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	2020 - 2021

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 chromatographic ~~and electrophoretic~~ 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 - Double Degree in Physics and Chemistry :

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

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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.

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.
The analytical applications of infrared absorption spectroscopy.
1.2) The influence of instrumental variables on molecular fluorescence: the spectrofluorometric

determination of quinine in tonic water.
1.3) Analysis of condensed milk (part 1). Polarimetric determination of sucrose.
1.4) Analysis of condensed milk (part 2). Determination of calcium 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	15,00	0
Resolution of online questionnaires	2,00	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 and before the laboratory session will answer a questionnaire related to the preparation of the practice to be carried out

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. 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.

To do this, the student will solve a questionnaire for each of the blocks once the practices have been completed.

(iv) Laboratory notebook and analytical reports.

Students must learn to keep a laboratory notebook of the work they carry out. The lecturer will periodically review the notebook. This notebook must be presented by the student after each block of sessions and at the end of the course by the deadline set by the lecturer.

When recording details in their notebook, students must remember that all scientific work should be capable of being reproduced by others. All raw data must be recorded with precision and information on the work conducted and observations found must be specified.

EVALUATION

FIRST CALL

Students' grades will be calculated from the weighted average of the following four activities: preparation and experimental technique; results of analyses of the samples; laboratory notebooks and analytical reports; and written examinations.

1. Experimental work and results:

The following aspects will be evaluated:

(a) Preparation of the practice sessions.

(b) Laboratory work: the student's abilities, interest and attitude will be taken into account when continuously evaluating his or her progress and work during the practice sessions. In particular, the student's implementation of proper experimental techniques in all laboratory operations will be 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 is considered to reflect the quality of the student's experimental work.

2.- Examinations:

After each block of sessions students will take a written examination on the concepts and skills they have acquired in the block.

The overall grade is calculated as the weighted average of the four sections. The score for each section must be at least 4.5 in order to apply the average. The minimum total score to pass the course is 5.0.

Experimental work and results	Examinations
70%	**30 %**

Students who obtain less than the minimum score in any section must take a written examination (worth 30%) and a practical examination in the laboratory (70%) in order to pass the course.

Students who do not obtain the minimum score in one of these three sections must take a written examination (worth 30%), and/or a practical laboratory examination worth 70% of the total score in order to pass the course.

Attendance at all seminars and laboratory sessions is compulsory and lost sessions cannot be recovered. The marks awarded for any session not recovered in this way 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

- MAURÍ, A.; LLOBAT, M. Y HERRÁEZ, R. Laboratorio de Análisis Instrumental. Madrid: Servei de Publicacions de la UV y Reverté, 2010. ISBN 9788429173956
- 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
- Compromiso ético con el Código Europeo de conducta http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

1.- The contents initially indicated in the teaching guide are maintained.

Workload and temporary teaching planning

Regarding the workload:

1.- The different activities described in the Teaching Guide are maintained with the intended dedication.

Regarding the temporary teaching planning:

1.- The material to follow the classroom-seminar classes and laboratory allows to continue the temporary teaching planning both in days and schedule, whether the teaching is face-to-face in the classroom or not.

Teaching Methodology

Laboratory courses: With regard to laboratory courses, the maximum face-to-face teaching will be lying in compliance with the rules of distance and occupation of spaces fixed by the academic authorities. In this sense, the teaching type "L" will be 100% face-to-face, and the teaching type "U" will be non-face-to-face and will be taught through the tools offered by the virtual classroom.

The methodology used for non-face-to-face classes shall be:

1. Synchronously using virtual classroom tools (Teams, Blackboard ...)

2. Asynchronously using locut power-point presentations or other virtual classroom tools

3. Resolution of exercises and questionnaires

If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom.

Evaluation

1. The evaluation system described in the Teaching Guide of the subject in which the various evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as set out in this guide.

References

1.- The literature recommended in the Teaching Guide is maintained since it is accessible.