COURSE DATA

DATA SUBJECT

Code: 33164
Name: Biomolecular chemistry
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Chemistry	BASIC

COORDINATION

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SUMMARY

Chemistry of Biomolecules is a subject of basic training of four-month nature that is taught in the second term of the first year of the degree in Biotechnology. In the curriculum there are a total of 6 ECTS credits. With this subject is intended that the student deepen in those knowledge of Organic Biological Chemistry acquired in previous courses. This knowledge and skills will establish the essential basis so that the student can subsequently address the study of the different aspects of biochemistry in which biomolecules chemistry are involved. As the subject is integrated in the degree of Biotechnology, it must be specifically oriented towards biological processes.

The subject has a mixed theoretical-experimental character.

The basic lines contained in the program of the subject are articulated around the fundamental concepts in organic chemistry. In particular it is intended that the student becomes familiar with the concepts of structure, bonding, functional groups, properties and basic reactivity of organic molecules of particular biological relevance.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

In order to successfully address the subject, it is essential that the student possesses a series of prior knowledge, according to the required level courses in high school. Such knowledge includes:

Nomenclature and chemical formula, both inorganic and organic.
Set of chemical reactions.
Basic stoichiometric calculations.
Know how to apply the concept of hybridization to explain the geometry of simple molecules.
Know the different types of intermolecular forces
Identification of common base -aci

COMPETENCES / LEARNING OUTCOMES

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Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Apply analytical, synthetic and critical thinking skills in the application of the scientific method.

Assimilate ethical and legal principles in scientific research in biotechnology.

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Communicate ideas, problems and solutions within the field of biotechnology.

Conocer la estructura y el enlace de las moléculas orgánicas

Conocer las bases químicas y moleculares del funcionamiento celular

Conocer las características estructurales y funcionales de las macromoléculas

Conocer los fundamentos de transporte y saber plantear y utilizar balances de materia y energía en los procesos bioindustriales

Conocer los fundamentos físicos y químicos que determinan las propiedades de las moléculas biológicas y que rigen las reacciones en las que participan

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Distinguir los principales tipos de reacciones en Química Orgánica utilizando un enfoque mecanístico

Emplear correctamente y con soltura la calculadora científica y otras herramientas de cálculo.

Entender los conceptos de hibridación de orbitales, isomería, óxido-reducción, electrófilo y nucleófilo

Participate in multidisciplinary teams, engaging in teamwork and collaboration.

Que el estudiantado demuestre su capacidad para calcular correctamente los parámetros relevantes de un proceso o un experimento mediante la representación de los datos experimentales

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Saber expresarse correctamente en términos matemáticos, estadísticos, químicos, físicos y biológicos.

Saber formular correctamente cualquier compuesto inorgánico u orgánico de relevancia biológica e identificar sus grupos funcionales y su comportamiento en soluciones acuosas.

Saber manejar correctamente unidades de concentración y preparar disoluciones ajustadas en volumen, concentración y a pH determinado.

Saber trabajar de forma adecuada en laboratorio incluyendo seguridad, manipulación y eliminación de residuos y registro anotado de actividades.

Ser capaz de predecir las propiedades químicas y la reactividad de compuestos inorgánicos y orgánicos relevantes en biología en base a la estructura atómica y/o molecular.

Use English to write reports and to interpret information from protocols, manuals and databases.

Work in laboratories, including safety procedures, waste management and accurate activity logging.

DESCRIPTION OF CONTENTS

1. CLASSIFICATION AND NOMENCLATURE OF ORGANIC COMPOUNDS

Representation of organic molecules. Main types of organic compounds; functional group, classification of functional groups. Empirical and molecular formula. Index of hydrogen deficiency. Naming organic compounds.

2. BONDING IN ORGANIC MOLECULES

Bonds in the molecule of methane, ethane, ethylene and acetylene. Hybridization of atomic orbitals and bond length. Hybrid orbital in the oxygen and nitrogen. Bonds in formaldehyde and methylimine.

Electronegativity and bond polarity. Inductive effect. Resonant structures. Conjugation and aromaticity.

3. ISOMERISM

Classification of isomers. Structural isomers. Stereoisomers. Geometrical isomerism. Nomenclature system E / Z. Representation of three-dimensional structures. Optical isomerism. Enantiomers. Optical activity. Specific rotation. Racemic mixture. Configuration. Nomenclature system R / S. Diastereoisomers. Meso compound. Stereoisomerism in cyclic compounds. Resolution of racemates. Conformational isomers. Conformational analysis of simple alkanes. Conformations of cyclic compounds.

4. ACIDS AND BASES

Acidity. pKa tables. Electronic and structural effects affecting acidity of organic compounds. Basicity. Influence of steric and electronic effects on the basicity. Basicity of some nitrogen heterocycles. Polyfunctional acids. Acid-base interactions. Amphoteric compounds. Amino acids.

5. ORGANIC REACTIONS

Mechanism of reaction. Classification of organic reactions. Nucleophiles and electrophiles. Mechanism and kinetics of a reaction. Intermediates and transition states. Oxidation levels of organic compounds

6. NUCLEOPHILIC REACTIONS

Nucleophilic substitution, SN1 and SN2. Nucleophilic eliminations, E1 and E2. Competition between substitution and elimination

7. NUCLEOFILIC REACTIONS POF CARBONYL GROUP

Structure of the carbonyl group. Nucleophilic additions to aldehydes and ketones. Addition of water, alcohol, hydride, carbon nucleophiles, addition of ammonia and derivatives to aldehydes and ketones.

Nucleophilic substitution in carboxylic acids and derivatives. Fischer esterification. Transesterification. Esters hydrolysis. Lactones. Amides. Hydrolysis of amides. Lactams. Nucleophilic substitution in phosphoric acids.

8. CARBOHYDRATES

Classification of carbohydrates. Monosaccharides. Classification of monosaccharides. Configuration D / L. Mutarotation. Glycosides. Enolization, tautomerism and isomerization. Ether formation. Ester formation. Formation of cyclic acetals. Oxidation and reduction of monosaccharides. Disaccharides. Polysaccharides. Polysaccharide hydrolysis.

9. AMINO ACIDS, PEPTIDES AND PROTEINS

Properties of -amino acids. Acid-base properties of -amino acids. Common reactions of -amino acids. Protection of the carboxyl group. Protection of the amino group. Resolution of amino acids. Peptides and proteins. Structure of a peptide. Determination of the structure of a peptide. Analysis of the N-terminal and C-terminal amino acid.

10. LIPIDS AND NUCLEIC ACIDS

Classification of lipids. Fatty acids, Fats and Oils. Waxes. Lipids of biological interest. Components of nucleic acids. Purine and pyrimidine bases.

11. LABORATORY PRACTICALS

1. Stereochemistry of organic compounds. Molecular models.
2. Intermolecular forces and physical properties of organic compounds.
3. Acid-base extraction. Isolation and purification of a solid compound.
4. Acid-base extraction. Isolation and purification of a liquid compound.
5. Extraction and separation of a natural product.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	4,00
Theory	41,00
Laboratory	15,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	60,00
Preparation for assessment activities	30,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The course of the subject is structured around four axes: Traditional lectures, Problem classes, Small group tutorial and the development of Laboratory classes

Traditional lectures: students will attend three sessions per week. These sessions will offer an overview of the topic and will emphasize in the key concepts for understanding of it. The student will be provided with a written document containing the information for each topic in advance.

Problem classes: for these classes the students will be provided, in advance and through the Virtual Classroom, with a collection of problems that will allow them to apply the contents learnt in the theory classes.

Small group tutorial: the tutorials consist of four compulsory class attendances, it will take place in groups of no more than sixteen students. In these classes the teacher will solve individual questions or collective proposals made by the students. Tutoring session will end with the resolution, by the student, of a short question-test of about 25 minutes.

Laboratory classes: of compulsory attendance, will take place in groups of no more than sixteen students who have the constant supervision of a teacher. In the first session, the student will be provided with all the information needed to perform safely and efficiently the experimental work. Moreover, during this same session, how to elaborate a Laboratory record will be explained. At the beginning of each session, if requested and prior to any experimental work, students will submit the preparatory problems associated to the particular session resolved. Next, the professor will discuss the characteristics of the experiment, highlighting the basic concepts included therein.

EVALUATION

Assessment of student' learning will take into account three different aspects:

1. Continuous evaluation and student's progress work developed throughout the course, mainly the test resolution during the tutorial sessions (10%)

2. Written exam at the end of the course (75%): this exam will be held on the date indicated by the Faculty. In order to pass the subject is required to obtain a minimum of 50 points out of 100.

3. Evaluation of laboratory work (15%): preparation of experimental work, resolution of the proposed issues, safety rules, experimental handling and results will be considered. Part of the evaluation will consist of brief test (30 minutes) concerning the work carried out in the laboratory.

It is important to note that for the first call a minimum score of 40 out of 100 points in the previous part **3** is required.

The minimum grade to pass the subject is 50 out of 100 points.

For the second call, only the part corresponding to the theoretical and laboratory exam, or both, will be evaluated again.

NOTE: The student may renounce the continuous evaluation. In order to do so, he must submit a written resignation to the Organic Department just after the first tutoring and on the date indicated by the teacher. In this case 85% of the final grade will be associated to the written exam.

REFERENCES

- Referencia b1: Paula Yurkanis Bruice, Fundamentos de Química Orgánica. 3ª edición, Pearson Education, 2015.
- Referencia b2: Karen C. Timberlake, Química General. Orgánica y Biológica. Prentice Hall, 2011.
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- Referencia b4: F.A. Bettelheim and J. March, Introduction to Organic and Biochemistry. Ed. Saunders College Publishing. United States of America, 1990.
- Referencia b5: H. Hart, L.C. Craine, D.J. Hart, C.M. Hadad. Química Orgánica. McGraw-Hill, 2007.
- Referencia b6: "ChemBioOffice Ultra", PerkinElmer (CambridgeSoft). Amplia selección de aplicaciones y funcionalidades que permite estudiar, dibujar, formular, modelar y editar

estructuras moleculares químicas y biológicas.
- K.P.C. Vollhart y N.E. Schore, Química Orgánica, 3ª Ed Omega, 2000 (3ª Edicion).
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- Streitweiser y C.H. Heathcock, Química Orgánica. Ed. Interamericana 1986 (3ª Edición).
- J. Sales y J. Vilarrasa, Introducció a la nomenclatura química. (4ª Edición). EDUNSA, Barcelona (1994).
- https://www.uv.es/quimicajmol/index.htm > Colección de problemas interactivos de Química Orgánica con videos y gráficos.