COURSE DATA

DATA SUBJECT

Code: 36470
Name: Biological Organic Chemistry
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Organic Chemistry Applied	ELECTIVES

COORDINATION

RAMIREZ DE ARELLANO SANCHEZ MARIA DEL CARMEN

SUMMARY

The subject "Organic Biological Chemistry" is part of the "Applied Organic Chemistry" subject of 22.5 ECTS credits within the Chemistry, Industry and Society module. It is an optional subject of 6 ECTS credits that is taught in the 8th semester of the fourth year.
The basic objective of this subject is to deepen and expand the knowledge acquired in the Organic Chemistry courses. Its focus is mainly directed to the study of the compounds that are part of the biomolecules (carbohydrates, amino acids, nucleotides and also phospholipids), to study their characteristics and reactivity, as well as the formation of these biomolecules. Once deepened in this, we must study the weak interactions that are present and that will be the key of the enzymatic mechanisms.
Knowledge of these processes, which occur in all living organisms, is essential to provide the student with sufficient resources for its application in the design of new bioactive compounds. Regarding the Sustainable Development Goals (SDGs), it is expected that students will be able to acquire a special sensitivity for the sustainable management of water (SDG 6), raw materials and energy sources (SDG 7) as well as for a sustainable development compatible with the environment (SDGs 11, 12, 13, 14 and 15).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Although the subject has a basic level, it is essential that the student has a solid formation in the terminology, nomenclature and structural properties of functional groups and organic molecules, that is, that has the learning bases of Organic Chemistry I, II and III. It is also important that the student is familiar with and demonstrates fluency with stereochemistry.
It is fundamental to have clear the fundamental concepts of Biochemistry.

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

At the end of the course, the student will be able to address new problems and develop strategies to solve them.

At the end of the course, the student will be able to identify chemical elements and compounds, including their production, structure, reactivity, properties and applications.

At the end of the course, the student will be able to identify chemical processes in everyday life.

At the end of the course, the student will be able to identify the structure and reactivity of the main classes of biomolecules and the chemistry of key biological processes.

At the end of the course, the student will be able to implement sustainable and environmentally friendly methodologies.

At the end of the course, the student will be able to relate theory and experimentation.

At the end of the course, the student will be able to solve problems effectively.

At the end of the course, the student will demonstrate inductive and deductive reasoning skills.

At the end of the course, the student will demonstrate the ability to analyse, synthesise and apply critical reasoning.

At the end of the subject, the student will evaluate, interpret and synthesize the chemical data and information correctly.

Capacidad de análisis, síntesis y razonamiento crítico en la aplicación del método científico.

Collaborate effectively in teams, assuming responsibilities and leadership roles and contributing to collective improvement and development.

Communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Contribute to the design, development and implementation of solutions that address social needs, taking the Sustainable Development Goals as a reference.

Demonstrate critical and self-critical reasoning within the field of study, considering aspects such as

professional ethics, moral values and the social implications of the different activities undertaken.

Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Ser capaces de analizar la influencia que sobre el diseño del sistema de información de costes, ejercen, tanto la actividad concreta desarrollada por la entidad como la tecnología utilizada, la estructura organizativa y el estilo de dirección. Calcular costes preestablecidos y relacionarlos con la planificación y el control de la actividad interna. Seleccionar aquellos indicadores de gestión que faciliten el desempeño personal, estableciendo la frecuencia y el formato en función del usuario de destino.

Understand and recognise, from within the discipline, inequalities based on sex and gender in society; integrate different needs and preferences related to sex and gender into problem-solving and solution design.

DESCRIPTION OF CONTENTS

1. Fundamentals

Scope of study. Natural products. Primary and secondary metabolism. Introduction to enzymatic mechanisms. Frontier orbitals and reactivity. Hydrogen bond and proton transfer. Prebiotic chemistry. Nonbonding interactions Modular design of basic biooligomers.

2. ADN

Deoxyribonucleotides and DNA: aromaticity, acidity and basicity, hydrolysis and chemical modifications. DNA forms: base pairing, tautomery, pi-stacking, reversible folding, self-assembly, DNA ligases. DNA superstructure Replication of DNA. Chemical synthesis of DNA. Separation of DNA by electrophoresis. Recombinant DNA. Photochemistry of nucleic acids. DNA as a target in the design of cytotoxic drugs.

3. ARN

Ribonucleòtids. Estructura dARN. Síntesi dARN. Control transcripcional. Ribonucleotides. RNA structure. RNA synthesis. Transcriptional control. mRNA processing in eukaryotes. Controlled degradation of RNA. Ribosomal translation of mRNA into proteins. Libraries of proteins from oligonucleotides

4. Peptide and Protein structure

Amino acids and peptides. Solid-phase peptide synthesis. Secondary structure of proteins. Disulfide crosslinks. Functional and estructural role of proteins domains. Higher levels of protein structure.

5. Protein function

Receptor-ligand interactions. A quantitative view of enzyme function. A mechanistic view of enzymes that catalyze multistep reactions. Enzymes that use organic cofactors. Engineering improved protein function.

6. Glycobiology I

Structure and nomenclature of monosaccharides. Polar and stereoelectronic effects. Chemistry and enzymology of the glycosodic bond. Mechanism of reteining and inverting glycosyl hydrolases and transferases. Relevant disaccharides and polysaccharides. Homeostasis of glucose and diabetes. Sweeteners.

7. Glycobiology II

Glycoproteins: O- and N-glycosylation of human proteins. Glycoproteins in drugs and cell recognition processes. Glycolipids: glycosphingolipids, glycosylphosphatidylinositols. Glycosylation in the cytosol. Chemical synthesis of oligosaccharides. Function of glicans in cell recognition processes: lectins, cell adhesion, blood groups antigens, toxins. Analysis of protein-glycan interactions.

8. Polyketides and terpenes

The Claisen reaction in polyketide biosynthesis. Biosynthesis of fatty acids. The biological role of human polyketides. Non-human polyketides natural products. Bioactive peptides and secondary metabolites. Human terpenes. Non-human terpene natural products.

9. Chemical control of signal transduction

Signal transduction. Overview of signal transduction pathways in human cells. Nuclear receptors. Cell surface receptors and transcription factors. Receptor tyrosine kinases. G protein coupled receptors. Ion channel receptors. Tumor necrosis factor receptors. Small gaseous molecules receptors.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	10,00
Independent study and work	60,00
Preparation of lessons	20,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The subject is designed for the student being the protagonist of their own learning. The subject structure is as follows:

- Theory lectures.- Two or three classes per subject for the discussion with the students of the most complicated subjects or those with present the higher difficulty. These classes are complemented by personal study time.
- Questions lectures.- These classes objective is the application of the knowledge that the students have acquired in theory classes. Students must have previously worked on the questions that will be solved. The resolution of these problems will be carried by the teacher or the students, either in a group or individually.
- Supervisions.- There will be 9 in total distributed evenly throughout the course. The duration of these sessions will be of one hour. The teacher will evaluate the learning process of the students. In the tutorial sessions the works that have been entrusted will be collected. Likewise, the tutorials will serve to solve all the doubts that may have arisen throughout the classes and will guide the students on the best methods for the resolution of problems that may arise. Advanced problems will also be proposed to stimulate students.

EVALUATION

The evaluation of the learning will be carried out continuously by the teacher. The different sections that will be evaluated are the following:

1. Direct evaluation of the teacher (5 %): This evaluation will take into account different aspects, among which include:

- Attendance and participation reasoned and clear in the discussions.
- Progress in the use of the characteristic language of biological organic chemistry.
- Problem solving and raising doubts.
- Critical spirit.

2. Seminars of Organic Chemistry and Tutorials (globally 15 %): The note of each student in this section will take into consideration

- Attendance / participation.
- Knowledge of the material explained up to that moment.
- Correction of the problems assigned to each student.

3. Exams (80 %): The exams will take place on the dates indicated by the faculty. Throughout the course, there may be controls to determine the evolution of continuous learning, whose qualification will be part of the "seminars and tutorials" section. The minimum number of points in this section is 40 over 100 in order to pass the subject. The exams will consist of theoretical-practical questions related to the subject and relationship questions. Questions of relationship are understood as questions that oblige the student to relate aspects of the subject that appear in different topics. These questions will allow the teacher to assess both the student's global knowledge and his or her ability to express themselves in writing. The time spent on exams will be limited so that the student demonstrates his ability to outline and summarize.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

- D. Van Vranken and G. Weiss, Introduction to Bioorganic Chemistry and Chemical Biology, Garland Science, 2013. 1ª Edición.

- J. Clayden, N. Greeves and W. Stuart, Organic Chemistry, Oxford University Press, 2012. 2ª Edición.

- J. E. McMurry and T. P. Begley, The Organic Chemistry of Biological Pathways, Roberts & Company Publ., 2016, 2ª Edición.

- J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe and J. B. Harborne, Natural Products. Their chemistry and biological significance, Longman Scientific and Technical, 1994, 1ª Edición.

- A. Varki, R. D. Cummings, J.D. Esko et al., editors, Essentials of Glycobiology, Cold Spring Harbor

Laboratory Press, 2022, Edición 4ª https://www.ncbi.nlm.nih.gov/books/NBK579918/

- R. Cooper and G. Nicola, Natural Products Chemistry. Sources, Separations, and Structures, CRC Press, 2015, 1ª Edición.

- J. A. Marco, Química de los Productos Naturales, Editorial Síntesis, 2006, 1ª Edición.

- RCSB Protein Data Bank: biological macromolecular structures enabling breakthroughs in research and education, 2022, Helen M. Berman, et al., Nucleic Acids Research 2000, 28, 235. http://www.rcsb.org/

- KEGG: Kyoto Encyclopedia of Genes and Genomes, M. Kanehisa, Post-genome Informatics, Oxford University Press, 2000 https://www.kegg.jp/kegg/

- P. M. Dewick, Essentials of Organic Chemistry, Ed. Wiley, 2006, 1ª Edición.