Universitat Autònoma de Barcelona

2019/2020

Organic Chemistry of Biochemical Processes

Code: 100889
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	FB	1	2

Contact

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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 at classroom

Teachers

Jordi Marquet Cortés

Prerequisites

It would be convenient to have taken o being studing the courses "Fonaments of chemistry" and "Termodinàmica i cinètica".

Objectives and Contextualisation

The main goals of this course are that the student could achieve the necessary knowledge in order to understand the molecular structures and main chemical reactions involved in biochemical processes. Thus, special focus will be made in the different mechanism that usual organic reactions follow. Organic molecules are involved in both primary and secondary metabolism, being fundamental part in the biosynthesis and different transformations of carbohydrates, amino acids, peptides and proteins, along with the nucleic acids. In order to understand other processes as the mechanism of action of drugs and their metabolism, knowledge of organic chemistry is also mandatory.

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. Intermediates 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, ciclyzations. Competitive reactions: elimination versus rearrangements. Biosynthetic examples.

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

Electrophilic addition to double bonds. Mechanism: regio- and stereochemistry. Olefines hydration: synthesis of alcohols. Syn and anty additions. Examples.

Nuclephilic addition to carbonyl group and related reactions. Carbonyl group reactivity. Additions of nitrogen compounds: formation of imines and enamines. Piridoxal phosphate and transamination. Hidryde 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. Carboxilic acids and related compounds. Peptides and proteins. Claisen condensation. Biosynthesis of fatty acids and polyketides. Beta-ketoacids decarboxilation.

Aromatic compounds 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: purines and pirymidines. Nucleic acids.

Radical reactions. Introduction. Starters of radical reactions. Oxidation with molecular oxygen. An important example: biosynthesis of prostaglandynes from fatty acids polyunsaturated. Oxidative dimerization of phenols. Biological examples.

Methodology

The development of the course is based on the following activities:

Magisterial classes

The student gets the scientific and technical knowledge of the matter attending magisterial classes that will be complemented with the personal study of the commented topics. Magisterial classes involve small interaction with the student and they are conceived as a unidirectional method of knowledge transmission from the teacher to the student.

Oral presentations of works by the students

The student applies the scientific and technical knowledge acquired in magisterial classes as well as by means of bibliographic search on a specific topic prepared with other students that will be presented followed by responses to the teacher or the other students. Herein, the interaction with the student is stronger.

Seminars (problem resolution)

The comprise sessions in which the knowledge from magisterial classes is worked in a critical and deep manner. The main goal is to promote the analysis and synthesis skills, the critical reasoning and the ability to solve problems.

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

Examinations

In the examinations, the knowledge of the contents in the course program will be evaluated with special emphasis in the resolution of problems.

There will be two qualifying examinations that will be mandatory and that will be carried out in April (40%) and June (50%) and a possible final examination at the end of June.

Evidences

They will be carried out over the course and will consist in exercises or short works that will be made in an individual way or in a group, in the classroom or at home. The works no presented will compute a 0 when the average will be calculated. The overall qualification of all evidences will be a 10% of the final mark.

To pass the course, it is necessary:

a) To have a mark $\geq$ 5.0 in both qualifying examinations.

Those students that do not achieve the requirement a), must pass the course at the final examination, which will include all the subjects of the course.

To participate in the final examination in order to pass the course, the students should have been evaluated in several activities whose relative weight will be $\geq$2/3 of the overall qualification of the course. If the evaluation activities carried out represents a balanced weight $\leq$67% of the final mark, the student will be "not able to be evaluated".

The students that pass the qualifying examinations but want to improve the mark can attend the final examination. In this case, the final mark will be that of the final examination.

It is mandatory to get a mark $\geq$ 5.0 over 10 inthe overall evaluation to pass the course.

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*, 11th Edition, John Wiley and Sons, New York, 2013 (o edicions anteriors).

(2) K. Peter. C. Vollhardt; Neil E. Schore, *Organic Chemistry* (7th Ed), Ed. Freeman, WH & Co., 2015 (o edicions anteriors).

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

Other references will be indicated during the course