



1. General information

Course: ORGANIC CHEMISTRY II

Type: CORE COURSE

Degree: 376 - UNDERGRADUATE DEGREE PROGRAMME IN PHARMACY

Center: 14 - FACULTY OF PHARMACY

Year: 2

Main language: Spanish

Use of additional
languages:

Web site:

Code: 14318

ECTS credits: 6

Academic year: 2023-24

Group(s): 10

Duration: First semester

Second language: English

English Friendly: Y

Bilingual: N

Lecturer: JOAQUIN CALIXTO GARCIA MARTINEZ - Group(s): 10

Building/Office	Department	Phone number	Email	Office hours
Facultad de Farmacia	QUÍMICA INORG., ORG., Y BIOQ.	+34926053224	joaquin.garcia@uclm.es	

Lecturer: ANTONIO MANUEL RODRÍGUEZ GARCÍA - Group(s): 10

Building/Office	Department	Phone number	Email	Office hours
Facultad de Farmacia	QUÍMICA INORG., ORG., Y BIOQ.		AntonioM.Rodriguez@uclm.es	

2. Pre-Requisites

There are no prerequisites for this course; however, it is recommended that students have previously taken General Chemistry and Introduction to Laboratory. As it is the second subject in the Organic Chemistry module, it is also recommended to have completed Organic Chemistry I.

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

As experts in medications and their therapeutic use in humans, future pharmacists must have knowledge of the chemical structure and properties of the main groups of natural products and heterocycles, as many drugs mimic the structure and functions of many of them. This subject, along with Organic Chemistry I, forms the foundation for Pharmaceutical Chemistry I and Pharmaceutical Chemistry II. Additionally, this course introduces the concepts of characterization and structural determination using spectroscopic techniques, primarily nuclear magnetic resonance (NMR) and infrared spectroscopy (IR).

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.
EQ08	Know and understand the chemical nature and behavior of functional groups in organic molecules.
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

Preparation of reports, summaries and presentations on bibliographic or experimental works, either individually or in teams, applying the capacity for criticism and self-criticism.

Ability to design simple organic compound synthesis from certain starting products and involving more than one reaction.

Ability to name organic compounds according to IUPAC standards and represent their structure from the systematic name.

Correlate the structure of organic compounds with their physical properties, reactivity and stability.

Characterization and identification of functional groups in organic compounds.

Ability to apply the knowledge acquired in laboratory practice and in solving problems and issues related to organic compounds.

To develop the necessary laboratory processes for the transformation, separation, isolation and purification of organic compounds, estimating the possible associated risks.

Structural determination of organic compounds from their chemical properties and chemical analysis data.

Recognize the three-dimensional structure of organic compounds and its implications.

6. Units / Contents

Unit 1: Structural Determination of Organic Compounds

Unit 1.1 Infrared Absorption Spectroscopy

Unit 1.2 Nuclear Magnetic Resonance Spectroscopy (NMR)

Unit 2: Electrophilic Aromatic Substitution (SEAr)

Unit 2.1 Electrophilic Aromatic Substitution Reactions on Benzene

Unit 2.2 Mechanism of Electrophilic Aromatic Substitution Reaction

Unit 2.3 Strategies for the Synthesis of Substituted Benzenes

Unit 2.4 Polynuclear Hydrocarbons

Unit 3: Heterocyclic Organic Compounds

Unit 3.1 Aromaticity and Heteroaromaticity

Unit 3.2 Six-Membered Aromatic Heterocycles

Unit 3.3 Five-Membered Aromatic Heterocycles

Unit 3.4 Synthesis of Aromatic Heterocycles

Unit 4: Amino Acids, Peptides, and Proteins

Unit 4.1 Structure of Amino Acids and Peptides. Stereochemistry and Nomenclature of Amino Acids

Unit 4.2 Acid-Base Properties

Unit 4.3 Synthesis of Amino Acids

Unit 4.4 Reactivity of Amino Acids

Unit 4.5 Peptides

Unit 4.6 Peptide Synthesis

Unit 5: Carbohydrates and Nucleic Acids

Unit 5.1 Classification of Carbohydrates

Unit 5.2 Cyclic Forms of Carbohydrates

Unit 5.3 Mutarotation

Unit 5.4 Other Sugars. Glycosides. Disaccharides. Polysaccharides

Unit 5.5 Reactivity of Monosaccharides

Unit 5.6 Nucleic Acids

Unit 6: Laboratory Practices

Unit 6.1 Synthesis of Cinnamic Acid. Use of Spectroscopic techniques

Unit 6.2 ArES. Synthesis of Martius Yellow

Unit 6.3 Synthesis of Knorr.

Unit 6.4 Chemistry of Milk. Proteins and Carbohydrates

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
							The availability of teaching

Class Attendance (theory) [ON-SITE]	Lectures	B01 B02 B03 B04 B05 EQ01 EQ02 EQ08 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	0.92	23	Y	N	resources will be accessible on the Moodle platform prior to the start of activities. Additionally, students will have access to supplementary bibliographic and audiovisual material (books, review articles, videos) both in the university library on the Albacete campus and on the Virtual Campus.
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	B01 B02 B03 B04 B05 EQ02 EQ03 EQ04 EQ08 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	0.8	20	Y	Y	Practical teaching will be delivered in small groups within designated periods on the academic calendar that do not coincide with other teaching activities. These sessions will take place in classrooms and/or laboratories, all equipped with the necessary resources to achieve the intended objectives. These activities are MANDATORY, meaning that students will not be able to pass the course if they do not complete them adequately. The knowledge acquired during these practical sessions will be assessed through the completion and grading of a laboratory notebook, the completion and grading of teaching activities related to Applied Organic Chemistry, and through observation of attitude and daily performance in the laboratory.
Workshops or seminars [ON-SITE]	Combination of methods	B01 B02 B03 B04 B05 EQ01 EQ02 EQ08 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	0.52	13	Y	N	Participation will be assessed through the completion of questionnaires, online quizzes, and the submission of problem-solving seminars. The teaching methodologies employed will include workshops and seminars, study and problem/case resolution, and assessment tests. In the case of case studies, they provide a practical and specific perspective on problems or phenomena in Organic Chemistry, facilitating critical analysis and the application of theoretical concepts to real-life situations.
Study and Exam Preparation [OFF-SITE]	Self-study	B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ08 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	Y	N	Students will have the opportunity to request personal tutoring on course content by scheduling an appointment with the respective professor.
Formative Assessment [ON-SITE]	Assessment tests	B01 B02 B03 B04 B05 EQ01 EQ02 EQ03 EQ04 EQ08 EQ11 G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G11 G12 G13 G14 G15 T01 T02 T03 T04 T05 T06 T07 T08	0.16	4	Y	N	Specific dates for evaluation tests have been reserved in the academic calendar, which do not coincide with other teaching activities. These tests will be evaluated based on the scoring of the problems and questions presented in them.
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
Test	70.00%	70.00%	Refer to the assessment section
Laboratory sessions	20.00%	20.00%	The practical sessions are, in ALL CASES, mandatory non-recoverable activities.
Assessment of active participation	10.00%	10.00%	Refer to the assessment section
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:

It will be assumed that all students choose the continuous assessment mode unless otherwise informed (non-continuous mode) by sending an email to the responsible professor of the subject, provided it is done before the student has completed 50% of all assessable activities or the class period has ended.

The subject will be passed when a minimum score of 5 points is obtained in the overall grade. To add up the grades of the two main components (theory and practice), it will be necessary to have obtained a minimum of 4 points in each of them, regardless of the mode of assessment.

THEORETICAL COMPONENT EVALUATION (70% of the final grade). It will consist of 2 non-mandatory partial exams (continuous assessment) and/or 1 mandatory and recoverable final exam (if continuous assessment is not passed). The partial exams will have a weight of 50% for the first exam and 50% for the second exam in the theoretical component.

PRACTICAL COMPONENT EVALUATION (20% of the final grade). Attendance to laboratory practical sessions is MANDATORY to pass the subject in the regular assessment period, and the practical sessions will NOT be recoverable. It will be evaluated through the submission of a laboratory notebook, attitude and performance in the laboratory, compliance with safety regulations, and waste management. To pass the practical module in the regular assessment period, students must attend all practical sessions and obtain a grade of at least 4 out of 10 in the arithmetic mean between the grade of the notebook and the practical sessions themselves. This grade will be maintained for the following two academic years.

Students who have failed the practical module in the regular assessment period but have attended all practical sessions will take a written exam on practical knowledge in the extraordinary assessment period.

PARTICIPATION EVALUATION (10% of the final grade). It will be evaluated through the submission of problem-solving seminars in the virtual campus and in the classroom (by completing activities proposed by the professor). These activities are NON-MANDATORY and RECOVERABLE.

It is reminded that the materials created by the professor and made available to students on the Virtual Campus platform are the property of the professor. Therefore, taking them out of that context and making them available to individuals not enrolled in the platform without the professor's consent will be considered a violation of copyright. Likewise, it is prohibited to record classes and other activities without the explicit consent of the professor. The use of unauthorized aids or materials during exams will be considered fraud. In accordance with Article 8 of the Student Assessment Regulations, any exam in which fraud is detected will be considered invalid and graded as a fail (0), including plagiarism.

Non-continuous evaluation:

To choose this form of assessment, it is necessary to request it by sending an email to the responsible professor of the subject, provided it is done before the student has completed 50% of all assessable activities or the class period has ended.

The subject will be passed when a minimum score of 5 points is obtained in the overall grade. To add up the grades of the two main components (theory and practice), it will be necessary to have obtained a minimum of 4 points in each of them, regardless of the mode of assessment.

THEORETICAL COMPONENT EVALUATION (70% of the final grade). It will consist of ONE mandatory and recoverable final exam.

PRACTICAL COMPONENT EVALUATION (20% of the final grade). Attendance to laboratory practical sessions is MANDATORY to pass the subject in the regular assessment period, and the practical sessions will NOT be recoverable. It will be evaluated through the submission of a laboratory notebook, attitude and performance in the laboratory, compliance with safety regulations, and waste management. To pass the practical module in the regular assessment period, students must attend all practical sessions and obtain a grade of at least 4 out of 10 in the arithmetic mean between the grade of the notebook and the practical sessions themselves. This grade will be maintained for the following two academic years.

Students who have failed the practical module in the regular assessment period but have attended all practical sessions will take a written exam on practical knowledge in the extraordinary assessment period.

PARTICIPATION EVALUATION (10% of the final grade). To pass, specific activities will be proposed to the student. These activities are NON-MANDATORY and RECOVERABLE (see the section on Extraordinary Assessment Specifics).

It is reminded that the materials created by the professor and made available to students on the Virtual Campus platform are the property of the professor. Therefore, taking them out of that context and making them available to individuals not enrolled in the platform without the professor's consent will be considered a violation of copyright. Likewise, it is prohibited to record classes and other activities without the explicit consent of the professor. The use of unauthorized aids or materials during exams will be considered fraud. In accordance with Article 8 of the Student Assessment Regulations, any exam in which fraud is detected will be considered invalid and graded as a fail (0), including plagiarism.

Specifications for the resit/retake exam:

The subject will be passed when a minimum score of 5 points is obtained in the overall grade. In order to combine the grades of the two main components (theory and practice), it will be necessary to have obtained at least a 4 in each of them independently.

THEORETICAL COMPONENT EVALUATION (70% of the final grade). It will consist of a mandatory and non-recoverable final exam.

PRACTICAL MODULE EVALUATION (20% of the final grade). Students who have failed the practical module in the regular assessment period but have attended all practical sessions will take a written exam on practical knowledge in the extraordinary assessment period.

PARTICIPATION EVALUATION (10% of the final grade). The grade obtained during the regular assessment period will be maintained. However, in the case of students who did not participate in this module during the regular assessment period, they may recover it by completing an original work that will be orally presented to the professor, upon prior request via email to the responsible professor of the subject (before 15 natural days prior to the date of the extraordinary exam). The grade can be maintained for the following two academic years if the student expresses their intention to do so.

Specifications for the second resit / retake exam:

Only students who meet the requirements stated in the Student Assessment Regulations of the University of Castilla-La Mancha will be eligible to participate in this extraordinary assessment. They will be evaluated according to the criteria applied in the extraordinary assessment period.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	23

Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Workshops or seminars [PRESENCIAL][Combination of methods]	13
Study and Exam Preparation [AUTÓNOMA][Self-study]	51.75
Formative Assessment [PRESENCIAL][Assessment tests]	4
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	23
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	20
Workshops or seminars [PRESENCIAL][Combination of methods]	13
Study and Exam Preparation [AUTÓNOMA][Self-study]	51.75
Formative Assessment [PRESENCIAL][Assessment tests]	4
Total horas: 111.75	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Soto Cámara, J. L.	Química orgánica. Vol. 3: Grupos funcionales y heterociclos https://www.sintesis.com/química%20básica-140/química%20orgánica.%20vol.%20iii.%20grupos%20funcionales%20y%20heterociclos-ebook-1301.html	Ed. Síntesis		84-7738-906-3 (o. c.	2005	
Cabildo, M.P; García, A; López, C. Santa, M.D. Gutiérrez, M.	Química orgánica / https://www.librosuned.com/LU616/Quimica-org%E1nica-.aspx	UNED		978-84-362-5528-7	2022	
Hesse, M., Meier, H., Zeeh, B.	Métodos Espectroscópicos en Química Orgánica https://www.sintesis.com/química%20básica-140/métodos%20espectroscópicos%20en%20química%20orgánica-libro-1106.html	Ed. Síntesis		9788477385226	2005	
Vollhardt, K.; Peter C.	Química orgánica : estructura y función La editorial Digitalia tiene varios libros de Química Orgánica http://www.digitaliapublishing.com/ La editorial Pearson tiene varios libros de Química Orgánica http://www.conten.es/ib/NPortada?CodPortada=1000188	Omega		978-84-282-1431-5	2007	Acceso on line libre para alumnos Acceso on line libre para alumnos
Ege, S.	Química orgánica : estructura y reactividad /	Reverté,		978-84-291-7067-2 (O	2013	
Soto Cámara, J. L.	Química Orgánica. Vol. 1: Conceptos básicos https://www.sintesis.com/química%20básica-140/química%20orgánica.%20vol.%20i%3A%20conceptos%20básicos-ebook-1300.html	Ed. Síntesis		9788499581453	2010	
García Calvo-Flores, F. Wade, Leroy G.	Problemas resueltos de química orgánica / Química orgánica / vol.1 https://pearson.es/españa/TiendaOnline/quimica-orgánica-9e-vol-i	Thomson, Pearson,		978-84-9732-458-8 978-607-32-3847-2 (2015 2017	
Vollhardt, K.; Peter C. Wade, Leroy G.	Organic chemistry : structure and function Química orgánica / vol.2 https://pearson.es/españa/TiendaOnline/quimica-orgánica-9e-vol-ii	W.H. Freeman, Pearson,		1-319-18771-4 9786073238496	2018 2017	
Soto Cámara, J. L.	Química orgánica. Vol. 2: hidrocarburos y sus derivados halógenos https://www.sintesis.com/química%20básica-140/química%20orgánica.%20volumen%20ii%3A%20hidrocarburos%20y%20sus%20derivados%20halogenados-ebook-1302.html	Ed. Síntesis		8477389055	2001	
Klein, D. R.	Química orgánica /	Médica Panamericana,		978-84-9835-169-9	2013	
D'Auria, M. V.	Guía razonada para resolver problemas de química orgánica : https://loghia.com/shop/index.php?id_product=54&controller=product&id_lang=4	Loghia,		978-88-95122-45-8	2018	
Soler Martínez, V.; González Rosend, M.E.	Química Orgánica para Ciencias de la Salud https://www.sintesis.com/biblioteca-de-quimica-138/quimica-organica-para-ciencias-de-la-salud-ebook-1299.html	Ed. Síntesis		9788497569347	2008	
Gómez Aspe, R.	Teoría y problemas resueltos de química orgánica / https://www.sintesis.com/biblioteca%20de%20química-138/teoría%20y%20problemas%20resueltos%20de%20química%20orgánica-ebook-1793.html	Ed. Síntesis		978-84-9958-884-1	2013	
Carey, Francis A.	Química orgánica /	McGraw Hill,		978-607-15-1210-9	2014	
González Rosende, M. E.	Fundamentos de química orgánica para ciencias de la salud / https://www.sintesis.com/manuales%20de%20químicas-198/fundamentos%20de%20química%20orgánica%20para%20ciencias%20de%20la%20salud.%20volumen%201-ebook-2442.html	Ed. Síntesis		978-84-9171-092-9 (2017	
Chaloner, P.	Organic chemistry: a mechanistic approach https://www.taylorfrancis.com/books/mono/10.1201/b17689/organic-chemistry-penny-chaloner	CRC Press.		978-0-19-969327-6	2014	