Organic Chemistry

Code: 100914
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biotechnology	FB	1

Contact

Name: Antonio Franconetti Garcia

Email: antonio.franconetti@uab.cat

Teaching groups languages

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

Prerequisites

There are no prerequisites to follow the course successfully.

Nonetheless it would be desirable if students were familiar with basic knowledge of the subject "Foundations of Chemistry" given in the first semester of these studies. In addition, the students must recall all the basic Organic Chemistry already studied before entering at the university.

Objectives and Contextualisation

Organic Chemistry studies carbon chemistry. Living beings are composed of compounds where their main base is this atom. It is a basic and fundamental material to understand vital processes in living beings; processes that will be studied in other subjects of this Degree.

In this subject, the introductory basis for the chemistry of carbon compounds is provided. The structure of compounds, their conformations and stereochemistry will be analyzed, always showing the importance of these concepts in the activity of enzymes and some compounds in the organism. The various functional groups that appear in organic compounds will also be presented. The guidelines will be given to understand the reactivity of the organic molecules and they will put examples of this in biologicalprocesses in order to understand them.

The training objectives of the subject can be summarized in:

1.- Understanding the need to know the reactivity of organic molecules in order to understand the biological mechanisms.

2.- To know the most common functional groups that may be present in organic molecules.

3.- To know how to name and recognize organic compounds.

4.- To be able to predict the physical properties of organic compounds according to their structure and intramolecular interactions.

5.- To know how to identify the different structures that may have compounds with the same molecular formula (isomers) and see how small changes affect a lot in their properties and activities.

6.- To understand the reactivity of organic molecules, depending on the functional groupsthat they present in their structures, and to be able to understand the functioning of the fundamental biological processes.

7.- To know the structure of several primary metabolites and their potential reactivity.

Learning Outcomes

1. CM11 (Competence) Formulate chemical synthesis strategies for products of special relevance in the biotechnological field.
2. CM12 (Competence) Working collaboratively in teams to solve problems in the field of general chemistry.
3. KM10 (Knowledge) Describe chemical bonding and intermolecular forces.
4. KM11 (Knowledge) Describe the mechanisms and main types of reactions of the main organic compounds.
5. SM10 (Skill) Correctly solve calculations relating to simple chemical reactions.
6. SM11 (Skill) Correctly interpret data and observations in the field of general chemistry.
7. SM12 (Skill) Determine the chemical properties of molecules relevant to living organisms and of special interest for biotechnological processes.

Content

Lesson 1: Introduction to the chemical bond. Chemical bond. Covalent bond (Lewis' structures, molecular geometry, resonance, Lewis' acids and bases, electronegativity and polarity). Hybrid orbitals and orbital overlapping. Simple and multiple covalent bonds (geometry and properties). Inter- and intramolecular non-covalent interactions.

Lesson 2: Organic compounds. Structure and formula of organic molecules. Classification (functional groups, oxidation state). Hydrocarbons (alkanes, alkenes and aromatic hydrocarbons). Organic compounds of the first oxidation state (organic halides, alcohols, phenols, esters, amines and thiols). Organic compounds of the second oxidation state (aldehydes and ketones). Organic compounds of the third oxidation state (acids and their derivatives). Nomenclature, structure and physical properties.

Lesson 3: Conformational analysis and stoichiometry. Structural isomers. Conformational isomers. Conformational analysis of alkanes (ethane and n-butane). Ring tension in cycloalkanes and conformational analysis of cyclohexane. Cys-trans and cyclic isomers. Alkanes Z-E isomers. Stereoisomers (enantiomers and diastereomers). Chirality. Optic activity (rotation power). Racemic mixtures. Relevance of chiral compounds in living organisms. Configuration (representation and R-S nomenclature). Compounds with several asymmetric centers. Meso forms. Topicity: homotopic, enantiotopic and diastereotopic groups and faces.

Lesson 4: Organic reactions. Thermodynamics and kinetics of organic reactions. Intermediates and reaction profiles. Classification of the organic reactions (addition, elimination, substitution and other reactions). C-oncept of electrophile and nucleophile.

Lesson 5: Addition to Carbon-Carbon multiple bonds. Addition reactions to Carbon-Carbon double bonds. Addition of hydrogen halides; cationic intermediates, Markovnikoff's rule. Water addition catalyzed by acids. Addition of alcohols. Addition of halogens. Additionof hydrogen (hydrogenation heat and double bond stability). Alkene oxidation. Addition to triple bonds. Biological examples.

Lesson 6: Nucleophile replacement on a saturated carbon. General concepts. Nucleophilic substitution on alkyl halides, alcohols and its derivatives. SN1 and SN2 reaction mechanisms, kinetics and stereochemistry. Factors affecting substitution reactions. Synthetic applications. Preparation of alcohols, ethers, alkyl halides, thiols and tioether, amines and nitrile derivatives. Biosynthetic applications.

Lesson 7: Elimination reactions. E1 and E2 elimination reactions (kinetics and mechanisms). Regiochemistry (Zaitsev's rule) and stereochemistry of reactions. Competition with substitution reactions. C-O double bond formation.

Lesson 8: Nucleophilic addition to the carbonyl group: Carbonyl group reactivity (electron structure, mechanisms of addition). Addition of alcohols (hemiacetal and acetal, with examples in carbohydrates). Addition of ammonia and its derivatives. Addition of hydrogen cyanide. Addition of hydride (NADH). Addition of enolates (aldol condensation). Quinones.

Lesson 9: Nucleophilic substitution to carbonyl groups and related groups: Organic compounds of the third oxidation state (electron structure). Addition-elimination mechanism. Interconversion reactions between functional groups (acids, acid halides, acid anhydrides, esters, thioesters and amines). Hydrolysis and saponification of carboxylic acid derivatives. Addition of hydride. Substitution by enolates (Claisen's condensation). Biosynthesis of fatty acids. Structural analysis of lipids, amino acids and peptides. Organic derivatives of phosphoric acid.

Lesson 10: Aromatic compounds: Aromaticity. Aromatic heterocyclic compounds. Purine and pyrimidine bases.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Autonomous activities	82.8	3.31	CM11, KM10, KM11, SM10, SM11, SM12, CM11
Class room exercises	15	0.6	CM11, CM12, SM10, SM11, CM11
Lectures	30	1.2	CM11, KM10, KM11, SM11, SM12, CM11
Solving exercises to be handed	16	0.64	CM11, CM12, SM10, SM11, CM11

The subject of Organic Chemistry will be organized in weekly welfare classes, two lectures and one for solving problems. The classes of problems will be done in two groups on different days.

Next we will analyze these face-to-face sessions, as well as other activities that will be carried out in order to achieve a better learning of the students.

Lectures master classes

During these classes the teacher will convey the basic knowledge of the subject; knowledge that will have to be complemented with the individual work of the student consulting the literature that the professor will indicate as well as participating and realizing the programmed activities. The lectures are a type of activity that demands little interactivity with the student; they are conceived as a fundamentally unidirectional method of transferring the teacher's knowledge to the student. During the lectures, students will be asked to make questions that must be resolved among the students using their previous knowledge and those that will be acquired throughout the course.

During the lectures, the exercises that the students will have to solve during the course will be defined and delivered. The UAB Virtual Campus will be used to publish both the material used in the classroom, as well as the one that can be formative in this subject, as well as the exercises that need to be resolved.

Class room exercises

A dossier of exercises that the students will have to solve during the course will be handed on the first days. A selected part of these exercises will be solved by the teachers so that students learn the appropriate methodology to find the solutions. During this process, students' participation is important. Teachers will help in developing the critical sense and logical reasoning, in order to increase the ability of students to solve problems.

Resolution of exercises to be delivered (individual work)

Throughout the course, as the subjects are finished, teachers will be delivering exercises that will allow the student to reinforce and practice the basic knowledge of the subject that the teacher will have shown in class. These exercises must be done individually and will be part of the continuous evaluation of the course (obligatory activity).

First partial exam

Chemistry is a matter that has to be worked day by day. In order for students to work on the syllabus continuously, the teacher of the subject will prepare some exercises that must be delivered. Together with these indications about the learning of the students, a first partial exam will be prepared, which will collect about 50% of the subject matter. The first part of the contents are very practical and it is considered interesting to take this exam to verify that the students have understood them and bring them up to date.

Second partial exam

The second part of the subject focuses mainly on the reactivity of the different functional groups, emphasizing the mechanisms of these reactions. The second test of evaluation of the subject will be done once the theoretical classes have finished and will be mainly focused on this reactivity, although it may include some of the concepts that have already been evaluated in the first partial exam.

These exams will be mainly composed of practical exercises to be solved and some short theoretical questions.

With all these activities, it is intended that students achieve the contents of the subject with a continuous work.

Programming of the subject

During the realization of the subject, the lectures' or exercises' teacher will hand some exercises to be part of the continuous evaluation. No date is set for these deliveries, since it depends on the evolution of the syllabus and the group of students that conform to the subject. The time spent in carrying out these exercises should be short (approx. 1h per delivery), which is why it is considered that it will not imply any extra burden even though overlapping with deliveries from other teachers.

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
Exercices handing	5%	0.2	0.01	CM11, CM12, SM10, SM11
First partial exam	45%	3	0.12	CM11, KM10, KM11, SM10, SM11, SM12
Second partial exam	50%	3	0.12	CM11, KM10, KM11, SM10, SM11, SM12

The evaluation of this subject will be assessed in a continuous or single way, in order to achieve the following main objectives:

1.- Monitor the teaching-learning process, allowing both the student and the teacher to know the degree of achievement of competencies and correct, if possible, the deviations that occur.

2.- To encourage the student's continued effort to over-exert, often useless, to study at the last minute for the final exam.

3.- Verify that the student has achieved the competences determined in the syllabus.

In addition, the following detailed objectives will also be evaluated:

1.- Understanding the need to know the reactivity of organic molecules in order to understand the biological mechanisms.

2.- To know the most common functional groups that may be present in organic molecules.

3.- To know how to name and recognize organic compounds.

4.- To be able to predict the physical properties of organic compounds according to their structure and intramolecular interactions.

5.- To know how to identify the different structures that may have compounds with the same molecular formula (isomers) and see how small changes affect a lot in their properties and activities.

6.- To understand the reactivity of organic molecules, depending on the functional groupsthat they present in their structures, and to be able to understand the functioning of the fundamental biological processes.

7.- To know the structure of several primary metabolites and their potential reactivity.

OPTION A: Continuous assessment (this the option by default)

The assessment of the course will be done individually. This monitoring will consist of:

Exercises to deliver. Throughout the course, as the subjects are finished, teachers will give the students exercises to practice and reinforce some of the knowledge that must be achieved; These exercises will be collected in the Virtual Campus of the subject. The answers must be submitted the day indicated by the teacher. The average grade obtained with these exercises will represent 5% of the overall mark of the subject.

First partial exam. Once taught during the master classes approximately half of the subject of the course, will be a partial exam that will allow to verify that the students are acquiring the knowledge until the moment. This exam will have a weight of 45% of the overall grade. The test will be done during the week at the time the coordination is considered more appropriate and the date will be indicated with weeks in advance. Attendance to this test will be mandatory for everyone. To be able to average this scoring with the second exam, the student should have obtained more than 4,0 points over 10 in this exam.

Second partial exam. Once the theoretical classes havefinished, the second partial exam will be programmed which will include practically the second half of the contents offered throughout the course. This examination will be focused mainly on the reactivity of organic reactions, their mechanismsand the obtained products. Some of the basic concepts included in the first partial exam, such as the stereo-chemistry of the products orthe different projections in which the molecules can be drawn, for example, among others, may be part of this second final exam. Your weight in the final mark will also be 50% of the overall grade. To be able to average this scoring with the first exam, the student should have obtained more than 4,0 points over 10 in this exam.

Retake exam. To be able to participate in this retake exam, students should havebeen previously evaluated on a set of activities with a weight > 67% (i.e., they had to have taken, at least, both partial exams). This exam will have two parts, one for each of the partials, and the student should take all the partials with a scoring lower than 5,00.

Excepcionally, students having passed the partial exams will be able to take this exam to improve their scorings. However, if they do it, they loose all the rights on the previous scorings. A scoring higher than 5,0 over 10 must be obtained to be able to make the average with the rest of scorings.

The "non-evaluable" ones. A student enrolled in the subject will receive the "Non-evaluable" grade if the number of assessment activities carriedout has been less than 67% of those programmed for the subject (that is, no more than one partial exam and the class exercises).

The review of the results of each of the parts that will be used to evaluate the students will be done individually in tutorials previously agreed with the teacher. There will be a review date for the exams carried out that will be indicated on the day the notes are made public with a minimum of 24 hours in advance.

In the event that a student could not perform any of the compulsory tests due to justified causes, presenting the corresponding certificates that confirm it, and whenever the coordinator considers it appropriate, another date will be arranged with the teacher of the subject to be able to perform the test. The coordinator and the teacher should be notifiedas soon as possible by e-mail, in order to arrange the new test date.

OPTION B: Single assessment (to join this option, the student should notify its intention to the academic office (Gestió Acadèmica) of the Faculty of Biosciences and to the professor, in the time period stablished for this purpose)

The single assessment is only applicable to the two partial exams and will consist in a single test where the contents of the whole subject will be evaluated, through exercices of different typology (multiple choice, problem solving, development of concepts, etc.). The obtained scoring will count the 95% of the final subject scoring. The other 5% will be obtained by the exercises to deliver, that will follow the same procedure than in the continuous assessment. The minimum scoring to pass the subject is of 5,00 over 10. The test for the single assessment will be at the same day, time and place than the last test for the continuous assessment (second partial exam). The single assessment test will have a retake exam for those students scoring fail (less than 5,00) that will be at the day fixed for the retake of the subject, as long as the student have taken the first test for the single assessment.

Bibliography

The course material will be found in the space of the subject of the Virtual Campus of the UAB. Among this material you will find: general information, transparencies used in class or support, videos of support, exercises to be delivered, reinforcement exercises (if deemed necessary), partial exam notes and any other information that is considered of interest.

Bibliography:

¨ G.H. Schmid. Biological chemistry. Ed. Inter-American.1986.

¨ T. W. G. Solomons. Organic Chemistry (12th Ed.), John Wiley and Sons, New York, 2017 (or any previous edition).

¨ K. P. C. Vollhardt, N. E. Schore. Organic Chemistry. Structure and Function (8th Ed.), W. Freeman and Co., New York, 2018 (or any previous editions).

¨ Organic Chemistry Nomenclature. Sections A, B and C. Final rules, Institut d'Estudis Catalans, Barcelona, 1989.

¨ W. R. Peterson, Formulation and Nomenclature in Organic Chemistry, EUNIBAR, 1987.

In general, any book on Organic Chemistry will be useful to follow this subject.

Electrònic books:

- M.P. Cabildo [y otros 3], *Química orgánica*, UNED - Universidad Nacional de Educación a Distancia, 2008. Llibre en línia. Enllaç: https://bibcercador.uab.cat/discovery/fulldisplay?docid=alma991038289349706706&context=U&vid=34CSUC_U/

- Paula Yunakis Bruice, *Essential organic chemistry,* 3rd Ed., Pearson Education, 2016. Llibre en línia. Enllaç: https://cataleg.uab.cat/iii/encore/record/C__Rb2084284?lang=cat

Software

- *ChemSketch*, ACDLabs. This is a free software for drawing molecules. Link: https://www.acdlabs.com/resources/freeware/chemsketch/index.php

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	411	Catalan/Spanish	second semester	afternoon
(PAUL) Classroom practices	412	Catalan/Spanish	second semester	afternoon
(TE) Theory	41	Catalan/Spanish	second semester	morning-mixed