UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: INSTRUMENTAL ANALYSIS I
Code: 57312
Type: CORE COURSE
ECTS credits: 6
Degree: 409 - CHEMISTRY
Academic year: 2023-24
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
Group(s): 20 23
Year: 2
Duration: C2
Main language: Spanish
Second language:
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **LUISA FERNANDA GARCIA BERMEJO** - Group(s): **23**

Building/Office	Department	Phone number	Email	Office hours
San Alberto Magno/planta baja	Q. ANALÍTICA Y TGIA. ALIMENTOS	3447	luisafernanda.garcia@uclm.es	M, T and W 10-12 h

Lecturer: **JOSE MARIA LEMUS GALLEGO** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
FACULTAD DE QUIMICAS	Q. ANALÍTICA Y TGIA. ALIMENTOS		josemaria.lemus@uclm.es	M, T and W 10-12 h

Lecturer: **JOSE ANTONIO MURILLO PULGARIN** - Group(s): **20 23**

Building/Office	Department	Phone number	Email	Office hours
Edificio San Alberto Magno	Q. ANALÍTICA Y TGIA. ALIMENTOS	3441	joseantonio.murillo@uclm.es	M,T and W 12-14 H

2. Pre-Requisites

There are no prerequisites set, but it is recommended:

1.-Have completed the subjects of "Fundamentals of Analytical Chemistry" and "Volumetric and Gravimetric Analysis" of the first semester of the 2nd year of the Degree in Chemistry.

2.- Know fundamental aspects of Statistics and the foundation of the linear least squares regression methodology.

3. Justification in the curriculum, relation to other subjects and to the profession

The Instrumental Analysis course is part of the INSTRUMENTAL ANALYSIS subject, of 18 ECTS credits, compulsory in the Degree in Chemistry. It is taught in the second semester of the second year, while the others

two subjects belonging to this subject, Instrumental Analysis II and Instrumental Separation Methods, are impacted in the 1st and 2nd semester of the third year of the Degree, respectively.

The student has already taken the subjects of Fundamentals of Analytical Chemistry and, Volumetric and Gravimetric Analysis, also in the second year, in which the foundations of Analytical Chemistry and Analytical Process are laid, providing

the basic competences and knowledge necessary to face this subject with guarantees of success.

In the second year, subjects in Physical Chemistry are also studied, reinforcing, among others, the concepts of spectroscopy and quantum chemistry, which are so necessary in instrumental analysis.

In the study plan, this subject, together with the other two of the same subject, Instrumental Analysis II and Instrumental Separation Methods, find their continuity with the fourth year Advanced Analytical Chemistry elective.

In this subject the foundation, instrumentation and applications of the main spectroscopic and non-spectroscopic optical methods are studied. It is the first contact that the student has with the instrumental analysis techniques,

pursuing the student to study the different analytical methodologies, with their own and common characteristics. It is intended that the student develop the necessary skills to be able to solve character problems

analytical, that graduates may consider in their professional career.

4. Degree competences achieved in this course

Course competences

Code	Description
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.

CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
E05	Know the chemical elements and their compounds, their forms of obtaining, structure, properties and reactivity, as well as the main techniques for their analysis
E06	Know the structural properties of chemical compounds, including stereochemistry, as well as the main structural research techniques
E14	Know and know how to apply the metrology of chemical processes, including quality management
E15	Know how to handle the standard chemical instrumentation and be able to elaborate and manage standardized procedures of work in the laboratory and chemical industry
E16	Plan, design and develop projects and experiments
E17	Develop the ability to relate to each other the different specialties of Chemistry, as well as this one with other disciplines (interdisciplinary character)
G02	Be able to gather and interpret data, information and relevant results, obtain conclusions and issue reasoned reports on scientific, technological or other problems that require the use of chemical tools
G03	Know how to apply the theoretical-practical knowledge acquired in the different professional contexts of Chemistry
G04	Know how to communicate, orally and in writing, the knowledge, procedures and results of chemistry, both specialized and non-specialized
G05	Acquire and adapt new knowledge and techniques of any scientific-technical discipline with incidence in the chemical field
T04	Ethical commitment and professional ethics
T05	Organization and planning capacity
T06	Ability to approach decision making
T09	Motivation for quality, job security and awareness of environmental issues, with knowledge of internationally recognized systems for the correct management of these aspects
T10	Ability to use specific software for chemistry at user level
T11	Ability to obtain bibliographic information, including Internet resources

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Train the student to be sensitive to the ethical exercise of the profession, becoming aware of the social responsibility of their reports and their impact on decision making

Understand the advantages, disadvantages, limitations and applications of the main instrumental methods of analysis

Acquire skills for practical laboratory work, being able to develop experimentally analytical processes that include the planning of sampling, its treatment and analysis using different instrumental methods, emphasizing its use to solve real analytical problems

Acquire skills for planning, writing and validating work protocols in the laboratory

Acquire critical judgment in the selection of the most appropriate analytical methodology according to the usual standards

Know the essential components of the current analytical instrumentation and its function within the configuration of the instrument

Know the basics of the main instrumental analytical techniques and their most relevant applications currently in laboratories

Train the student to tackle an analytical problem, search and select the most relevant bibliography, synthesize it by extracting its most important parts, and expose and explain it in public

Additional outcomes

Understand the processes of interaction of electromagnetic radiation with matter, classify optical methods and describe the differencies between molecular and atomic spectrometry.

6. Units / Contents

Unit 1: Introduction to instrumental methods.

Unit 2: Introduction to spectroscopic and non-spectroscopic optical methods.

Unit 3: Components of the spectroscopic instruments.

Unit 4: Ultraviolet-visible molecular absortion spectroscopy.

Unit 5: Molecular luminiscence spectroscopy.

Unit 6: Atomic spectroscopy.

ADDITIONAL COMMENTS, REMARKS

Unit 1. Introduction to instrumental methods. Overview. Classification. Selection of the analysis method. Calibration. Quality parameters. Instrumental signal and noise.
Unit 2. Introduction to spectroscopic and non-spectroscopic optical methods. Properties of electromagnetic radiation. Photoelectric effect. Radiation absorption and emission processes. Classification of optical methods spectroscopic and non-spectroscopic.
Unit 3. Components of the spectroscopic instruments. Basic elements of the instrumentation used. Sources. Wavelength selectors. Containers for samples. Detectors.
Unit 4. Ultraviolet-visible molecular absorption spectroscopy. Introduction. Terms used in molecular absorption. Absorbent species in the UV-Visible region. Lambert-Beer law. Instrumentation. Applications to analysis qualitative, quantitative and mixtures. Photometric and spectrophotometric evaluations.qualitative, quantitative and mixtures.
Unit 5. Molecular luminescence spectroscopy. Introduction. Basic concepts. Absorption, excitation and emission. Excitation and emission spectra. Fluorescence. Variables that affect fluorescence. Applications. Phosphorescence and Chemiluminescence.
Unit 6. Atomic spectroscopy. Fundamentals. Atomization methods. Atomic absorption techniques. Atomic emission techniques. Instrumentation.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-	Lectures	E05 E06 E14 E17 G02 G03	1.08	27	N	-	The fundamental aspects of the syllabus will be exposed, interacting with the students through questions

SITE]		G04 G05 T11					that favor the monitoring of the contents covered.
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	E05 E06 E14 E15 E16 G02 G03 G04 G05 T05 T09 T10	0.64	16	Y	Y	Requisito imprescindible para aprobar la asignatura
Workshops or seminars [ON-SITE]	Problem solving and exercises	E05 E06 E14 E15 E16 E17 G02 G03 G04 G05 T04 T05 T06 T10 T11	0.4	10	Y	N	Seminar of problems and practical cases
Group tutoring sessions [ON-SITE]	Group tutoring sessions	E05 E14 E17 G03 G04	0.08	2	N	-	Discussion and resolution of concepts and doubts
Practicum and practical activities report writing or preparation [OFF-SITE]	Self-study	E05 E06 E14 E16 E17 G02 G03 G04 G05 T04 T05 T06 T10 T11	1	25	Y	Y	Study prior to practical sessions and preparation of reports
Study and Exam Preparation [OFF-SITE]	Self-study	E05 E06 E14 E16 E17 G02 G03 G04 G05 T04 T05 T06 T10 T11	0.96	24	N	-	Documentation, preparation, learning and resolution of practical cases; study and test preparation.
Mid-term test [ON-SITE]	Assessment tests	E05 G03 G04 T04 T05	0.08	2	Y	N	A written evaluation test on topics 1-4. This will consist of solving a test, theoretical practical questions and graphical-numerical problems.
Final test [ON-SITE]	Assessment tests	E05 G03 G04 T04 T05	0.12	3	Y	Y	Final evaluation written test. This will consist of solving a test, theoretical practical questions and graphical-numerical problems.
Writing of reports or projects [OFF-SITE]	Self-study	CB03 CB05 E14 G03 T04 T05 T06 T11	1.64	41	Y	N	Resolution of practical cases
		Total:	**6**	**150**			
Total credits of in-class work: 2.4							**Total class time hours: 60**
Total credits of out of class work: 3.6							**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Assessment of active participation	15.00%	0.00%	Questions in class, participation in problem seminars, reports required by the teacher,
Mid-term tests	35.00%	0.00%	THERE IS A PARTIAL TEST THAT CONSISTS OF THREE PARTS: - TEST (3 INCORRECT QUESTIONS SUBTRACT ONE CORRECT) - SOME SHORT THEORETICAL-PRACTICAL QUESTIONS - GRAPHIC-NUMERICAL PROBLEMS corresponding to topics 1-4. Out of 10, a grade of at least 4 must be obtained in order not to be examined for its contents in the final test.
Final test	35.00%	85.00%	IT IS COMPOSED OF THREE PARTS: - TEST (3 INCORRECT QUESTIONS SUBTRACT ONE CORRECT) - SOME SHORT THEORETICAL-PRACTICAL QUESTIONS - GRAPHIC-NUMERICAL PROBLEMS corresponding to topics 4 and 5. Those students who have not obtained a grade higher than 4.0 in the partial test, described above, or who want to improve their grade in said part, will carry out a test of the entire subject with a weight in the evaluation of 70%. It is necessary to obtain a minimum grade of 4 to be able to calculate it with the rest of the activities.
Laboratory sessions	15.00%	15.00%	Attendance at practices is mandatory. You are not allowed to miss or be late to any lab session. In addition to the above, in order to pass the subject, the student Must demonstrate behavior appropriate to the work carried out in the laboratory. In any of the exams carried out, reference questions and specific of the practices carried out and it will be necessary to present a report of the same
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

Class attendance is recommended, although it is not required.

A. The final written exam will be scored between 0 and 10 points and its weight in the final evaluation will be 70%. If a student has passed the mid-term test

with a exam score greater than 4, only the contents not included in the mid-term test will be examinated.
B. The practices are obligatory and these will be evaluated according to: attendance and punctuality, attitude and use in the laboratory and interest, quantitative results and presentation of the memory of practices. The qualification between 0 and 10 has a weight in the final evaluation of 15%.
C. Questions in class, participation in problem seminars, etc ... Their weight in the final evaluation will be 15%. The final grade for the ordinary call will therefore be: Grade = 0.7 * A + 0.15 * B + 0.15 * C
In order to apply the assessment percentages indicated in the assessment system, it is necessary to obtain at least a 4 in the final test and in the laboratory practices. If the above requirements are not met, the final score will be suspended and the numerical value will be the one obtained in the final test or in case of passing this but not the laboratory practices, the numerical value of 4.
Finally, it is necessary to obtein a final score of 5.0 in the sum 0.7 * A + 0.15 * B + 0.15 * C to approve the subjet.

Non-continuous evaluation:

Final test (85%) and Practices (15%). In order to apply the indicated percentages, it is necessary to obtain a score higher than 4 out of 10 both in the written exam and in the laboratory practicals.

Specifications for the resit/retake exam:

There will be a single written exam of the entire subject (85%). Laboratory practices 15%, either in the realization of them or in the test enabled to pass them. In order to apply the indicated percentages, it is necessary to obtain a score higher than 4 out of 10 both in the written exam and in the laboratory practicals.

Specifications for the second resit / retake exam:

There will be a written exam that will be graded with the same criteria of the extraordinary call.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
Hours	**hours**
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	16
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	25
Study and Exam Preparation [AUTÓNOMA][Self-study]	24
Mid-term test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	3
Writing of reports or projects [AUTÓNOMA][Self-study]	41
Unit 1 (de 6): Introduction to instrumental methods.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 2 (de 6): Introduction to spectroscopic and non-spectroscopic optical methods.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	2
Unit 3 (de 6): Components of the spectroscopic instruments.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Unit 4 (de 6): Ultraviolet-visible molecular absortion spectroscopy.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	3
Unit 5 (de 6): Molecular luminiscence spectroscopy.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	2
Unit 6 (de 6): Atomic spectroscopy.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	3
Global activity	
Activities	**hours**
Mid-term test [PRESENCIAL][Assessment tests]	2
Class Attendance (theory) [PRESENCIAL][Lectures]	27
Workshops or seminars [PRESENCIAL][Problem solving and exercises]	10
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	25
Writing of reports or projects [AUTÓNOMA][Self-study]	41
Study and Exam Preparation [AUTÓNOMA][Self-study]	24
Final test [PRESENCIAL][Assessment tests]	3
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	16
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Rubinson, Kenneth A.	Análisis instrumental	Prentice Hall		84-205-2988-5	2004	
Skoog, Douglas A	Fundamentos de química analítica	Reverté		84-291-7554-7 (v.2)	2003	
D.A. Skoog, F.J. Holler, T.A. Nieman	Principios de análisis instrumental	Mc Graw Hill		84-481-2775-7	2003	

Schwedt, Georg	The essential guide to analytical chemistry	John Willey & Sons	0471899542	1999
Hernández Hernández, Lucas	Introducción al análisis instrumental	Ariel	84-344-8043-3	2002