

**1. General information****Course:** APPLIED ANALYTICAL CHEMISTRY**Type:** ELECTIVE**Degree:** 409 - CHEMISTRY**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY**Year:** 4**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 57331**ECTS credits:** 6**Academic year:** 2022-23**Group(s):** 20**Duration:** C2**Second language:** English**English Friendly:** Y**Bilingual:** N**Lecturer:** JOSE MARIA LEMUS GALLEGO - Group(s): 20

Building/Office	Department	Phone number	Email	Office hours
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Lecturer: JOSE ANTONIO MURILLO PULGARIN - Group(s): 20

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2. Pre-Requisites

Have approved Basic Training Module

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

The subject of Applied Analytical Chemistry I has optional character in the Degree in Chemistry. The student has already taken the subjects of Fundamentals of Analytical Chemistry and, Volumetric and Gravimetric Analysis and Instrumental Analysis I in the second year in which the foundations of the Analytical Chemistry and the Analytical Process, providing the basic skills and knowledge necessary to face the present subject with guarantees of success. In the third year they study the subjects of Instrumental Analysis II and Instrumental Methods of Separation, compulsory subjects of the third year. This subject studies the application of the main analytical methods supported by the knowledge acquired in the compulsory subjects previously mentioned. It is intended that students develop the necessary skills to be able to solve problems of an analytical nature, that the graduate can be raised in their career

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

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
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.
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
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
T11	Ability to obtain bibliographic information, including Internet resources

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

Ability to perform a correct evaluation, interpretation and synthesis of the data and chemical information received

Train the student to solve analytical problems based on the use of usual analytical techniques in the control laboratories

Know the main trends of applied analytical chemistry

Know the principles on quality management in analytical laboratories and the standards on which they are based.

Ability to learn to work autonomously in a laboratory and ability to interpret the experimental results obtained.

6. Units / Contents

Unit 1: UNIT 1.- Introduction. Definitions of Analytical Chemistry and Chemical Analysis. Analytical methodology. Stages of the general analytical process. Analytical methods: classification. Importance of chemical analysis.

Unit 2: UNIT 2.- Sampling. Basic requirements of sampling. Sampling plan. Conservation and transport of samples. Errors in sampling. Storage of the sample. Preparation of the sample for analysis. Manual of sampling and registration in the laboratory.

Unit 3: UNIT 3.- Automatic methods and process analyzers Automatic analysis methods. Classifications Continuous and discontinuous automatic analyzers. Process analyzers Components Photometric, electrochemical and process chromatograph analyzers.

Unit 4: UNIT 4. Principles of laboratory management. Standardization. Sections of a norm of analysis. Reference materials: Requirements, preparation, employment and types. Quality control: Basic principles. Quality and traceability Quality assurance plan.

Unit 5: UNIT 5.- Introduction to the Environment. Contamination. Atmospheric pollution. The environment and its components. Pollution processes. Air pollutants Sample taking of air and vapors. Analysis of inorganic compounds. Analysis of organic compounds. Determination of particulate material in air.

Unit 6: UNIT 6.- Water pollution. Taking and treatment of samples. Physical-chemical and organoleptic characteristics of water. Undesirable and toxic components. Determination of metallic components. Determination of non-metallic inorganic compounds. Determination of organic compounds.

Unit 7: UNIT 7.- Soil pollution. Properties of soils and sediments. Interaction of pollutants. Determination of the general characteristics of the soils. Determination of heavy metals. Determination of organic compounds.

Unit 8: UNIT 8.- Limestone and siliceous materials. Stony, refractory materials, glasses. Ceramic materials. Minerals Analysis of silicon materials. Analysis of a limestone. Analysis of cements.

Unit 9: UNIT 9.- Metallic Materials. Ferrous materials: Steels. Analysis of iron minerals. Analysis of steels. Non-ferrous materials: Brass, bronze and other alloys. Analysis of Bronzes and Brass.

Unit 10: UNIT 10.- Coals and derivatives. Classification of Coals and their derivatives. Majority and minority components. Sulfur content. Content in trace elements.

Unit 11: UNIT 11.- Petroleum products. Physical and chemical characteristics Specifications for the different fractions. Some determinations in petroleum products: Ashes, traces of water, index of acidity and sulfur.

Unit 12: UNIT 12.- Food analysis. Methods and methodologies in Food Science. Basic analysis, acidity of the food and mineral analysis. Analysis in milk and derivatives. Analysis in oils and fats. Analysis in alcoholic drinks. Analysis of additives.

Unit 13: UNIT 13.- Pharmaceutical, clinical and toxicological analysis. Identification, characterization and purification of active ingredients. Analytical techniques of separation of active products and their metabolites. Clinical analysis. Toxicological analysis

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CB01 CB02 E05 E14 G01 G03	0.92	23	N	-	
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	CB01 CB02 E15 G03 T09	0.64	16	Y	N	
Workshops or seminars [ON-SITE]	Guided or supervised work	CB01 CB02 E14 G03 T04 T05 T06	0.4	10	N	-	
Group tutoring sessions [ON-SITE]	Group Work	CB01 CB02 E05 E14 G01 G03	0.08	2	N	-	
Study and Exam Preparation [OFF-SITE]	Self-study	CB01 CB02 E05 E14 E15 G01 G03 T06	0.84	21	N	-	
Other off-site activity [OFF-SITE]	Project/Problem Based Learning (PBL)	CB01 CB02 E14 G03 T04 T05 T06 T11	3	75	N	-	
Final test [ON-SITE]	Assessment tests	CB01 CB02 G03 T04 T05 T06 T11	0.12	3	Y	N	
Total:			6	150			
Total credits of in-class work: 2.16			Total class time hours: 54				
Total credits of out of class work: 3.84			Total hours of out of class work: 96				

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%	30.00%	-
Theoretical exam	60.00%	70.00%	-
Projects	25.00%	0.00%	-
Total:	100.00%	100.00%	

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:

Final numerical rating from 0 to 10 depending on the current legislation.

Continuous evaluation through the acquisition of theoretical knowledge (40%), practical knowledge (laboratory) (25%) and solving practical cases in the classroom (35%)

Non-continuous evaluation:

Evaluation criteria not defined

Specifications for the resit/retake exam:

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
Workshops or seminars [PRESENCIAL][Guided or supervised work]	10
Group tutoring sessions [PRESENCIAL][Group Work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	21
Other off-site activity [AUTÓNOMA][Project/Problem Based Learning (PBL)]	75
Final test [PRESENCIAL][Assessment tests]	3
Unit 1 (de 13): UNIT 1.- Introduction. Definitions of Analytical Chemistry and Chemical Analysis. Analytical methodology. Stages of the general analytical process. Analytical methods: classification. Importance of chemical analysis.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 2 (de 13): UNIT 2.- Sampling. Basic requirements of sampling. Sampling plan. Conservation and transport of samples. Errors in sampling. Storage of the sample. Preparation of the sample for analysis. Manual of sampling and registration in the laboratory.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Unit 3 (de 13): UNIT 3.- Automatic methods and process analyzers Automatic analysis methods. Classifications Continuous and discontinuous automatic analyzers. Process analyzers Components Photometric, electrochemical and process chromatograph analyzers.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Unit 4 (de 13): UNIT 4. Principles of laboratory management. Standardization. Sections of a norm of analysis. Reference materials: Requirements, preparation, employment and types. Quality control: Basic principles. Quality and traceability Quality assurance plan.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Unit 5 (de 13): UNIT 5.- Introduction to the Environment. Contamination. Atmospheric pollution. The environment and its components. Pollution processes. Air pollutants Sample taking of air and vapors. Analysis of inorganic compounds. Analysis of organic compounds. Determination of particulate material in air.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Unit 6 (de 13): UNIT 6.- Water pollution. Taking and treatment of samples. Physical-chemical and organoleptic characteristics of water. Undesirable and toxic components. Determination of metallic components. Determination of non-metallic inorganic compounds. Determination of organic compounds.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Unit 7 (de 13): UNIT 7.- Soil pollution. Properties of soils and sediments. Interaction of pollutants. Determination of the general characteristics of the soils. Determination of heavy metals. Determination of organic compounds.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1.5
Unit 8 (de 13): UNIT 8.- Limestone and siliceous materials. Stony, refractory materials, glasses. Ceramic materials. Minerals Analysis of silicon materials. Analysis of a limestone. Analysis of cements.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 9 (de 13): UNIT 9.- Metallic Materials. Ferrous materials: Steels. Analysis of iron minerals. Analysis of steels. Non-ferrous materials: Brass, bronze and other alloys. Analysis of Bronzes and Brass.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 10 (de 13): UNIT 10.- Coals and derivatives. Classification of Coals and their derivatives. Majority and minority components. Sulfur content. Content in trace elements.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 11 (de 13): UNIT 11.- Petroleum products. Physical and chemical characteristics Specifications for the different fractions. Some determinations in petroleum products: Ashes, traces of water, index of acidity and sulfur.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	1
Unit 12 (de 13): UNIT 12.- Food analysis. Methods and methodologies in Food Science. Basic analysis, acidity of the food and mineral analysis. Analysis in milk and derivatives. Analysis in oils and fats. Analysis in alcoholic drinks. Analysis of additives.	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Unit 13 (de 13): UNIT 13.- Pharmaceutical, clinical and toxicological analysis. Identification, characterization and purification of active ingredients. Analytical techniques of separation of active products and their metabolites. Clinical analysis. Toxicological analysis	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	23
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	16
Workshops or seminars [PRESENCIAL][Guided or supervised work]	10
Group tutoring sessions [PRESENCIAL][Group Work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	21

Other off-site activity [AUTÓNOMA][Project/Problem Based Learning (PBL)]

75

Final test [PRESENCIAL][Assessment tests]

3

Total horas: 150**10. Bibliography and Sources**

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Baird C.	Química Ambiental	Reverté				
APHA (American Public Health Association), AWWA (American Water Works Association), WPCF (Water Pollution Control Federation)	Métodos normalizados para el análisis de aguas potables y residuales	Ed. Diaz de Santos			1994	
Boubel R.W., Fox D.L., Turner D.B. y Stern A.C.	Fundamentals of air pollution	Ed. Academic Press.			1994	
C.Camara	Toma y tratamiento de muestras	Sintesis			2002	
Developments in food analysis techniques	R.D. King.	Applied Science Publishers.	London		1978	
H.D. Belitz y W. Grosch.	Food Chemistry	Ed. Spriger-Verlag	Heidelberg		1987	
M. Repetto.	Toxicología avanzada	Ed. Diaz de Santos	Madrid		1995	
Miroslav Radojevic and Vladimir N. Bashkin	.Practical Environmental Analysis	Ed. Royal Society of chemistry			1999	
Pérez-Bendito D. y Rubio S.	Environmental Analytical Chemistry	Elsevier			1999	
Rodier, J.	Análisis de aguas	Omega			1989	
	Página web de Jose Maria Lemus Gallego http://www.uclm.es/profesorado/jmlemus/				2013	Archivos de la asignatura