VNIVERSITAT DE VALÈNCIA

Course Guide
34232 Analytical Chemistry Laboratory II

COURSE DATA

Data Subject	
Code	34232
Name	Analytical Chemistry Laboratory II
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	3	First term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	6 - Analytical Chemistry	Obligatory

Coordination

Name	Department
MAURI AUCEJO, ADELA DE LOS REYE	310 - Analytical Chemistry

SUMMARY

Analytical Chemistry Laboratory II is a core course taught in the third year (fall semester) of the Degree in Chemistry for a total of 6 ECTS credits.

This course familiarizes students with the most common analytical instrumental techniques (both the fundamentals of the technique and the optimization of the chemical and instrumental working conditions) and the treatment of the analytical signals produced by each technique. In their laboratory work students will acquire an awareness of the risks of using the instrumentation for each technique and the importance of respecting the safety rules in each case.

The course also introduces students to the field of application for these techniques and how the techniques are used to solve a wide range of problems.

Experiments are conducted using optical methods of analysis, electroanalytical methods, and separation methods.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

1108 - Degree in Chemistry V1-2009 :

1110 - Degree in Chemistry V2-2018 :

1929 - Programa de doble Grado Física-Química :

1934 - Programa de doble Grado Química-Ingeniería Química_2023 :

R5-OBLIGATION TO PURSUE THE COURSE SIMULTANEOUSLY

34230 - Analytical Chemistry III

34230 - Analytical Chemistry III

34230 - Analytical Chemistry III

34230 - Analytical Chemistry III

Other requirements

To successfully complete this course, students should have acquired experience of working with instrumental techniques and knowledge of the main instrumental analysis techniques. They must therefore have passed Analytical Chemistry II and be in the process of taking Analytical Chemistry III. This will enable them to relate the contents of the theoretical lectures with the practice sessions conducted in Analytical Chemistry Laboratory I.

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.
- Learn autonomously.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Interpret the variation of the characteristic properties of chemical elements according to the periodic table.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.
- Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
- 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.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Evaluate, interpret and synthesise chemical data and information.
- 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.
- Recognise and evaluate chemical processes in daily life.
- 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 previous section includes the competences contained in the document VERIFICA.This subject addresses part of the learning results of the matter 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 Lab of 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 Lab of Analytical Chemistry II 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)

COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Lab of Analytical Chemistry II that contemplate the learning outcomes EUROBACHELOR®
Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Competences for the evaluation, interpretation and synthesis of information and chemical data.	Evaluate, interpret and synthesise chemical data and information..(CE16). Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20).
Ability to recognize and implement science and the practice of measurement.	Show knowledge of the metrology of chemical processes including quality management..(CE10) Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20).

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 Lab of Analytical Chemistry II that contemplate the learning outcomes EUROBACHELOR®
Capabilities necessary to perform standard laboratory procedures as well as to use instrumentation in synthetic and analytical works, in both cases in relation to both organic and inorganic systems.	Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems..(CE18). Relate theory and experimentation..(CE22). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
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).

Ability to perform risk assessments of the use of chemical substances and laboratory procedures.	Understand the qualitative and quantitative aspects of chemical problems..(CE24). Develop sustainable and environmentally friendly methods.(CE25). Evaluate the risks in the use of chemicals and laboratory procedures..(CE21).
GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject Lab of Analytical Chemistry II 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).
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).

These learning outcomes should ensure that on successful completion of Analytical Chemistry Laboratory II students will be able to:

Use personal and collective protective equipment in the laboratory appropriately.

Keep a laboratory notebook that reflects the essential data for the work done.

Handle materials and basic analytical instrumentation and take analytical measurements.

Link the observations found using several applied instrumental techniques to the corresponding theoretical background.

Develop procedures for preparing working solutions (sample, standards and reagents) in accordance with sustainability parameters.

Apply various sample treatment procedures.

Use various calibration strategies.

Perform the calculations needed to transform analytical signals into concentrations, mass or percentages.

Explain the purpose or objectives and the fundamentals and experimental procedure for each practice session.

Justify, on the basis of the experiments conducted, the methodological differences involved in solving analytical problems based on the type or concentration of the analyte in the sample, the physical state of the sample matrix, the complexity, etc.

The learning outcomes achieved by the competences CG10 (Acquire a permanent sensitivity for quality and the environment, sustainable development and the prevention of occupational hazards.) and CE25: Develop sustainable and environmentally friendly methods, are related to the goals of sustainable development. Specifically the following:

SDG 6: Ensure availability and sustainable management of water and sanitation for all

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable

SDG 12: Ensure sustainable consumption and production patterns

SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

DESCRIPTION OF CONTENTS

1. Optical Methods of Analysis

This unit comprises numerous practice sessions in which several optical methods of analysis are used to determine analytes in samples of various compositions.
Many sessions also involve studying the effects of different chemical and instrumental variables. The scheduled practice sessions are:
1.1) The determination of binary samples by ultraviolet/visible absorption spectroscopy: use of derivative spectra and multiple linear regression.
1.2) The influence of instrumental variables on molecular fluorescence: the spectrofluorometric determination of quinine in tonic water.
1.3) Analysis of condensed milk.Polarimetric determination of sucrose.
1.4) Determination of calcium in milk by flame atomic absorption spectroscopy.
1.5) The determination of lithium in natural waters: how the variables influence the analytical signal.

2. Electroanalytical Methods

The practice sessions in this thematic unit use some of the most common electroanalytical techniques, e.g. potentiometric and electroplating techniques. One practice session uses voltammetric determination and therefore involves the study and visualization of current-potential curves. The scheduled practice sessions are:
2.1) The use of selective electrodes for the potentiometric determination of fluoride in toothpaste.
2.2) The electrogravimetric determination of copper in brass.
2.3) Analytical applications of voltammetric techniques.

3. Chromatographic Methods

The three practice sessions in this thematic unit involve differents techniques of separation,column liquid chromatography and gas chromatography. The scheduled practice sessions are:
3.1) Determination of caffeine by liquid chromatography.
3.2) Determination of phenols in urine samples by gas chromatography.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	48,00	100
Tutorials	12,00	100
Development of group work	15,00	0
Development of individual work	10,00	0
Study and independent work	28,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	10,00	0
Preparation of practical classes and problem	17,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The materials (scripts, guidelines, schedule, questions, etc.) will be made available to students via the virtual classroom before the beginning of the introductory session. Before work in the laboratory, each block of sessions will begin with a seminar to:

• Explain the general rules of Analytical Chemistry Laboratory II.

• Explain how the course will develop and discuss the various sections of this course guide.

Introduce skills students have not previously acquired but are necessary for the subject and, if appropriate, discuss any previous knowledge required.

• Provide the information and materials students will need to prepare the first practice session or first block of sessions.

The course is structured around the following axes:

(i) Preparation of the practice to be conducted.

The student must prepare a work outline in the laboratory notebook

It is intended to advise that the student understand the foundation of what she is going to do, and the reasons why experimental techniques are applied in a certain way and not in another.

The aim of this preparation is to ensure that, before entering the laboratory, students understand what they need to do and why.

(ii) Laboratory work.

The sessions are conducted in pairs. Sometimes, however, in order to encourage teamwork, several pairs may share their results. At this stage of the work the lecturer will encourage a positive attitude from students toward their scientific work.

Keeping a laboratory notebook during their practical sessions is an important part of the students' laboratory work (point iv). At no time should the notes in the laboratory notebook be re-written.

(iii) Treatment of the results.

The treatment of the results will begin in the laboratory. The lecturer will first guide the students in this task before the students complete the work by themselves. When presenting the results of the laboratory sessions, students must draw appropriate figures and tables to collect the data and use the correct units and significant figures. As the aim of this stage is to develop the students' analytical skills, they must not only calculate the results they obtain in the laboratory but also analyse them as well as their previous estimates.

(iv) Laboratory notebook and analytical reports.

Students must learn to carry a laboratory notebook in which he indicates the work he has done. The student will upload the scanned laboratory notebook daily to the virtual classroom assignment and submit the analytical reports within the time limit set by the teacher.

5.- Individually, once the laboratory sessions have ended, the student will have to propose an experimental procedure for a problem posed by the teacher. The procedure may include any equipment used during the practice sessions, and must consist of: sample treatment, selected analytical technique, experimental procedure and potential interferences.

EVALUATION

FIRST CALL

Students' grades will be calculated from the weighted average of different activities: preparation and execution of the experiments; results of analyses of the samples; laboratory notebook and analytical reports; and a written exam. Two parts will be considered:

1. Experimental work and results (70 %):

The following aspects will be evaluated in this part:

(a) Preparation of the practice before the laboratory session

(b) Laboratory work: there will be a continuous evaluation of the progress and work carried out by the students. The teacher will consider the student's abilities in laboratory work, interest and attitude. The

progress made in the proper implementation of experimental techniques will be specially assessed.

(c) Laboratory notebook

(d) Analysis of test samples: At each practice session students must analyse a sample of unknown composition and/or concentration. The quality of the results obtained is considered to reflect the quality of the experimental work carried out by the student. Moreover, the student will prepare an analytical report with all the experimental results obtained.

(e) Proposed analytical procedure. The suitability of the procedure proposed, the justification made by the student for the selection of the sample treatment, analytical technique and experimental protocol, and the discussion of potential interferences will be assessed.

2.- Exam (30%)

At the end of the course students will take a written exam.

The overall grade will be calculated as the weighted average of the two parts. To pass the subject it is necessary to obtain a minimum average grade of 5.0 and reach a minimum score of 4.5 points on a scale of 0 to 10 in each section.

Experimental work and results	Examinations
70%	30 %

Attendance at all seminars and laboratory sessions is compulsory and lost sessions cannot be recovered. The grade awarded for a session not recovered will be zero.

SECOND CALL

In the second call the final grade is obtained by applying the same weighting criteria as in the first call. There will be a written examination (worth 30%) and a practical examination in the laboratory (70%).

NOTE: This course is excluded from the regulations on advance calls for completing graduate studies

(Degree Committee agreement of 26/03/2015).

REFERENCES

Basic

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- SKOOG, D.A.; HOLLER, F. Y CROUCH, S.R. Principios de Análisis Instrumental (6ª edición). México: Cengage Learning Editores, 2008. ISBN 9789706868299
- PINGARRÓN CARRAZÓN, M. Y SANCHEZ BATANERO, P. Química electroanalítica: Fundamento y aplicaciones. Madrid: Síntesis, 1999 ISBN 8477386633
- VALCÁRCEL CASES, M. Y GÓMEZ HENS, M. Técnicas analíticas de separación, Barcelona: Reverté, 1988. ISBN 9788429179842
- CELA, R.; LORENZO R.A. Y CASAIS, M.C. Técnicas de separación en Química Analítica. Madrid: Síntesis, 2002. ISBN 8497560280
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