Bachelor´s Degree in Chemistry

Subject Guide

1. Information about the subject

SUBJECT	Organic Chemistry II	**CODE**	GQUIMI01-3-007
EDUCATIONAL OFFER	Bachelor´s Degree in Chemistry	**CENTER**	Facultad de Química
TYPE	Compulsory	**N° TOTAL CREDITS**	6.0
PERIOD	Second Semester	**LANGUAGE**	Spanish

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2. Context

Organic Chemistry II is a core course that is given in the Basic Module “Organic Chemistry” in the second semester of the third year of the Degree in Chemistry. It is lectured by instructors from the Organic and Inorganic Chemistry Department (Organic Chemistry Section). The Course is intimately related to Organic Chemistry with nevertheless clearly differentiated contents and closes the basics of Organic Chemistry.

Along the course, the student will be introduced into the main techniques of structural characterization, the synthesis of relevant heterocyclic molecules such as indole or pyridine, and study their reactivity. Also, the student will enter into the study of the most representative families of

natural products, together with their biosynthetic aspects. Finally, the course will focus on the design of synthetic methodologies and its relevance.

All in all, the course has different goals:

- Complete the basic chemical knowledge acquired in year 1
- Apply the basic chemical concepts to organic chemistry
- Know the different types of compounds and fundamental reactions in organic chemistry directed to the design of synthetic pathways
- Provide the student with the skills required to study the rest of organic chemistry topics

The following instructors from the Organic Chemistry Area of the Organic and Inorganic Chemistry Department will be in charge of the course, with their corresponding dedication specified:

- Coordinator: José M. González Díaz
- CEXs: José M. González Díaz
- PAs: Eduardo Rubio Royo
- TGs 1 & 2: Eduardo Rubio Royo

It is mandatory to pass this course to apply to “Experimentation in Organic Chemistry II”.

3. Requirements

It will be mandatory to have passed *General Chemistry, Basic Laboratory Operations and Information Technology Tools and Organic Chemistry I.*

4. Competencies and learning results

4.1.- General Objectives.

(CG-1) Rationalization and analysis abilities.

(CG-2) Being capable of effectively solving specific problems

(CG-4) Planning and Organizing abilities

(CG-5) Decision making abilities

(CG-6) Manage information properly

(CG-9) Self-learning abilities

(CG-12) Have environmental conscience

(CG-17) Develop critical thinking

4.2.- Specific Obejectives:

(CE-1) Acquire the grounds of chemical terminology, naming, conventions and units.

(CE-2) Relate macroscopic properties with those of atoms and individual molecules

(CE-5) Describe the types of chemical reactions and their related characteristics

(CE-6) Apply the principles and procedures used in chemical analysis for the determination, identification and characterization of chemicals.

(CE-7) Apply the principles of thermodynamics and their implications in chemistry.

(CE-8) Learn the kinetics of chemical changes including catalysis and mechanisms of reaction.

(CE-10) Recognize the nature and behavior of functional groups in organic molecules as well as the main synthetic pathways in organic chemistry.

(CE-11) Infer the properties of organic and organometallic compounds.

(CE-17) Identify the structure and reactivity of biomolecules and the chemistry of the main biological processes.

(CE-19) Demonstrate knowledge and understanding of the essential facts, principles and theories related to chemistry.

(CE-20) Solve quantitative and qualitative problems applying mathematic models.

(CE-22) Acquire skills to evaluate, interpret and analyze chemical information.

(CE-33) Recognize and evaluate chemical processes in daily life.

4.3.- Learning.

- Consult and use the scientific information in an efficient manner
- Recognize and analyze new problems in organic chemistry and devise strategies aimed to solve them
- Show knowledge and understanding facts, concepts, principles and theories related to organic chemistry and their application to solve problems. Specifically, the student should know :
- The chemical bond in organic molecules, the relationship between structure and physical properties, acidity and basicity
- The basic terminology of organic chemistry, how to express ideas precisely and be able to establish relations among different concepts
- The basis of Thermodynamics and Kinetics and their applications to organic chemistry
- The basics of heterocyclic chemistry y natural products
- The functional groups, their characteristics, the structure/reactivity relationship and the main types of organic reactions
- The possibilities that organic chemistry offers for planning simple organic synthesis sequences
- Understand the utility of the “chiral pool” in order to obtain enantiopure polyfunctional compounds
- Analyze and interpretate multistep sequential sequences
- Design multistep sequential sequences of medium difficulty
- Know and understand the notions of chemo-, region- and stereoselective synthetic transformations

The possibilities of prediction the organic chemistry offers to design synthetic pathways.

5. Contents

The course is divided in the following units:

Part A. Natural Products.

Unit 1. Carbohydrates

Introduction. Naming, structure and reactivity of monosaccharides. Disaccharides and polysacharides..

Unit 2. Aminoacids

Introduction. a-Aminoacids: essential aminoacids. Isoelectric point. Synthesis of a-Aminoacids. Peptides, polypeptides and proteins. Synthesis of polypeptides. Determination of the primary structure of polypeptides. Other natural products.

Part B. Heterocyclic Compounds.

Unit 3. 6-Membered Aromatic Heterocycles with One Heteroatom.

General Aspects. Aromaticity. Pyridine: Synthesis and Reactivity. Benzopyridines: Synthesis and Reactivity.

Unit 4. 5-Membered Aromatic Heterocycles with One Heteroatom.

Introduction. Pyrrole, Furan, Thiophene, Indole, Benzofuran and benzothiophene. Synthesis and Reactivity.

Part C. Synthetic Methodology.

Unit 5: Carbon-Carbon single bonds.

Formation of carbon-carbon single bonds: polar, radical and carbene reactions.

Unit 6: Carbon-Carbon multiple bonds.

Formation of carbon-carbon multiple bonds. Phosphorus, Sulfur and Silicon derivatives in the formation of carbon-carbon multiple bonds.

Unit 7: Synthesis of Cyclic Systems.

Free Radical Mediated Cyclizations. Cationic Cyclizations. Pericyclic Reactions. Dipolar Reactions. Other Cyclizations.

Unit 8: Functional Group Transformations and Synthetic Planning.

Oxidation of Alcohols, Activated C-H bonds and Unsaturated Systems. Reduction Reactions.

6. Methodology and working plan

In lectures, the instructor will present and discuss the different subjects in detailed manner.

At TGs, the student will solve questions and exercises previously proposed to this regard. The instructor will clarify any doubt found by the students. TGs will not he subject of any evaluation, but attendance is mandatory.

Periodical sets of problems will be handled to students. Students are encouraged to work in and out of class to solve the sets of problems that will be discussed at the seminars/practical classes.

Presentations, slides and questions will be available to students on the eCampus: https://www.innova.uniovi.es/innova/aulanet/aulanet.php

The following table shows the dedication of a student to this course:

Modes	Hours	%	Totals

In-class work	*Lectures*	**42**	**28**	**56**
	Classroom practices /Seminars/ Workshop	**7**	**4,6**	
	Laboratory work /field worko /informatic classroom / languages classroom	**0**		
	Clinic and hospital practices	**0**		
	Group tutorials	**4**	**2,7**	
	Other activities	**0**	**0**	
	Exams and evaluation activities	**3**	**2**	
Out-of-class work	Team work			**94**
	Personal work	**94**	**62,7**	
	Total	**150**		

7. Evaluation of the student's learning results

There will be a final exam for the regular as well as for the extraordinary call that will account for the 100% of the final mark. A mark of 5.0 or higher is required to pass the course

8. Resources, bibliography and complementary documentation

Bibliography:

Parts A and B:

Recommended textbook for a good following up of the subject:

“Organic Chemistry”, K. P.C. Vollhardt, N. E. Schore; W. H. Freeman; 6th edition, 2010.

“Heterocyclic Chemistry”, M. Sainsbury, The Royal Society of Chemistry, Cambridge, 2001.

Part C:

“Modern Organic Synthesis. An Introduction”, G. S. Zweifel, M. H. Nantz, W. H. Freeman and Co., New York, 2007.

“Modern Methods of Organic Synthesis”, W. Carruthers, I. Coldham*, 4ª Ed.*, Cambridge University Press, Cambridge, 2004.