UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: CHEMICAL ANALYSIS I
Code: 14309
Type: BASIC
ECTS credits: 6
Degree: 376 - UNDERGRADUATE DEGREE PROGRAMME IN PHARMACY
Academic year: 2022-23
Center: 14 - FACULTY OF PHARMACY
Group(s): 10
Year: 1
Duration: C2
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **FERNANDO DE ANDRES SEGURA** - Group(s): **10**

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Lecturer: **VIRGINIA RODRIGUEZ ROBLEDO** - Group(s): **10**

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Lecturer: **MOHAMMED ZOUGAGH ZARIOUH** - Group(s): **10**

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2. Pre-Requisites

Although no previous requirements are stablished, it is highly recommended, to ensure a certain guarantee of success, that the student has previously studied General Chemistry and Lab Introduction, and to possess basic knowledge on Physics and Mathematics as well.

To this extent, it is also recommended for the students to have studied Physics and Chemistry at the college.

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

JUSTIFICATION IN THE CURRICULUM:

The Pharmacist, as a health professional at the degree level, and according to the 2005/36/CE Guideline by the European Parliament and the European Council, from the 7th of September of 2005, is competent for performing the activities related to the production, preservation, and distribution of medicines, as well as to collaborate in the analytical, pharmacotherapeutic, and public health surveillance processes (article 6.2b). To develop these activities is necessary to have a wide knowledge, among others, of the contents and to acquire the competences related to the subject of Chemical Analysis I.

As described in the study programme for the degree of Pharmacy, the contents of the subject Chemical Analysis I, within the framework of the Chemistry Module, are mainly based on the study of the analytical process and its stages within the Pharmaceutical field: sampling and sample preparation, validation of analytical methods, and the teaching of the required knowledge to know the classical analytical quantitative methods, as well as an introduction to the analytical separations, even though this issue will be more intensively analyzed in the following courses, more specifically, in the subject of Chemical Analysis II.

RELATION TO OTHER SUBJECTS:

Chemical Analysis I is a subject taken in the second semester of the first course, and serves as essential basis for the subsequent subject Chemical Analysis II, which is taken at the second course of the degree.

Furthermore, to become the pharmacist a competent professional, capable of assuming all the challenges existent in a continuously growing field, which constantly demands of new experts, it will be essential to give the students a multidisciplinary education, which has permitted in the past to many pharmacists to give extraordinary contributions in many different fields of knowledge (i.e. botany, chemistry, biochemistry, bromatology, edaphology, parasitology, microbiology, etc.). It is, therefore, clearly exposed the multidisciplinary relation and links among the different basic subjects described at the Degree of Pharmacy.

RELATION TO THE PROFESSION:

As a consequence of this multidisciplinary formation in the scientific, technical and health science fields, the student who obtained the degree in Pharmacy will be capable to perform the profession in pharmacist's, at the pharmaceutical companies, in hospital and non-hospital specialized positions, in health analytical laboratories, in the field of health management, and in education or research works.

The subject of Chemical Analysis gives the professional a solid basis of knowledge in analytical chemistry, classical and instrumental analysis, in the validation of analytical methods at the pharmaceutical field, as well as in the chemical analysis using separation techniques coupled with different detection techniques (e.g. mass spectrometry) which allow to identify and determine many different compounds of pharmaceutical interest.

4. Degree competences achieved in this course

Course competences

Code	Description
B01	Proficiency in a second foreign language at level B1 of the Common European Framework of Reference for Languages.
B02	Knowledge of Information and Communication Technologies (ICT).

B03	A correct oral and written communication
B04	Ethical commitment and professional deontology.
B05	Ability to develop those learning skills necessary to undertake further studies.
EQ01	Identify, design, prepare, analyse and produce active principles, drugs and other materials and products of sanitary interest.
EQ02	Adequately choose the techniques and methodologies for the evaluation, design and application of chemical reagents, laboratory methodologies and analytical techniques.
EQ03	Complete standard laboratory processes including the employment of scientific equipment related to synthesis and analysis.
EQ04	Evaluate risks/hazards associated to the use of chemical substances and lab processes.
EQ06	Know and understand the characteristics of chemical reactions in solution, the different states of matter and the principles of thermodynamics and their application to pharmaceutical sciences.
EQ09	Know origin, nature, design, production, analysis and drugs quality control and sanitary products.
EQ10	Know principles and procedures for the analytical determination of compounds: analytical techniques applied to water, food and environment analysis.
EQ11	Know and apply the main structural determination techniques, including spectroscopy.
G01	Identify, design, obtain, analyze, control and produce drugs and medicines, as well as other products and raw materials of sanitary interest for human or veterinary use.
G02	Evaluate the therapeutic and toxic effects of substances with pharmacological activity.
G03	Know how to apply the scientific method and acquire skills in the handling of legislation, sources of information, bibliography, elaboration of protocols and other aspects considered necessary for the design and critical evaluation of preclinical and clinical trials.
G04	Design, prepare, supply and dispense medicines and other products of health interest.
G05	Provide therapeutic advice in pharmacotherapy and dietotherapy, as well as in the nutritional and food field in the establishments where they provide services.
G06	Promote the rational use of medicines and medical devices, as well as to acquire basic knowledge in clinical management, health economics and the efficient use of health resources.
G07	Identify, evaluate and assess problems related to drugs and medicines, as well as participate in pharmacovigilance activities.
G08	Conducting clinical and social pharmacy activities, following the pharmaceutical care cycle.
G09	Intervene in health promotion and disease prevention activities at the individual, family and community levels, with an integral and multi-professional vision of the health-disease process.
G10	Design, apply and evaluate clinical reagents, methods and analytical techniques, knowing the basic principles of clinical analysis and the characteristics and contents of laboratory diagnostic reports.
G11	Evaluate the toxicological effects of substances and design and apply appropriate tests and trials.
G12	Develop hygienic-sanitary analyses, especially those related to food and environment.
G13	Develop communication and information skills, both oral and written, to deal with patients and users of the centre where they carry out their professional activity. Promote the capacity to work and collaborate with multidisciplinary teams and those related to other health professionals.
G14	Know the ethical and deontological principles according to the legislative, regulatory and administrative provisions governing professional practice, understanding the ethical implications of health in a changing social context.
G15	Recognise own limitations and the need to maintain and update professional competence, with particular emphasis on self-learning of new knowledge based on scientific evidence.
T01	Critical thinking skills based on the application of the scientific method
T02	Ability to manage quality scientific information, bibliography, specialized databases and resources accessible through the Internet.
T03	Handling of basic and specific software for the treatment of information and experimental results.
T04	Motivation for quality, safety at work and awareness of environmental issues, with knowledge of the internationally recognised systems for the correct management of these aspects.
T05	Organizational, planning and implementation skills.
T06	Ability to address human resources decision-making and management.
T07	Ability to work as a team and, where appropriate, exercise leadership functions, encouraging entrepreneurship.
T08	Develop interpersonal skills and the ability to function in an international and multicultural context.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Application of the gained knowledge on solution reactions for the qualitative analysis of substances of pharmaceutical interest.

To understand the validation strategies of analytical methodologies.

To understand the basis of the quality assurance program and of good laboratory practices with application in the pharmaceutical industry, as well as to learn about the control on raw materials, excipients, intermediary and final products.

To understand the physicochemical principles in which the different techniques of instrumental analysis are based.

Ability to apply the general system of the analytical process to solve simple practical issues with application in different fields.

Capacity to estimate the analytical results reliability together with a deep understanding of the statistical criteria applied for their evaluation, especially those related to accuracy and precision.

Good environmental practices for the management of chemical substances and residues.

Ability to select the ideal instrumental technique for the analytical and structural study of substances of pharmaceutical interest.

To identify and to understand the importance of each stage of the analytical process.

Capacity to elaborate reports on the analytical results obtained, also understandable for no experts in the field.

Self-learning: organization capacity, ability to analyze and to manage the information.

To learn the different automatic systems of analysis developed to obtain better productivity in a pharmaceutical lab.

To differentiate the sense of chemical reactions, their extension and influence on concurrent equilibria. To interpret titration curves.

Teamwork: critical and self-critical ability.

Additional outcomes

To learn the correct use of the language for an adequate oral and written communication.

The student will be capable of undertaking advanced subjects within the area of Chemistry.

Acquisition of the capacity to assimilate new principles and knowledge, as well as critical reasoning based on the evidences and the scientific method.

To apply the acquired knowledge on the fundamental principles of classical analytical methods and techniques to the drugs and pharmaceutical analysis, as

well as for the analysis of potentially toxic substances or of health interest.

6. Units / Contents

Unit 1: PART I. INTRODUCTION TO CHEMICAL ANALYSIS. Unit 1: Introduction to Analytical Chemistry.

Unit 1.1

Unit 1.2

Unit 1.3

Unit 1.4

Unit 2: Chemical Analysis.

Unit 2.1

Unit 2.2

Unit 2.3

Unit 2.4

Unit 3: PART V. LAB PRACTICAL LESSONS.

Unit 3.1 Preparation of solutions and reagents required to perform the practical lessons proposed.

Unit 3.2 Gravimetric determination of Nickel using Dimethylglyoxime.

Unit 3.3 Strong base (NaOH) titration using a primary standard solution. Hydrochloric acid (HCl) titration with a sodium hydroxyde solution (NaOH) previously normalized.

Unit 3.4 Determination of the content of acetyl salicilic acid in an analgesic.

Unit 3.5 Titration of a Potassium permangante (KMnO4) solution with Sodium Oxalate (COONa)2

Unit 3.6 Determination of Hydrogen Peroxyde (H2O2) in a commercial sample.

Unit 3.7 Liquid-liquid extraction of Amaranth and Erythrosine from commercial samples (non-alcoholic beverages). Comparison between simple and multiple step extraction approaches.

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	B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ06 EQ09 EQ10 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06	1.44	36	Y	N	All the educational resources will be at the students' disposal at Moodle platform before the start of each activity. Furthermore, the students will have access to complementary bibliographic and audiovisual material (e.g. books, review articles, videos) sited at the University Library in the Campus of Albacete. The active participation of the student through the cooperative work, not only during the lessons but also out of the classroom for the elaboration of works as well as at problem solving, defense of works and seminars, will be considered for the final evaluation.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ06 EQ09 EQ10 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06	0.8	20	Y	Y	Labwork will be carried out in reduced groups within the time periods previously established at the academic schedule, in order to not concur with other educational activities. The activities will be carried out in laboratories totally equipped with the necessary instruments and reagents required to reach the proposed objectives. The student will not pass the whole subject unless he/she does not pass the practical lessons. The labwork of Chemical Analysis I consists of tutored practical lessons, closely related to the theoretical contents of the subject.
Study and Exam Preparation [OFF-SITE]	Self-study	B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ06 EQ09 EQ10 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	3.6	90	N	-	Individual work performed by the student to study and to acquire the required knowledge of the contents of the subject. The student can ask for individual tutorship sessions on certain contents of the subject. With this purpose, the student should previously arrange an appointment with the corresponding professor.
		B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ06 EQ09 EQ10 EQ11 G01 G02 G03 G04 G05					There are specific dates at the academic calendar reserved for the evaluation tests which do not coincide with other academic activities. Two proofs will be

Final test [ON-SITE]	Assessment tests	G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	0.16	4	Y	Y	performed throughout the course, in which the student will demonstrate the correct acquisition of the required capacities to pass the subject by continuous evaluation.
		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
Final test	70.00%	70.00%	The student will pass the subject by continuous evaluation during the academic year. With this purpose, he /she will have to pass two progress tests including both theoretical contents and problems seminar or real cases to be solved. 70% of the final score will be distributed by these two non-mandatory tests, also retrievaable. Each of these two progress tests will account for 35% of the final score each. Each progress test will consist of two independent tests, one to evaluate the theoretical concepts acquired and the second one focused in solving several problems or seminars proposed. Each part will account from 40 up to 60% of the score corresponding to each progress test. To pass the subject, the student must pass the module of theoretical contents (Parts I, II, III and IV).
Laboratory sessions	20.00%	20.00%	Application to labwork of the knowledge previously acquired. The skills obtained in reagents and lab material handling, as well as the student's attitude, and the adequate elaboration of the laboratory notebook will be evaluated. Additionally, an exam regarding the practical activities will represent the remaining evaluation of this final score. The final score of the practical module accounts for 20% of the final score of the subject. Once the student passes the Practical Module, the score obtained will be maintained for the following two courses.
Assessment of active participation	10.00%	10.00%	During the course, the professor will propose to the students to elaborate individually a maximum of two theoretical works, (Units 4 and 14). The active participation of the student at the lectures, the tutored lessons and other diary activities will also be evaluated. Group or individualized tutored lessons will be given to monitor the learning process of the students. These lessons would contain theoretical contents, seminars, problem solving lessons, or performing real cases related to the contents of the subject. The autonomous work of the student performed for the individual works asked by the professor will be positively considered, as well as the rate of performance at the public exposition of this work, or his/her role at developing teamwork if required. Model exercises will be solved at the lessons in order to help the students to understand the theoretical concepts acquired during the previous lectures. The active role of the student at the seminars will additionally be considered.
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:

The subject consists of two modules, one on theoretical contents and the second linked to practical knowledge. In case of not passing the subject by continuous evaluation, according to the aforementioned evaluation criteria, will have to take a final retrievable exam. In this exam, the student will take two tests: the firs related to the theoretical contents of the subject which accounts for 70% of the final score, whereas an additional 10% of the score comes from the evaluation of the activities performed by the student during the course, and the remaining 20% of the final score is obtained from the evaluation of the labwork carried out by the student.

Non-continuous evaluation:

Evaluation criteria not defined

Specifications for the resit/retake exam:

In case of not passing the final retrievable exam, the student can take the resit exam. For the final score, the contents evaluated in this test will account for 70% of it, as well as the score obtained for practical work performed, will account for 20% of the final score. The activities performed by the student during the course will also be evaluated, accounting for 10 % of the final mark.
In case of not having passed the Practical Module of the subject, the student will have to take a resit exam, in which he/she will be evaluated of the theoretical (70%) and practical contents of the subject (20%). These two results will sum up 90% of the final score of the subject. At this exam, the score related to the

activities performed by the student during the course will also be considered (10%).
Specifications for the second resit / retake exam:

Only the students who accomplished the requisites exposed at the Student Evaluation Regulation of the University of Castilla-La Mancha will hace access to this exam, and will be evaluated according to the criteria exposed for the Retake Exam.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	36
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Final test [PRESENCIAL][Assessment tests]	4

Global activity

Activities	hours
Final test [PRESENCIAL][Assessment tests]	4
Class Attendance (theory) [PRESENCIAL][Lectures]	36
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
M. Valcárcel	Principios de Química Analítica	Springer-Verlag Ibérica	Barcelona	84-07-00500-1	1999	
D.C. Harris	Análisis Químico Cuantitativo 3ª ed., (6ª ed. orig.)	Reverté, D.L.	Barcelona	978-84-291-7225-6	2016	
Burriel Martí, F., Lucena Conde, F., Arribas Jiméno, S. y Hernández Méndez, J.	Química Analítica Cualitativa	Paraninfo, S.A	Madrid	9788497321402	2008	
C. Cámara, P. Fernández, A. Martín-Esteban, C. Pérez-Conde y M. Vidal	Toma y tratamiento de muestra	Síntesis	Madrid	8477389624	2002	
Douglas A. Skoog, Donald M. West, F. James Holler y Stanley R. Crouch	Fundamentos de química analítica	Cengage Learning	Mexico DF	978-607-519-377-9	2015	
J. Ruiz Soriano	Problemas de laboratorio químico y farmacéutico (2a Ed.)	Elsevier	Amsterdam	978-84-8086-339-1	2009	
J.A. López Cancio	Problemas resueltos de Química Analítica	Thomson-Paraninfo	Madrid	978-84-9732-348-2	2015	
M. Silva, J. Barbosa	Equilibrios iónicos y sus aplicaciones analíticas	Editorial Síntesis	Madrid	978-84-9756-025-2	2008	
Miller, J.N., Miller, J.C.	Estadística y quimiometría para química analítica	Pearson Educación		978-84-205-3514-2	2008	
Gary D. Christian	Química Analítica (6ª Edición)	Mc Graw Hill	Mexico DF	978-970-10-7234-9	2009	
R. Cela, R.A. Lorenzo, M.C. Casais	Técnicas de separación en Química Analítica.	Síntesis	Madrid	84-9756-028-0	2010	
R. Compañó y A. Ríos	Garantía de la calidad en los laboratorios analíticos	Síntesis, D. L.	Madrid	84-9756-024-8	2002	
Yañez-Sedeño Orive, Paloma; Pingarrón Carrazón, José Manuel; de Villena Rueda, Francisco Javier Manuel.	Problemas resueltos de Química Analítica	Síntesis	Madrid	84-9756-071-X	2008	