

DESCRIPTION OF CONTENTS

1. .Introduction to industrial analysis

1.1. The analytical laboratory in the control of industrial processes. 1.2. Analytical problem and analytical process. 1.3. Analytical properties 1.4. Comparison and rejection of values. Control diagrams 1.5. Methods and standards of analysis applied to industrial analysis.

2. Sampling and sample preparation

2.1. Importance of sampling: Sampling plan. 2.2. Gaseous samples Liquid samples Solid samples 2.3. Sample treatments for the determination of inorganic substances: Dissolution, disintegration and dissolution assisted by microwaves. 2.4. Sample treatments for the determination of organic substances: liquid-liquid extraction, Soxhlet solid-liquid extraction, accelerated extraction with solvents, microwave assisted extraction, supercritical fluid extraction, solid phase extraction, solid phase microextraction.

3. Methods of analysis of majority, minority and trace components

3.1. General characteristics of analytical instrumentation: Classification of instrumental techniques. 3.2. Measurement of the observable signal: Linear calibration, Calibration using the standard addition method, Internal standard method. 3.3. Selection of the appropriate method.

4. Agri-food analysis I

4.1. General determinations: Content of water / dry matter, fat, proteins, carbohydrates, ashes, crude fiber.

5. Agri-food analysis II

5.1. Analysis of alcoholic beverages, juices and soft drinks. 5.2. Analysis of milk and derivatives. 5.3. Analysis of meat products.

6. Agri-food analysis III

6.1. Pesticides and phytosanitary products in agricultural and livestock products. 6.2. Heavy metals in fishing products.

7. Pharmaceutical analysis

7.1. Usual instrumental techniques. 6.2. Quality control of active ingredients.

8. Analysis of plastics

8.1. Classification of plastics. 8.2. Quality control of raw materials.

9. Analysis of paints and varnishes

9.1. Usual instrumental techniques. 9.2. Quality control of pigments and charges. 9.3. Quality control of solvents and adhesives.

10. Analysis of aggregates

10.1. Raw materials in quarries and mines. 10.2. Quality control of minerals and cements: Samples solid vs wet digestion.

11. Analysis of metals and alloys

11.1. Usual instrumental techniques. 11.2. Analysis of iron and ferrous alloys. 11.3. Analysis of non-ferrous alloys.

12. Energy sector

12.1. Quality control of raw materials: Oil, gas and coal. 12.2. Solar energy: purity of Si.

13. Green chemistry

13.1. Principles of green chemistry. 13.2. Online decontamination strategies. 13.3 Green evaluation of analytical procedures. 13.4. Control networks.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	51,00	100
Tutorials	9,00	100
Development of group work	25,00	0
Study and independent work	22,00	0
Preparation of evaluation activities	19,00	0
Preparation of practical classes and problem	24,00	0
TOTAL	**150,00**	

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.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

Basic

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- CHRISTIAN, G. D. Química Analítica, 6ª edición. Méjico: Ed. McGraw-Hill, 2009. ISBN 9789701072349
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Additional

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  - www.epa.gov Environmental Protection Agency
- 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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- PANREAC QUÍMICA SA, Colección Métodos Analíticos en Alimentaria: Aceites y grasas, Carne y productos cárnicos, Leche y productos lácteos, Productos derivados de la uva, aguardientes y sidras, Técnicas usuales de análisis en enología.

- BERNAL F. y otros técnicos del INSHT, Higiene Industrial, Madrid, 2006, 4a edició. ISBN 978-84-7425-757-1