

**1. General information**

**Course:** GRAVIMETRIC AND TITRIMETRIC ANALYSIS  
**Type:** CORE COURSE  
**Degree:** 409 - CHEMISTRY  
**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY  
**Year:** 2

**Main language:** Spanish  
**Use of additional languages:**  
**Web site:**

**Code:** 57311  
**ECTS credits:** 6  
**Academic year:** 2022-23  
**Group(s):** 20 23  
**Duration:** First quarter  
**Second language:**  
**English Friendly:** Y  
**Bilingual:** N

Lecturer: <b>AURELIA ALAÑÓN MOLINA</b> - Group(s): <b>20 23</b>				
Building/Office	Department	Phone number	Email	Office hours
San Alberto Magno/planta baja	Q. ANALÍTICA Y TGIA. ALIMENTOS	6702	aurelia.alanon@uclm.es	Lunes martes miércoles 10 a 12
Lecturer: <b>CARMEN GUIBERTEAU CABANILLAS</b> - Group(s): <b>20 23</b>				
Building/Office	Department	Phone number	Email	Office hours
San Alberto Magno/planta baja	Q. ANALÍTICA Y TGIA. ALIMENTOS	3442	carmen.guiberteau@uclm.es	Lunes martes miércoles 10 a 12
Lecturer: <b>JOSE ANTONIO MURILLO PULGARIN</b> - Group(s): <b>20 23</b>				
Building/Office	Department	Phone number	Email	Office hours
Edificio San Alberto Magno	Q. ANALÍTICA Y TGIA. ALIMENTOS	3441	joseantonio.murillo@uclm.es	Lunes martes miércoles 10 a 12

**2. Pre-Requisites**

No prerequisites have been established, although it is very recommended to have passed the first-year Chemistry course.

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

Gravimetric and Volumetric Analysis is a subject that belongs to module 2 (Fundamentals of Chemistry). Gravimetric and Volumetric Analysis and Fundamental of Analytical Chemistry constitute Analytical Chemical Matter which has 12 credits. Both of them are taught in the first semester of the second year.

It is a compulsory subject of 6 ECTS (4.5 theoretical credits and 1.5 practical credits). Furthermore, the knowledge acquired in this subject is necessary to learn subjects from other areas of knowledge, due to its multidisciplinary character

**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.
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
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
G01	Know the principles and theories of Chemistry, as well as the methodologies and applications characteristic of analytical chemistry, physical chemistry, inorganic chemistry and organic chemistry, understanding the physical and mathematical bases that require
G03	Know how to apply the theoretical-practical knowledge acquired in the different professional contexts of Chemistry
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
T11	Ability to obtain bibliographic information, including Internet resources

**5. Objectives or Learning Outcomes****Course learning outcomes**

## Description

Train the student for autonomous work and learning, as well as for personal initiative.

Train the student to search for information, its analysis, interpretation and use for analytical purposes

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

Train the student to solve analytical problems based on the use of volumetric and gravimetric analysis techniques, planning laboratory work protocols.

Know the stages that make up the analytical process

Acquire skills for practical laboratory work, being able to experimentally develop analytical processes that include sample planning, treatment and analysis using volumetric and gravimetric techniques.

Know the principles of Analytical Chemistry.

Know the basis of volumetric and gravimetric techniques and the main analytical methods based on these techniques.

## 6. Units / Contents

**Unit 1: INTRODUCTION. Classical techniques: Gravimetry and Titrimetry. Classification of volumetric methods. Primary standards**

**Unit 2: ACID- BASE TITRATIONS. Acid-base Indicators. Types of indicators. Titration curves: Titration of monoprotic and polyprotic protolytes. Analytical applications.**

**Unit 3: COMPLEXATION TITRATIONS. Complexation reactions. Titration curves. Complexometric EDTA Titrations. Metallochromic indicators. Types of complexation titration. Applications.**

**Unit 4: REDOX TITRATIONS. Titration Curves. Redox indicators. Pre-treatment in redox titrations. Titrations with permanganate. Titrations with dichromate. Titrations involving iodine.**

**Unit 5: PRECIPITATION TITRATIONS: Introduction. Titration Curves. Titration involving Ag(I).**

**Unit 6: GRAVIMETRIC ANALYSIS**

## 7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CB02 CB03 CB05 E05 E14 G01 G03	1.12	28	N		The fundamental concepts of the matter will be explained. Student participation will be encouraged through questions or issues. The necessary teaching material will be provided on the Campus Virtual
Workshops or seminars [ON-SITE]	Workshops and Seminars	CB02 CB03 CB05 E14 G03 T05 T06	0.4	10	N		Previously, the teacher will deliver problem relationships for each topic so that the student can solve it autonomously. In these seminars problems will be solved and doubts that have arisen will be clarified.
Group tutoring sessions [ON-SITE]	Group tutoring sessions	CB02 CB03 CB05 E05 E14 G01 G03	0.08	2	N		They will be dedicated to solving problems and doubts prior to the evaluation tests.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	CB02 CB03 CB05 E14 E15 G03 T05 T09	0.64	16	Y	Y	Laboratory sessions, based on analytical methodologies explained in theory.
Practicum and practical activities report writing or preparation [OFF-SITE]	Self-study	CB02 CB03 CB05 E14 G03 T05 T06 T11	0.6	15	Y	Y	Previous study and elaboration of reports related to the practical activities
Writing of reports or projects [OFF-SITE]	Individual presentation of projects and reports	CB02 CB03 CB05 E05 E14 G03 T05 T06 T11	0.6	15	Y	N	The student must submit problems previously assigned by the teacher
Study and Exam Preparation [OFF-SITE]	Combination of methods	CB02 CB03 CB05 E14 G03 T05 T06 T11	1.2	30	N		The student will study the theoretical concepts presented in the master classes, will work on the problems proposed in the seminars.
Other off-site activity [OFF-SITE]	Problem solving and exercises	CB02 CB03 E14 G03 T05 T06 T11	1.2	30	N		The student will autonomously solve the problems that the teacher will deliver in advance. The student will autonomously solve the problems that the teacher will deliver in advance. Doubts will be resolved in the seminar
Mid-term test [ON-SITE]	Assessment tests	CB02 CB03 CB05 E05 E14 G01 G03 T05	0.08	2	Y	N	A written assessment test that will consist of solving theoretical, theoretical-practical questions and numerical / analytical problems from lessons 1 to 3 If the grade obtained in this test is higher than 6, you only have to examine from lessons 4 to 6 in the final test.
Final test [ON-SITE]	Assessment tests	CB02 CB03 CB05 E05 E14 G01 G03 T05	0.08	2	Y	N	A written assessment final test that will consist of solving theoretical, theoretical-practical questions and numerical / analytical problems.
<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			
Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Laboratory sessions	15.00%	15.00%	The evaluation will take into account the work done during the laboratory practices sessions and the reports presented from each practice It is necessary to obtain a grade of 5 out of 10 to pass the course. If this is not achieved, a specific test will have to be carried out in the ordinary and / or extraordinary exam. The laboratory sessions are of compulsory attendance
Mid-term tests	40.00%	0.00%	A written assessment test that will consist of solving theoretical, theoretical-practical questions and numerical / analytical problems from lessons 1 to 3
Final test	40.00%	85.00%	A written assessment test that will consist of solving theoretical, theoretical-practical questions and numerical / analytical problems from lessons 4 to 6 . A final test will only be done by students who have not passed the mid-term test or who want to improve their grade The final test will consist of solving theoretical, theoretical-practical questions and numerical / analytical problems for the entire subject. In this case the assessment of this exam will be 80% It is necessary to obtain a minimum grade of 5, to be able to compute it with the rest of the activities.
Assessment of problem solving and/or case studies	5.00%	0.00%	The student will be asked to deliver solved exercises, solve different issues related to the subject, solve practical cases
<b>Total:</b>		<b>100.00%</b>	<b>100.00%</b>

According to art. 6 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. 13.2) 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:

To pass the course it is necessary:

- 1.- Obtain a grade equal to or greater than 4 in the final test or in the average of the progress tests (the progress test grades must be greater than 4)
- 2.- Obtain a grade of 4 out of 10 in the laboratory practices (mandatory).
- 3.- obtain a minimum grade of 5 once the evaluation percentages of each activity (theoretical part, problems-cases and laboratory practices) have been applied.

The applied assessment percentages will be 80% for the final test Or progress tests , 15% for laboratory practices and 5% for problem solving

##### Non-continuous evaluation:

To pass the course it is necessary:

- 1.- Obtain a grade equal to or greater than 4 in the final test
- 2.- Obtain a grade of 4 out of 10 in the laboratory practices (mandatory).
- 3.- obtain a minimum grade of 5 once the evaluation percentages of each activity ( 85% for the final test and 15% for laboratory practices.).

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

The final mark of this examen will be obtained by taking a final exam (85%) and the grade obtained from the laboratory practices (15%) will be taken into account. It is necessary to obtain at least a rating of 4 out of 10 in both items.

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

Same as in the retake examen

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	16
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	15
Writing of reports or projects [AUTÓNOMA][Individual presentation of projects and reports]	15
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	30
Mid-term test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	2
<b>Unit 1 (de 6): INTRODUCTION. Classical techniques: Gravimetry and Titrimetry. Classification of volumetric methods. Primary standards</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	2
<b>Unit 2 (de 6): ACID- BASE TITRATIONS. Acid-base Indicators. Types of indicators. Titration curves: Titration of monoprotic and polyprotic protolytes. Analytical applications.</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	3
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	8
<b>Unit 3 (de 6): COMPLEXATION TITRATIONS. Complexation reactions. Titration curves. Complexometric EDTA Titrations. Metallochromic indicators.</b>	

<b>Types of complexation titration. Applications.</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	2
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	8
<b>Unit 4 (de 6): REDOX TITRATIONS. Titration Curves. Redox indicators. Pre-treatment in redox titrations. Titrations with permanganate. Titrations with dichromate. Titrations involving iodine.</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	3
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	8
<b>Unit 5 (de 6): PRECIPITATION TITRATIONS: Introduction. Titration Curves. Titration involving Ag(I).</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	1
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	3
<b>Unit 6 (de 6): GRAVIMETRIC ANALYSIS</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	1
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	3
<b>Global activity</b>	
<b>Activities</b>	<b>hours</b>
Mid-term test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	2
Class Attendance (theory) [PRESENCIAL][Lectures]	28
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	10
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	2
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	16
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	15
Writing of reports or projects [AUTÓNOMA][Individual presentation of projects and reports]	15
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	30
Other off-site activity [AUTÓNOMA][Problem solving and exercises]	30
<b>Total horas: 150</b>	

<b>10. Bibliography and Sources</b>						
<b>Author(s)</b>	<b>Title/Link</b>	<b>Publishing house</b>	<b>Citv</b>	<b>ISBN</b>	<b>Year</b>	<b>Description</b>
D. Skoog, D. West y F. Holler	Fundamentos de Química Analítica	Reverté			1996	
M. Silva y J. Barbosa	Equilibrios Iónicos y sus Aplicaciones Analíticas	Síntesis	Madrid		2002	
P. Hadjiidannou, G. Christian, C. Efstathion, D. Nikolelis	Problem Solving in Analytical Chemistry	Pergamon Press	London		1988	
P. Yáñez-Sedeño, J. M. Pingarrón, F. J. Manuel de Villena	Problemas resueltos de Química Analítica	Síntesis			2003	
D.C.Harris	Análisis Químico Cuantitativo	Reverte		ISBN 13: 97884291722	2003	
G.D CHristian, P.K.DasGupta and K.A. Schug	Analytical Chemistry	Wiley		978-0471214724	2014	
D.C.Harris	Quantitative Chemical Analysis	McMillan		9781319154141	2015	