Universitat Autònoma de Barcelona

2021/2022

Organic Chemistry of Biochemical Processes

Code: 100889
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Carles Jaime Cardiel
Email: Carlos.Jaime@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

English use is not expected in the lectures, but most of the bibliographic material will be in english

Teachers

Rosa Maria Ortuño Mingarro
Ona Illa Soler

Prerequisites

It is advisable to have taken or to be taking the subjects "Fundamentals of Chemistry" and "Thermodynamics anc

Objectives and Contextualisation

This is a first-year subject with basic training in organic chemistry.

The main objectives of the course are for the student to acquire the knowledge necessary to understand the structures and fundamental chemical reactions involved in biochemical processes. It will therefore be necessary to delve into the structure of organic molecules and the mechanisms of their transformations.

Organic molecules are involved in both primary and secondary metabolism and are as important as the biosynthesis and transformations of carbohydrates, the formation of amino acids, peptides and proteins, as well as nucleic acids.

Other processes that lead to the formation of secondary metabolites are also of interest. The concepts acquired in the subject "Fundamentals of Chemistry" and the principles and theories learned in "Thermodynamics and Kinetics" will be useful for the study of biochemical processes from the perspective of the organic reactions involved and their mechanisms. As examples, different reactions involving biological systems will be discussed.

Competences

- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and ones own language.

Learning Outcomes

1. Characterise functional organic groups in the context of biomolecules.
2. Explain the effect of the three-dimensional structure of molecules on biological activity.
3. Identify the functional organic groups and describe their chemical properties.
4. Interpret experimental results and identify consistent and inconsistent elements.
5. Manage information and the organisation and planning of work.
6. Read specialised texts both in English and ones own language.

Content

INTRODUCTION.

Main organic reactions. Polar reactions and radical-mediated reactions. Intermediate species in organic reaction. Kinetic and thermodinamyc control. Hammond postulate.

NUCLEOPHILIC SUBSTITUTION ON SATURATED CARBON.

Mechanism and stereochemistry. Substituent effects. Relative reactivity of nucleophiles. Leaving groups. Examples: SAM methylations, hydrolisis reactions, cyclizations. Competitive reactions: elimination versus rearrangements. Biosynthetic examples.

ELIMINATION REACTIONS.

Mechanisms and stereochemistry. Regiochemistry of E2 elimination. Synthesis of alkenes. Biological examples.

ELECTROPHILIC ADDITIONS TO DOUBLE BONDS.

Mechanism: regio- and stereochemistry. Olefines hydration: synthesis of alcohols. Syn and anti additions. Examples.

NUCLEOPHILIC ADDITION TO CARBONYL GROUP AND RELATED REACTIONS.

Carbonyl group reactivity. Additions of nitrogen compounds: formation of imines and enamines. Pyridoxal phosphate and transamination. Hydride ion as nucleophile: NADH. Addition-Elimination reactions. Reactions with alcohols: acetal formation. Carbohydrates: cyclic hemiacetal forms. Aldol reaction. Biosynthesis of fructose and Glucose. Conjugated addition reactions: examples in the biosynthesis of lignans and other metabolites.

SUBSTITUTION REACTIONS ON CARBONYL GROUP DERIVATIVES.

Carboxyilc acids and related compounds. Peptides and proteins. Claisen condensation. Biosynthesis of fatty acids and polyketides. Beta-ketoacids decarboxylation.

AROMATIC COMPUNDS AND ELECTROPHILIC SUBSTITUTION.

Aromaticity. Aromatic electrophilic substitution: mechanism and examples. Influence of substituents in the reactivity. Alkylation and acylation: biological examples. Heterocyclic aromatic compounds of biological interest: purinesand pyrimidines. Nucleic acids.

RADICAL REACTIONS.

Radical reactions initiators. Oxidation with molecular oxygen. An important example: biosynthesis of prostaglandines from polyunsaturated fatty acids. Oxidative dimerization of phenols. Biological examples.

These will be the contents of the course unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

The teaching methodology proposed in the following lines may undergo modifications depending on the restrictions on attendance imposed by the health authorities.

The focus of the learning process is the work of the student, who learns by working. The professor's mission is to help the student in this task by providing them with information or by showing them the sources where they can get it from. The professor guides the steps so that the learning process can be done effectively.

In line with these ideas, and in accordance with the objectives of the subject, the development of the course is based on the following activities:

Master classes

The student acquires the scientific-technical knowledge of the subject by attending the master classes and complementing them with the personal study of the topics explained. Master classes are the activities in which less interactivity is required of the student. They are conceived as a fundamentally one-way method of transmitting knowledge from the professor to the student. However, the student must complement the professor's explanations with their study and extension on the suggested bibliography. The master classes will be complemented with practical exercises on the topics explained and discussions on topics proposed by the professor based on research or dissemination articles.

Seminars (problem classes)

The seminars are sessions in which the scientific-technical knowledge exposed in the master classes is reinforced to complete their understanding and to deepen into them by developing diverse activities, from the typical resolution of problems to the discussion of practical cases. The mission of the seminars is to promote the capacity for analysis and synthesis, critical reasoning, and the ability to solve problems.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercices and problems	16	0.64	1, 2, 5, 3, 4, 6
Magisterial classes	32	1.28	1, 2, 5, 3, 4, 6
Type: Autonomous			

Study and resolution of exercices	95	3.8	1, 2, 3, 4, 6

Assessment

The assessment proposed below may be subject to changes depending on the restrictions on attendance imposed by the health authorities.

The subject will be passed if a grade equal to or higher than 5.0 points out of 10 is obtained in the continuous assessment (evidences and partial exams), provided that a grade equal to or higher than 5.0 has been obtained in each of the partial exams.

In case of not passing by continuous assessment, the student may take a retake exam as long as he / she has taken continuous assessment tests, the weight of which has to be higher than 67% of the final grade (ie, the two partial ones, one partial and the evidence does not reach 67%). Otherwise, you will be graded as "Not assessable" and will not be able to take the retake exam.

Evidences

Throughout the course, exercises or small assignments can be proposed to be done individually or in groups, in the classroom or outside the classroom at the discretion of the teacher. Papers not presented will account for 0 points when calculating the average of the subject. The average of all the evidence will represent 10% of the final grade.

Partial exams

The partial exams will assess the knowledge acquired throughout the academic year, with special emphasis on the ability to solve exercises.

There will be two compulsory partial exams that will be performed throughout the course, during the months of April (40%) and June (50%), and a possible retake exam in late June or early July.

Retake exam

All grades obtained during the continuous assessment will be cancelled for any student attending the retake exam (partial exams and evidences).

This test will include all the subjects explained during the whole course. To pass it, it will be necessary to obtain agrade equal to or higher than 5.0 points out of 10.

Students who, despite having passed by continuous assessment, want to improve the grade obtained, may take the June/July retake exam by renouncing all grades previously obtained.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evidences	10%	1	0.04	2, 5, 3, 6
Qualifying examinations	90%	6	0.24	1, 2, 5, 3, 4, 6

Bibliography

(1) T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder, *Organic Chemistry*, 12th Edition, John Wiley and Sons, New York, 2017 (o edicions anteriors).

(2) K. Peter. C. Vollhardt; Neil E. Schore, *Organic Chemistry* (8th Ed), Ed. Freeman, WH & Co., 2018 (o edicions anteriors).

(3) P. Y. Bruice, *Essential organic chemistry* (3rd Ed), Pearson Education Ltd. 2016, e-book link: https://cataleg.uab.cat/iii/encore/record/C__Rb2084284?lang=cat

(4) M.P. Cabildo, *Química Orgánica*, UNED, 2008, e-book link: https://cataleg.uab.cat/iii/encore/record/C__Rb1995693__Squimica%20organica__Ff%3Afacetcloud%3Allibres%2

(5) https://www.organic-chemistry.org/

Any other book on "Organic Chemistry" will be useful to follow the contents of this subject.

Other references will be indicated during the course

Software

The use of free ChemSketch software for drawing and obtaining the systematic names of organic molecules is re

https://www.acdlabs.com/resources/freeware/chemsketch/index.php