



Universitat de Lleida

DEGREE CURRICULUM  
**ORGANIC CHEMISTRY AND  
BIOCHEMISTRY**

Coordination: LARA AYALA, ISABEL

Academic year 2022-23

## Subject's general information

|   |   |               |                  |                  |
|---|---|---------------|------------------|------------------|
| <b>Subject name</b>                             | ORGANIC CHEMISTRY AND BIOCHEMISTRY                      |               |                  |                  |
| <b>Code</b>                                     | 102519  |               |                  |                  |
| <b>Semester</b>                                 | 2nd Q(SEMESTER) CONTINUED EVALUATION                    |               |                  |                  |
| <b>Typology</b>                                 | <b>Degree</b>   | <b>Course</b> | <b>Character</b> | <b>Modality</b>  |
|   | Bachelor's Degree in Agricultural and Food Engineering  | 1             | COMMON/CORE      | Attendance-based |
| <b>Course number of credits (ECTS)</b>          | 6   |               |                  |                  |
| <b>Type of activity, credits, and groups</b>    | <b>Activity type</b>                                    | PRALAB        | PRAULA           | TEORIA           |
|   | <b>Number of credits</b>                                | 0.8           | 1                | 4.2              |
|   | <b>Number of groups</b>                                 | 6             | 2                | 1                |
| <b>Coordination</b>                             | LARA AYALA, ISABEL                                      |               |                  |                  |
| <b>Department</b>                               | CHEMISTRY   |               |                  |                  |
| <b>Important information on data processing</b> | Consult <a href="#">this link</a> for more information. |               |                  |                  |

| Teaching staff                       | E-mail addresses                | Credits taught by teacher | Office and hour of attention |
|--------------------------------------|---------------------------------|---------------------------|------------------------------|
| DAVID , CALIN ADRIAN                 | calinadrian.david@udl.cat       | ,4                        |                              |
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## Subject's extra information

### PERSONAL PROTECTIVE EQUIPMENT (PPE) for the practical sessions

It is **MANDATORY** that students have the following personal protective equipment (PPE) in the course of teaching practices.

- Laboratory coat UdL unisex
- Safety glasses
- Chemical / Biological protection gloves

The PPE can be purchased at UdL's ÚDELS store

Center for Cultures and Cross-Border Cooperation - Cappont Campus

Carrer de Jaume II, 67 low

25001 Lleida

<http://www.publicacions.udl.cat/>

For more information, check the product listings: <http://www.biotechnologia.udl.cat/en/pla-formatiu/equipament.html>

For other protection equipment (for example, caps, respiratory masks, etc.), they will depend on the type of practice to be performed. In this case, the responsible professor will inform if the use of these specific PPE is necessary.

Not carrying the PPE described or not complying with the general security regulations detailed below will mean that the student can not access the laboratories or have to leave the same.

## GENERAL SAFETY RULES IN LABORATORY PRACTICES

- Maintain the place of performance of clean and tidy practices. The work table must be free of backpacks, folders, coats ...
- In the laboratory you can not come with shorts or short skirts.
- Bring closed and covered shoes during the performance of the practices.
- Bring long hair always collected
- Keep the cords fit to protect against spills and spills of chemical substances.
- Do not carry wide bracelets, pendants or sleeves that can be trapped by the equipment, assemblies ...
- Avoid wearing contact lenses, since the effect of chemicals is much greater if they are introduced between the contact lens and the cornea.
- Do not eat or drink in the laboratory
- Smoking is prohibited within laboratories
- Wash your hands whenever you have contact with a chemical and before leaving the laboratory.
- Follow the teacher's instructions and consult any questions about security

## Learning objectives

### Knowledge objectives:

It is a first-year subject, with basic training in the fundamentals of organic chemistry and biochemistry, both from a structural and reactivity point of view. The knowledge acquired should allow the student to understand the concepts of isomerism related to organic compounds and to chemically interpret the biochemical processes that will be seen later in other subjects of the degree.

More specifically, the objectives of the course are:

- Achieve knowledge and understanding of the basic concepts of the various binding theories applicable to organic compounds.
- Know the basic organic nomenclature, recognize functional groups and the main associated properties.
- Be able to describe and understand the different types of isomerism of organic compounds.
- Be able to identify and describe the reactivity and reaction mechanisms of the main organic reactions, as well as the various factors that affect them.
- Know the structural bases that explain the function of the main biological macromolecules: carbohydrates, lipids, proteins, enzymes and nucleic acids.

## Competences

### Basic Competences

CB1. That students have demonstrated to possess and understand knowledge from the base of general secondary education at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study .

CB2. That students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature.

CB4. That students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences

CB5. That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy

## General Competences

CG1. Analyze specific situations, define problems, make decisions and implement action plans in search of solutions.

CG2. Interpret studies, reports, data and analyze them numerically.

CG3. Select and manage the available written and computerized sources of information related to the professional activity.

CG4. Work alone and in a multidisciplinary team.

CG5. Understand and express themselves with the appropriate terminology.

CG6. Discuss and argue in various forums.

CG7. Recycle in new technological advances through continuous learning.

CG8. Value comprehensive training, personal motivation and mobility.

CG9. Analyze and assess the social and ethical implications of professional activity.

CG10. Have a critical and innovative spirit.

CG11. Analyze and assess the environmental implications in professional activity

## Subject contents

### THEORETICAL AGENDA

#### 1. Introduction (7 h).

Object of Organic Chemistry and Biochemistry. Links in Organic Chemistry. Lewis theory. Rules of structural chemistry. Formal charge. Resonant structures. Theory of repulsion of electron pairs. Intermolecular forces in Organic Chemistry. Functional groups and Classes. Chemical radical.

#### 3. Isomerism (9 h).

Isomers. Types of isomers. Structural isomers. Stereoisomers. Optical isomers. Optical activity. Racemic mixtures. Representation of stereoisomers. Absolute configurations R, S. Relative configurations D, L. Diastereoisomers. Meso forms. Geometric stereoisomers of cycles and double link. Conformational analysis. Formers in acyclic compounds and in cyclic compounds. Newman's projections.

#### 3.- Basic physical-chemical properties (5 h).

As the characteristics and structure of molecules are useful to explain properties of matter such as its physical state at different temperatures and its solubility. Application to the most important classes within organic chemistry: hydrocarbons, halogenated derivatives, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids and derivatives thereof

#### **4. Chemical kinetics (7 h).**

Reaction speed concept. Reaction rate constant. Order of reaction. Median life time concept. Study of processes with kinetics of order 0, 1 and 2. Systems to determine the order of a reaction. Mechanism of reactions. Stages of a reaction. Transitional and intermediate state. Activation energy. Effect of temperature on the rate of the reaction. Arrhenius Law. Effect of the catalyst on the rate of the reaction.

#### **5.-Basic concepts of chemical reactivity (9 h).**

How the characteristics and structure of molecules are useful to explain the reactivity of substances. Homolytic and heterolytic breaking and opening of chemical bonds. Types of reactions according to the exchanges of atoms and bonds that take place: isomerization reactions, substitution reactions, addition reactions, elimination reactions, redox reactions. Concept of radical, nucleophile and electrophilic center. Application to the most important classes within organic chemistry: hydrocarbons, halogenated derivatives, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids and derivatives thereof.

#### **6. Carbohydrates (4 h).**

Characteristics. Monosaccharides. Classification. Properties. Monosaccharide cyclization. Mutarotation. Derivatives formation. Glycosidic bond. Disaccharides. Types. Nomenclature. Polysaccharides: characteristics and types. Homopolysaccharides and heteropolysaccharides. Glucoconjugates.

#### **7. Amino acids, peptides and proteins (4 h).**

Protein amino acids. General structure. Classification. Properties. Chirality. Amphoteric character. Dissociation equilibria. Isoelectric point. Henderson-Hasselbach equation. Peptide bond. Structure and properties. Oligo- and polypeptides. Fibrous and globular proteins. Structural levels. Primary, secondary, tertiary and quaternary structure. Forces involved in the stability of protein structures. Native conformations. Denaturation.

#### **8. Enzymes (4 h).**

Definition, properties and classification. Apoenzyme and holoenzyme. Concept of cofactor, coenzyme, cosubstrate and prosthetic group. Active center. Definition and properties. Michaelis-Menten kinetics. Lineweaver-Burk transformation. Activation and inhibition of enzymatic activity. Dependence of pH and temperature. Denaturation of enzymes. Irreversible inhibitors. Reversible inhibitors. Competitive inhibitors. Non-competitive inhibitors. Uncompetitive inhibitors.

#### **9. Lipids (2 h).**

Characteristics. Fatty acids. Nomenclature. Structure and properties. Saponifiable lipids: structures, types and properties. Unsaponifiable lipids: structures, types and properties. Supramolecular structures.

#### **10. Nucleic acids (2 h).**

Nucleosides and nucleotides. Structure. Functions. Oligo- and polynucleotides. Structure. Phosphodiester bond. DNA. Structure. Forces involved in its stabilization. Functions. RNA. Structure. Major types: mRNA, tRNA, rRNA. Features and functions.

### **PRACTICAL ACTIVITIES**

#### **Laboratory practices**

##### **Practice 1: Use of Molecular Models (2 h).**

Basis. Construction of organic molecules through molecular models. Conformation studies. Stereoisomer studies. Enantiomers. Diastereoisomers. Meso forms.

## Practice 2: Extraction procedures (2 h).

Basis. Solid-liquid extraction and liquid-liquid extraction. Applications in mixture separation: Separations based on pH, separations based on polarity.

## Practice 3: Separation processes (fundamentals of chromatography) (2 h).

Basis. Thin layer chromatography. Applications. Qualitative analysis of ergosterol.

## Practice 4: Titration of amino acids (2 h).

Basis. Construction of titration curves of a basic amino acid. Buffering capacity. PKas and Isoelectric point.

## Problem seminars (10 h):

Sessions in small groups where the main concepts seen in the theory classes will be reinforced by solving problems and multiple choice questions. They will essentially understand aspects of Lewis Theory of organic compounds, concept and type of isomers, chemical reactivity and kinetics, amino acid dissociation equilibria, enzyme kinetics. Isomerism and types of bonds in Carbohydrates

## Methodology

Methodological axes are:

- Master classes of theory.
- Classes of problems and questions in small groups.
- Laboratory practices in small groups with the aim of expanding theoretical knowledge and knowing the handling of material and basic laboratory techniques.

## Development plan

| Type of activity   | Description                                   | Student Face-to Face Activity                                |       | Student non face-to -face activity                           |       | Evaluation<br>Hours | Total time |       |
|--------------------|---|--|-------|--|-------|---------------------|------------|-------|
|                    |   | Objetivs   | Hours | Student work   | Hours |                     | Hours      | Hours |
| Theory             | Master class (Classroom. Large group)         | Explanation of the main concepts                             | 42    | Study: know, understand and synthesize knowledge             | 59    | 3                   | 83         | 4     |
| Problems and cases | Participatory class (Classroom. Small groups) | Troubleshooting and cases                                    | 10    | Learn to solve problems and cases                            | 21    | 2                   | 45         | 1.5   |
| Laboratory         | Laboratory practices (Small groups)           | Execution of the practice, understand phenomena, measure.... | 8     | Execution of the practice, understand phenomena, measure.... | 4     | 1                   | 22         | 0.5   |

|        |    |    |   |     |   |
|--------|----|----|---|-----|---|
| Totals | 60 | 84 | 6 | 150 | 6 |
|--------|----|----|---|-----|---|

## Evaluation

| Type of activity | Evaluation activity                                | Qualification |     |
|------------------|--|---------------|-----|
|                  |  | Number        | (%) |
| Master lesson    | Written tests on the theory of the subject program | 2             | 40  |
| Test             | Resolution of exercises and on-line tests          | 3             | 10  |
| Problems         | Delivery or written tests on practical cases       | 2             | 40  |
| Laboratory       | Delivery of reports or written tests               | 4             | 10  |
| Total            |  |               | 100 |

## Bibliography

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## Others

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