UAB
Universitat Autònoma de Barcelona

Organic Chemistry of Biochemical Processes

Code: 100889
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500252 Biochemistry	FB	1

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

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 one's 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 one's own language.

Content

INTRODUCTION.

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

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.

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.

Activities and Methodology

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

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.

Assessment

Continous 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

Option A. Continued assessment (default)

The subject will be approved by obtaining a rating equal to or greater than 5.0 points out of 10 in the continuous assessment (evidences and partial tests), provided that a rating equal to or greater than 4.5 has been obtained in each of the partial examinations.

Those students who, by continuous assessment, reach a mark below 3.5 will not be able to submit to recovery and will have the subject suspended.

In case of attaining a continuous assessment mark between 3.5 and 5.0, the student may submit to a recovery test provided that he has carried out continuous evaluation tests weighing more than 67% of the final mark (i.e., at least two partial stages). Otherwise, it will get the grade "Not Evaluable" and will not be able to stand for the recovery test.

- Evidences

Throughout the course, exercises or small jobs may be considered for individual or group work, in the classroom or outside the classroom at the teacher's discretion. Unsubmitted works compute a 0 when calculating the mean of the subject. The average of all evidence will represent 10% of the final mark.

- Partial tests

In the part-sessions, the knowledge acquired during the academic year will be evaluated, with special emphasis on the ability to solve problems.

There will be two compulsory examinations that will take place during the course, during April (40%) and June (50%), and a possible recovery test in early July.

- Resit test

To participate in the resit test, students must have been previously evaluated in a set of activities whose weight is equivalent to a minimum of two thirds of the total qualification of the subject or module (i.e., must have been presented to at least two partial tests).

STUDENTS WHO ATTAIN an average course of less than 3.50 WILL NOT BE ABLE TO BE PRESENTED TO THE RECOVERY EXAM. All students who obtain an average course score above 3.5 and below 5.00, will have to submit to the partial or partial suspension recovery. Recovery will consist of two parts, one for each part, and the student will have to recover those partials in which he has not reached a note greater than 5.00. The qualifications achieved during the continued evaluation (partial examinations) will be annulled for those students who submit to the recovery test.

Students who, despite having approved by continuous evaluation, wish to improve the mark achieved, may submit to the June/July recovery test and renounce all previously obtained notes.

Option B. Single evaluation (option to apply for academic bioscience management and responsible professor)

The single evaluation will consist of a single test in which the contents of the entire subject program will be evaluated. The test will consist fundamentally of a written test where theoretical/practical exercises will have to be solved. The note obtained in this assessment will represent 100% of the final note of the subject.

The single evaluation test will be held on the same day, time and place as the last continuous evaluation test of the subject (Parkial 2 QO, in the official schedule). The subject will be approved by obtaining a rating equal to or greater than 5.0 points out of 10.

The single assessment can be recovered on the day set by the overall recovery of the subject.

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

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	311	Catalan	second semester	afternoon
(TE) Theory	31	Catalan/Spanish	second semester	afternoon