COURSE DATA

Data Subject	
Code	34778
Name	Instrumental techniques of chemical analysis
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	4	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	23 - Optional subjects	Optional

Coordination

Name	Department
TORRES LAPASIO, JOSE RAMON	310 - Analytical Chemistry

SUMMARY

The subject “Instrumental Techniques of Chemical Analysis” is an optional character subject that is taught in the fourth year of the Bachelor's degree in Chemical Engineering during the spring semester. The curriculum consists of a total of 6 ECTS.

This course aims to provide students with the information needed to successfully address analytical problems related to the professional practice of chemical engineering. In this sense, the program focuses on the study of instrumental analysis techniques commonly used in industry, both for process control, quality of raw materials and manufactured goods and for environmental control.

After an overview of the so-called "analytical process" which provides general working methodology in Analytical Chemistry, a set of instrumental analysis techniques are studied indicating for each principles, basic instrumentation and variables of interest to focus, finally , in its application to solving analytical problems of interest in industry .

The course involves performing labs in which students carry out a series of determinations that allow them to put into practice the knowledge acquired. In addition, work in the laboratory is also pursuing

students to gain an awareness of the risks of the instrumentation used in each technique and therefore the importance of respecting the safety rules stated in each case.

The contents of the subject are: Calibration and validation of methods, Molecular spectrometry, and Electrochemical and chromatographic methods.

The theory classes will be taught in Spanish and practical classes as stated in the course sheet available on the website of the degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Prior requirements or recommendations
In order to successfully address this course, students should have some previous knowledge of general chemistry already studied in Chemistry I and Chemistry II courses listed in the compulsory curriculum. Specifically, the concepts relating to the preparation and handling of solutions or calculation and expression of results, and the treatment of chemical equilibrium in various forms: acid-base, complexation, solubility and redox.

OUTCOMES

1401 - Degree in Chemical Engineering

- O1 - More comprehensive skills than those acquired in compulsory subjects.

LEARNING OUTCOMES

• Enter the basic criteria for choosing an instrumental analytical technique (O1).

• Explain the rationale for the different instrumental techniques studied (O1).

• Write and interpret the relationship between the analytical signal obtained in each of the techniques studied and the concentration of analyte (O1).

• Draw a diagram corresponding to the different analytical instrumentation techniques justifying the function of each of its components and their position on the instrumental design (O1).

• Describe the experimental methodology for conducting a determination by each of the techniques included in the program (O1).

• List the most common types of interference in the studied techniques and how to correct them (O1).

• Describe the different types of calibrated setting their differences and applicability (O1).

• Solve analytical problems based on the use of different types of calibration (O1).

• Perform the necessary calculations for solving analytical problems correctly expressing the result (O1).

• Apply statistical test data processing: rejection of anomalous results and comparison of results (O1).

• Quote representative examples of application of instrumental techniques studied and justify the proposed procedure in each case (O1).

• Use proper equipment for individual and collective protection in the laboratory (O1).

• Write analytical reports (O1).

• Proceed properly with the waste generated in the laboratory (O1).

• Justify the importance of the selection of waste and minimization of masses and volumes to reduce the environmental impact of the analytical methods (O1).

DESCRIPTION OF CONTENTS

1. Introduction to Analytical Chemistry

Objectives of Analytical Chemistry. Analytical Terminology. The analytical process: Steps thereof. Classification of instrumental methods of analysis.

2. Evaluation of results, calibration and validation of methods

Precision. Accuracy. Statistics for comparison of results. Calibration. Analytical characteristics of an analytical method. Validation.

3. Molecular Spectrometry (I)

Introduction. UV-Vis spectrophotometry absorption: Basis and instrumentation, analytical utility and applications.

4. Molecular Spectrometry (II)

Introduction. Fluorimetry: Basis and instrumentation, analytical utility, applications.

5. Polarimetry

Introduction. Polarimetry: Basis and instrumentation, analytical utility, applications.

6. Atomic spectroscopy

Introduction. Atomic spectroscopy with flame atomization. Atomic spectroscopy with electrothermal atomization. Other sources of atomization.

7. Electrochemical methods: Potenciometry

Introduction: Electrochemical cells' and redox potential. Potentiometry: Reference electrodes. Working electrodes. Ion selective electrodes. Analytical applications Nernst equation.

8. Amperometry and voltammetry

Current-potential curves. Amperometry. Voltammetry techniques. Stripping voltammetry. Analytical applications.

9. Chromatographic methods

Basis of chromatography: Various types. Column chromatography. Basic instrumentation. Chromatographic parameters. Bandwidth: Van-Deemter equation.

10. Gas chromatography

Introduction. Basic instrumentation. Experimental methodology. Analytical usefulness. Gas chromatography-mass spectrometry.

11. Liquid chromatography

Introduction: High-resolution liquid chromatography. Basic components of a HPLC. Partition chromatography: normal phase and reverse phase. Experimental methodology. Analytical usefulness and application areas.

12. Laboratory

Working methodology in Instrumental Analysis. Application of different instrumental techniques to determining substances of industrial or environmental interest.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Classroom practices	20,00	100
Laboratory practices	15,00	100
Development of group work	15,00	0
Study and independent work	25,00	0
Readings supplementary material	10,00	0
Preparation of evaluation activities	25,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The course is structured around theory sessions, lab sessions and a series of seminars where students present papers, previously established by the teacher and carried out in small groups.

In the theory sessions an overview of each topic will be featured. Teacher will insist in the key concepts and fostered student engagement by posing questions. In addition, the teacher will explain how problems-type address both its approach and its numerical solution in order to consolidate the concepts developed in theory (O1).

Seminars complement the lectures and in them, the role will go to students, working in groups, they will face problems and issues related to the concepts developed in the lectures (O1).

In the lab, students will work in pairs and before the experimental sessions, have the information necessary for the preparation of the experiences. Once completed the experience, students must prepare and submit an analytical report which shall contain experimental data, results and conclusions. Attendance at laboratory practice sessions is compulsory (O1).

EVALUATION

The evaluation was carried out considering the different activities both face no face. Specifically:

First call

-Tasks presented at the seminars by the various working groups are valued at 15% of the final mark. This is non-recoverable activity. (O1)

-The mark obtained in the laboratory practices constitutes 25% of the final mark (minimum to pass the subject 5.0) (O1).

-A final exam that will mean 50% of the final grade (minimum grade 4.0) (O1).

- Finally, with the remaining 10% attendance and participation in class will be assessed. This is non-recoverable activity. (O1)

To pass the course, the final grade must be greater than 5.0.

Alternatively, students may benefit from an evaluation system in which the weight of the marks obtained in the examination is 65% (minimum grade 5.0), remaining 25% for laboratory practice (minimum grade 5.0). The remaining 10% may be obtained by submitting a job (preferably literature search) proposed by the teacher (minimum grade 5.0) (O1). Also in this case, to pass the course, the final grade must be greater than 5.0.

Students must indicate, within a period of one month after the start of school evaluation system that they wish to. By default, the rating system applied will be which involves continuous assessment.

Second Call

Students who have not passed the minimum score indicated for the test or the labs should be submitted to the relevant examinations. With regard to laboratory practice an examination of questions relating to the practices carried out will be performed. In addition, students who have not attended at least 80 % of the hours of this activity must take a practical test (O1).

Moreover, in the case of not pass the subject in this second call, the grade obtained in the practices may be considered as a possible enrollment the following year.

Finally, the advanced call only possible if the labs have been overcome the previous year. The final grade will be obtained according to the criteria for alternative assessment (not continuous).

In any case, the assessment system will be governed by that established in the Reglament de Avaluació i Qualificació de la Universitat de València per a títols de Grau i Màster (http://links.uv.es/7S40pjF).

REFERENCES

Basic

- Análisis químico cuantitativo 3ªedición (6ª edición original), D.C.Harris, Editorial Reverté (2007)
- Química Analítica 6ª edición, G.C.Christian, McGraw-Hill, México (2009)
- Principios de Análisis Instrumental (6ª edición), D.A.Skoog, F.Holler, S.R.Crouch, Cengage Learning Editores, México (2008)

Additional

- Principios de Análisis Instrumental (6ª edición), D.A.Skoog, F.Holler, S.R.Crouch, Cengage Learning Editores, México (2008)
- Técnicas de separación en Química Analítica, R.Cela, R.A.Lorenzo y M.C.Casais, Síntesis, Madrid (2002)
- Técnicas analíticas de separación, M.Valcárcel Cases y M.Gómez Hens, Reverté, Barcelona (1988)
- Laboratorio de Análisis Instrumental, A.Maurí, M.Llobat y R.Herraez. Servei de Publicacions de la UV y editorial Reverté (2010)

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

The contents initially established in the Course Guide are maintained.

Workload and planning of teaching

Workload:

The activities described in the Course Guide with their time dedication are maintained.

Planning of teaching:

The material for the follow-up of the classes allows to continue with the teaching time planning both in days and in time, whether the teaching is face-to-face in the classroom or not.

Teaching methodology

If it is required by the sanitary situation, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaption to each subject, establishing the specific conditions in which it will be developed, taking into account the actual enrolment data and the space availability.

Evaluation

The evaluation system described in the Course Guide in which the 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 sanitary reasons that affect the development of any face-to-face evaluable activity, it will be replaced by a test/activity 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 course will remain unchanged, as established in this guide.

References

The recommended manuals in the Course Guide are maintained and are available in electronic version. In addition, it will be complemented with notes, slides and problems uploaded to the Virtual Classroom.