

**1. General information****Course:** INSTRUMENTAL ANALYSIS II**Type:** CORE COURSE**Degree:** 409 - CHEMISTRY**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY**Year:** 3**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 57316**ECTS credits:** 6**Academic year:** 2023-24**Group(s):** 20 23**Duration:** First semester**Second language:** English**English Friendly:** Y**Bilingual:** N

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**2. Pre-Requisites**

There are not previous requirement established. Nevertheless it is strongly recommended the following:

- 1.- To have coursed the following subjects: Fundamentos de Química Analítica and Análisis Volumétrico y Gravimétrico of 2nd course.
- 2.- To know fundamentals of Chemometrics, analytical calibration including.
- 3.- To have coursed Análisis Instrumental I of 2nd course.

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

Análisis Instrumental II is a part of the 18 ECTS credits grouped subject ANÁLISIS INSTRUMENTAL. The latter is mandatory in the Chemistry career and Analysis Instrumental II has 6 ECTS credits and belongs to the third course. The other two subjects belonging to Analysis Instrumental are Analysis Instrumental I that is studied in the second course and Métodos Instrumentales de Separación that is studied in the third course.

When Analysis Instrumental II is studied, the student has already coursed the subjects of Fundamentos de Química Analítica, Análisis Volumétrico y Gravimétrico and Analysis Instrumental I, where the fundamentals of Analytical Chemistry, the Analytical Process and Instrumental Analysis have been cementado which provides basic competencias and knowledge in order to para afrontar la presente asignatura con garantías de éxito.

In second course, there are also other subjects such as Química Física, than enforce the concepts of spectroscopy, and quantic chemistry which are most needed in Analysis Instrumental.

Analysis Instrumental II meets its continuity with the third subject of Analysis Instrumental: Métodos Instrumentales de Separación. Besides, , en un enfoque aplicado y real de la vida cotidiana con la asignatura optativa de Química Analítica Aplicada.

In Análisis Instrumental II it is studied after the introduction, the fundamentals, instrumentation and applications of the main electroanalytical techniques. The most important techniques considered are the potentiometric and amperometric ones, as well as the voltamperometric. Conductimetry titrations is also studied. Besides, an introduction to mass spectrometry and other instrumental analytical techniques, such as flow injection analysis, are studied too.

**4. Degree competences achieved in this course****Course competences**

Not established.

## 5. Objectives or Learning Outcomes

### Course learning outcomes

Not established.

## 6. Units / Contents

**Unit 1: Introduction to Electroanalytical Chemistry**

**Unit 2: Electrodes. Direct Potentiometry**

**Unit 3: Potentiometric and Amperometric Titrations**

**Unit 4: Voltammetry.Polarography**

**Unit 5: Modified electrodes**

**Unit 6: Mass spectrometry**

**Unit 7: Others instrumental analytical techniques**

**Unit 8: Laboratory sessions**

### ADDITIONAL COMMENTS, REMARKS

Theme 1. Introduction to Electroanalytical Chemistry. Electroanalytical cells. Influence of intensity on potentials. Intensity-Potential curves. Electroanalytical methods classification.

Theme 2. Electrodes. Direct Potentiometry. Introduction. Reference electrodes. Metal indicator electrodes .Membrane electrodes. Direct Potentiometry. Selective electrodes.

Theme 3. Potentiometric and Amperometric electrodes. Potentiometric titration types (null intensity, constant intensity) and analytical applications. Amperometric titration types and applications.

Theme 4. Voltammetry. Polarography. Fundamentals. Mercury drop electrode. Polarography features. Classic polarography, Tast polatrography, Normal and differential impulse polarography. Analytical applications. Other voltamperometric techniques.

Theme 5. Modified electrodes. Introduction. Chemically modified electrode preparation. Analytical applications.

Tema 6. Mass spectrometry. Introduction. Fundamentals. Mass spectrometer componets. Coupled and direct sample entry systems. Ionization types. Detectos. Analytical applications.

Theme 7. Other instrumental analytical techniques.

Theme 8. Laboratory sessions.

## 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-SITE]	Lectures	E05 E06 E15 E16 E17 T10 T11	1.08	27	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	E05 E14 G02 G03 T10	0.2	5	N	-	
Other on-site activities [ON-SITE]	Group Work	E16 E17 G02 G03 G04 T10 T11	0.2	5	N	-	
Progress test [ON-SITE]	Assessment tests	G02 G03 G04 T05	0.08	2	Y	N	
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	E14 E15 E16 G02 G03 T05	0.64	16	Y	Y	
Practicum and practical activities report writing or preparation [OFF-SITE]	Guided or supervised work	E05 E14 E16 E17 G02 G03 G04 T10 T11	1	25	N	-	
Study and Exam Preparation [OFF-SITE]	Combination of methods	E17 G02 G03 T05 T06 T10 T11	0.96	24	N	-	
Group tutoring sessions [ON-SITE]	Case Studies	E05 E06 E16 E17 G02 G03 G04 T05 T06	0.08	2	N	-	
Final test [ON-SITE]	Assessment tests	G02 G03 G04 T05	0.12	3	Y	N	
Writing of reports or projects [OFF-SITE]	Guided or supervised work	E05 E14 E16 E17 G02 G03 G04 T10 T11	1.64	41	N	-	
<b>Total:</b>			<b>6</b>	<b>150</b>			
<b>Total credits of in-class work: 2.4</b>			<b>Total class time hours: 60</b>				
<b>Total credits of out of class work: 3.6</b>			<b>Total hours of out of class work: 90</b>				

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

	Continuous	Non-	
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Evaluation System	assessment	continuous evaluation*	Description
Mid-term tests	85.00%	0.00%	<p>THE EXAM IS A TEST IN WHICH EACH QUESTION HAS FOUR POSSIBLE ANSWERS AND ONLY ONE IS CORRECT. WRONG ANSWERED QUESTIONS DEDUCT (3 WRONG QUESTIONS EQUAL ONE CORRECT). THERE IS ONLY ONE CORRECT ANSWER.</p> <p>The test is divided in three parts. The first one evaluates the laboratory. It has questions in the proportion 9 out of 60. The second part evaluates the theoretical aspects. It has questions in a proportion 34 out of 60. The final part evaluates the problems. It has questions in a proportion 17 out of 60.</p> <p>If the progress exam is passed, it will not be necessary to do the final ordinary exam.</p>
Laboratory sessions	15.00%	15.00%	<p>The laboratory sessions are of compulsory attendance. It is not allowed to come late to the laboratory. Besides, the student behaviour should be adequate to the laboratory work. The student has also to set out the results of the laboratory practice once it is finished.</p> <p>A laboratory exam will be done together with the progress exam. This will consist of test questions.</p>
Final test	0.00%	85.00%	<p>THE EXAM IS A TEST IN WHICH EACH QUESTION HAS FOUR POSSIBLE ANSWERS AND ONLY ONE IS CORRECT. WRONG ANSWERED QUESTIONS DEDUCT (3 WRONG QUESTIONS EQUAL ONE CORRECT). THERE IS ONLY ONE CORRECT ANSWER.</p> <p>The test is divided in three parts. The first one evaluates the laboratory. It has questions in the proportion 9 out of 60. The second part evaluates the theoretical aspects. It has questions in a proportion 34 out of 60. The final part evaluates the problems. It has questions in a proportion 17 out of 60.</p> <p>If the progress exam is passed, it will not be necessary to do the final ordinary exam.</p>
<b>Total:</b>	<b>100.00%</b>	<b>100.00%</b>	

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:

This final ordinary exam will be done by the students that have not passed the progress exam.

The evaluation criteria will be the same as those for the progress exam.

##### Non-continuous evaluation:

This final ordinary exam will be done by the students that have not passed the progress exam.

The evaluation criteria will be the same as those for the progress exam.

#### Specifications for the resit/retake exam:

This extraordinary evaluation will consist of a written exam.

The evaluation criteria will be the same as those for the final ordinary exam

#### Specifications for the second resit / retake exam:

This second extraordinary evaluation will consist of a written exam.

The evaluation criteria will be the same as those for the final ordinary exam

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Other on-site activities [PRESENCIAL][Group Work]	5
Progress test [PRESENCIAL][Assessment tests]	2
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	70
Group tutoring sessions [PRESENCIAL][Case Studies]	2
Final test [PRESENCIAL][Assessment tests]	3
Unit 1 (de 8): Introduction to Electroanalytical Chemistry	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	10
Unit 2 (de 8): Electrodes. Direct Potentiometry	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3

Unit 3 (de 8): Potentiometric and Amperometric Titrations	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Unit 4 (de 8): Voltammetry.Polarography	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 5 (de 8): Modified electrodes	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 6 (de 8): Mass spectrometry	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 7 (de 8): Others instrumental analytical techniques	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 8 (de 8): Laboratory sessions	
Activities	Hours
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	16
Practicum and practical activities report writing or preparation [AUTÓNOMA][Guided or supervised work]	20
Global activity	
Activities	hours
Progress test [PRESENCIAL][Assessment tests]	2
Practicum and practical activities report writing or preparation [AUTÓNOMA][Guided or supervised work]	20
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	70
Group tutoring sessions [PRESENCIAL][Case Studies]	2
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	16
Class Attendance (theory) [PRESENCIAL][Lectures]	27
Final test [PRESENCIAL][Assessment tests]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Other on-site activities [PRESENCIAL][Group Work]	5
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Pablo Fernández López	Moodle UCLM					
Schwedt, Georg	The essential guide to analytical chemistry	John Wiley and Sons		0471899542	1999	
Hernández Hernandez Lucas	Introducción al Análisis Instrumental	Ariel		84-344-8043-3	2002	
Gary A. Mabbott	Electroanalytical Chemistry	Wiley		978-1-119-53858-5	2020	
Douglas A. Skoog, F. James Holler, Stanley R. Crouch	PRINCIPLES OF INSTRUMENTAL ANALYSIS, 7th Edition	Cengage Learning-USA		978-1-30-57721-3	2017	
Skoog Douglas A.	Fundamentos de Química Analítica	Reverté		84-291-7554-7 (v.1)	2003	
Rubinson Kenneth A.	Análisis Instrumental	Prentice Hall		84-205-2988-5	2004	