VNIVERSITAT DE VALÈNCIA

Course Guide
34214 Industrial and environmental chemical analysis

COURSE DATA

Data Subject	
Code	34214
Name	Industrial and environmental chemical analysis
Cycle	Grade
ECTS Credits	6.0
Academic year	2017 - 2018

Study (s)

Degree	Center	Acad. year	Period
1108 - Degree in Chemistry	Faculty of Chemistry	4	First term

Subject-matter

Degree	Subject-matter	Character
1108 - Degree in Chemistry	14 - Applied analytical chemistry	Optional

Coordination

Name	Department
MORALES RUBIO, ANGEL ENRIQUE	310 - Analytical Chemistry

SUMMARY

Industrial Chemical Analysis and the Environment is divided into twelve lessons that provide an overview of the subject descriptors: i) Analytical control of raw materials, production process and finished products, ii) Analytical applications related to current industrial sectors, iii) environmental chemical analysis, iv) analytical applications in atmospheric samples, water, soil and biota, and v) analytical results in environmental impact assessment.

The first four lessons of the course are an introduction to the basics of industrial analysis and environmental contamination from the point of view of the analytical chemist, with particular emphasis on sampling and sample preparation and analysis methods based on matrix and the concentration of the species of interest.

Lessons 5–11 focus on core production sectors: i) agrofood analysis, ii) pharmaceutical analysis, iii) analysis of plastics, iv) analysis of paints and varnishes, v) analysis of aggregates, vi) analysis of electronic components, and vii) the energy sector. Each lesson presents the most important samples and analytes in each sector and the analytical techniques used for controlling the quality of raw materials and the finished products. Also considered are the most important environmental problems associated with each sector.

The final lesson focuses on Green Chemistry, which aims to provide students with a global awareness of the analytical processes, from the origin of the raw materials, the production process and the manufactured product to the final residue generated at the end of the product's 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 no enrolment restrictions with other subjects in the curriculum have been specified, to successfully complete the course, students need to know the fundamentals of courses in Analytical Chemistry and associated laboratories as well as general concepts such as: i) nomenclature and chemical formulation, ii) the adjustment of chemical reactions, iii) basic stoichiometric calculations, iv) mathematical algebra and statistics applied to chemical analysis.

OUTCOMES

1108 - 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.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.
- 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 learning outcomes for this course, which are contained in the Degree document under Applied Analytical Chemistry subject area, are:

1. 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. (CG6, CG8, CG10, CE4, CE8, CE15, CE22, CE24, CE25)

2. To clearly explain two phenomena and processes related to analyses of chemicals used in industry. (CG1, CG2, CE18, CT1)

3. To understand and use bibliographic and technical information relating to analytical chemical processes. (CG7, CT1, CT3)

4. To take decisions with rigour. (CG3, CG4)

5. To know the tools and principles of sustainable chemistry. (CG10, CE25)

6. To understand the chemical parameters of environmental quality. (CG10)

7. To reason critically. (CG1)

8. To demonstrate the ability to manage information. (CG7)

9. To demonstrate a commitment to ethics and an understanding of the gender perspective. (CG6)

10. To develop experimental procedures for analysing industrial and environmental samples. (CG5, CE7, CE18)

11. To develop bioassay techniques. (SC7, CE18, CE26)

12. To know the theoretical and practical aspects needed to deal with the quality systems of a chemical company. (CG10, CE10)

13. To know the tools needed to perform an audit in a chemical company. (CG10, CE10)

14. To assess the risks involved in the use of chemicals and chemical company procedures. (CE17, CE19, CE20, CE21)

DESCRIPTION OF CONTENTS

1. Introduction to industrial analysis

1.1. The analytical laboratory in the control of industrial processes. 1.2. Analytical problems and analytical processes. 1.3. Analytical properties. 1.4. Comparison and rejection of values. Control Charts. 1.5. Analysis methods and standards applied to industrial analysis.

2. Sampling and sample preparation

2.1. The importance of sampling: sampling plan. 2.2. Gaseous samples. Liquid samples. Solid samples. 2.3. Sample treatments for determining inorganic substances: dissolution, disintegration and microwave-assisted dissolution. 2.4. Sample treatments for determining organic substances: liquid-liquid extraction, Soxhlet solid-liquid extraction, accelerated solvent extraction, microwave-assisted extraction, supercritical fluid extraction, solid phase extraction, solid phase microextraction.

3. Methods of analysis of major, minor and trace components

3.1. General characteristics of analytical instrumentation: classification of instrumental techniques. 3.2. Observable signal measurement: linear calibration, calibration by the standard addition method, the internal standard method. 3.3. Choosing the right method.

4. Environmental pollution

4.1. Sources of pollution: the pollution of air, water, soil and living things. 4.2. Classification of contaminants. 4.3. Bioaccumulation and biomagnification. 4.4. Pollution bioindicators and biomarkers.

5. Agro-food analysis

5.1. General determinations: Content of water/dry matter, lipids, proteins, carbohydrates, ash, crude fibre. 5.2. Analysis of alcoholic beverages, juices and soft drinks. 5.3. Analysis of milk and dairy products. 5.4. Analysis of meat products. 5.5. Pesticides and plant protection in agricultural and livestock products. 5.6. Mercury in fish products.

6. Pharmaceutical analysis

Tècniques instrumentals habituals. 6.2. Control de qualitat de principis actius. 6.3. Petjada ambiental: Medicaments en sediments, aigües i fauna salvatge.

7. Analysis of plastics

7.1. Classification of plastics. 7.2. Quality control of raw materials. 7.3. Biodegradability.

8. Analysis of paints and varnishes

8.1. Common instrumental techniques. 8.2. Quality control of pigments and fillers. 8.3. Quality control of solvents and adhesives. 8.4. Solvents in environmental samples.

9. Analysis of aggregates

9.1. Raw materials in quarries and mines. 9.2. Quality control of ceramics and cement: solid samples vs. wet digestion. 9.3. Air quality: PM2.5, PM10. 9.4. Heavy metals in water, soil and sediments.

10. Analysis of electronic components

10.1. Common instrumental techniques. 10.2. Composition and quality control of electronic components. 10.3. Electronic waste.

11. The energy sector

11.1. Quality control of raw materials: oil, gas and coal. 11.2. Solar energy: silicon purity. 11.3. Combustion waste. 10.4. Hydraulic fracturing.

12. Green chemistry

12.1. Principles of green chemistry. 12.2. Monitoring of pollution. 12.3. Control networks.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	51,00	100
Tutorials	9,00	100
Development of group work	15,00	0
Development of individual work	10,00	0
Study and independent work	16,00	0
Readings supplementary material	6,00	0
Preparation of evaluation activities	8,00	0
Preparing lectures	16,00	0
Preparation of practical classes and problem	8,00	0
Resolution of case studies	11,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

In the lectures the instructor will teach the key concepts for each topic and solve any problems that arise. Students will have prior access to any required materials via the virtual classroom.

In the seminars students will complete exercises and answer questions on the various topics.

In the tutorials the students' work will be checked individually and the progress of each student will be monitored. The exercises and questions set for homework will be reviewed and any questions arising from the topics studied or the individual or group work completed will be answered.

Homework activities may involve solving problems or other issues by searching for bibliographic information on any course-related topic.

EVALUATION

Learning will be evaluated by taking into account all the aspects outlined in the methodology section of this teaching guide.

FIRST CALL

Final grade:

Activities proposed in the seminars	Activities proposed in the tutorials	Written examination
20% (Active participation: 10%; Critical reports: 5%; Solution of practical cases: 5%)	15% (The questions and problems proposed will be evaluated)	65% (Theoretical questions and numerical exercises similar to those completed in class)

The minimum score on each of these three parts must be at least 4.5 in order to apply the average.

The minimum overall grade to pass the course is 5.0.

Note:

Students may submit a request in writing to be evaluated only by examination. In this case, the examination will consist of three parts. One part will be identical to the examination taken by the other students. It will be held simultaneously and will count for 65% of the overall score. The other two parts will consist of a series of questions that will evaluate the skills demonstrated by the other students when completing the activities set during their seminars and tutorials.

SECOND CALL

In the second call the grade is obtained by applying the same criteria as in the first call.

Students who failed any of the three parts of the evaluation in the first call will have to take an examination on all the parts that they failed.

NOTE: This course is excluded from the regulations on advance calls for completing graduate studies (Degree Committee agreement of 26/03/2015).

REFERENCES

Basic

- Apuntes de la asignatura. Aula virtual.
- SOGORB, M. A. Y VILANOVA, E. Técnicas analíticas de contaminantes químicos: aplicaciones medioambientales y alimentarias. Madrid: Díaz de Santos, 2004. ISBN 8479786620
- HARRIS, D.C. Análisis químico cuantitativo, 3ª edición en español. Barcelona: Ed. Reverté, 2007. ISBN 9788429172249
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Additional

- CAMARA, C. Toma y tratamiento de muestras. Ed. Síntesis, Madrid 2002. ISBN: 978-8477389620
- www.epa.gov Environmental Protection Agency
- http://environmentalchemistry.com/
- 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 nº 104, 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
- 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
- TOWNSHED, A. Ed. (1995): Encyclopedia of Analytical Science, Academic Press. ISBN 0122267001
- DE LA GUARDIA M., GARRIGUES S. Eds., Handbook of Green Analytical Chemistry, Wiley, (2012). ISBN 9780470972014