

| Degree | Type | Year |
|---------|------|------|
| Biology | FB | 1 |

Contact

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Teachers

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Teaching groups languages

You can view this information at the [end](#) of this document.

Prerequisites

There are no official prerequisites. However, it is assumed that the student has assimilated the concepts acquired during the first term, particularly those contained in the subjects of Chemistry and Cell Biology, such as those related to chemical functional groups, chemical equilibrium, basic thermodynamics, biological membranes and cellular compartmentalization.

Objectives and Contextualisation

The course Structure and Function of Biomolecules is the first part of the subject "*Biochemistry*" in the Biology degree; it covers the structural and functional characteristics of biomolecules from a point of view which is basic and simple but also with the necessary depth required for further use, mainly related to the structure and function of enzymes and the bioenergetics concepts that will be used in the second part of the subject to be taught in the third term under the name *Biosignalling and Metabolism*. Similarly, the concepts on the structure and function of biomolecules are essential for the understanding of more specialised courses in the Biology degree.

Objectives:

- To understand, based on previously acquired chemistry knowledge, the fundamental structural characteristics of biological molecules, being able to draw conclusions about their stability, functionality and ability to replicate structures.
- To acquire the conceptual basis of bioenergetics processes as a primer to the second part of the subject Biochemistry, dedicated to metabolism.

- To understand the kinetics of enzymatic action in the context of the study of biological reactions and their metabolic relationships.
- To understand the basic methods of purification, characterization, structural analysis of biomolecules and recombinant DNA methodologies.

Learning Outcomes

1. CM17 (Competence) Design processes and experiments using biochemistry and biotechnology techniques.
2. CM18 (Competence) Interpret the kinetic and thermodynamic parameters that define enzymatic reactions to provide innovative responses to the needs and demands of society.
3. KM30 (Knowledge) Describe the basic structural and functional characteristics of amino acids, proteins, carbohydrates, lipids and biological membranes, nucleotides and nucleic acids.
4. KM31 (Knowledge) Describe the catalytic mechanisms of enzymatic reactions and their inhibition and regulation mechanisms.
5. KM32 (Knowledge) Identify the specific bibliographic sources in biochemistry that allow, in an autonomous way, to develop and broaden the knowledge acquired.
6. SM27 (Skill) Apply the most appropriate experimental approaches to the study of the structure and function of biomolecules.

Content

THEORY

Block 1. INTRODUCTION

ELEMENTS, MOLECULES, PHYSICAL ENVIRONMENT AND BIOENERGETICS OF LIVING ORGANISMS

The chemical logic of biological processes. Chemical elements present in living beings. Biomolecules: general characteristics. Biological importance of water. Non-covalent interactions in aqueous media. Ionization of water, ionic equilibrium, and buffering systems. Energy transformations in living organisms and the laws of Thermodynamics. Free energy and equilibrium constant. Universal biochemical reactions and processes.

Block 2. PROTEINS

PRIMARY STRUCTURE AND BIOLOGICAL FUNCTIONS

Classes of proteins and their functions. Structure and properties of amino acids. Stereochemistry and acid-base behavior. Peptides and the peptide bond. Protein sequence: analysis and evolutionary implications.

THREE-DIMENSIONAL STRUCTURE OF PROTEINS

General concepts on protein structure. Secondary structure: α -helix and β -sheets. Tertiary structure: fibrous and globular proteins. Protein folding: determining factors. Quaternary structure. Molecular chaperones and the proteasome. Introduction to conformational diseases. Protein structure prediction. Introduction to protein purification and characterization techniques.

STRUCTURE-FUNCTION RELATIONSHIP AND PROTEIN EVOLUTION

Oxygen storage and transport: myoglobin and hemoglobin. Allosterism and cooperativity in hemoglobin. Myoglobin and hemoglobin as examples of protein evolution. Use of protein sequences to analyze evolutionary relationships.

BIOLOGICAL CATALYSTS

Nature and function. Enzymatic cofactors. Classification and nomenclature of enzymes. Effects of catalysts on chemical reactions: general mechanisms. Description of enzymatic mechanisms. Enzyme kinetics: concept of initial velocity; Michaelis-Menten model. Enzyme inhibition. Regulation of enzymatic activity: (inhibition) allosterism, covalent modification, and changes in enzyme concentration. Biomedical and biotechnological applications.

STRUCTURAL CHARACTERIZATION

Spectroscopic methods and their applications: absorption spectroscopy, fluorescence, circular dichroism, infrared. Mass spectrometry. Determination of the three-dimensional structure of macromolecules by X-ray diffraction and nuclear magnetic resonance.

Block 3. NUCLEIC ACIDS

STRUCTURE AND BIOLOGICAL FUNCTIONS

Nature and function. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: DNA supercoiling and transfer RNA. DNA-protein complexes: chromosome organization.

RECOMBINANT DNA. TECHNIQUES AND APPLICATIONS

Brief introduction to nucleic acid metabolism: replication, transcription, and translation. Materials and methodology for DNA cloning: restriction enzymes, vectors, recombinant protein expression, and purification methods. Examples of recombinant DNA techniques. Applications in protein production and modification. DNA sequencing and genome projects. Some analytical and biotechnological applications. Genomics and proteomics.

Block 4. OTHER MACROMOLECULES

CARBOHYDRATES

Types of carbohydrates and their functions. Monosaccharides: description and properties. Monosaccharide derivatives. Glycosidic bond. Oligosaccharides. Structural and storage polysaccharides. Glycoconjugates: glycoproteins, proteoglycans, and glycolipids. Carbohydrates as informational molecules.

LIPIDS AND BIOLOGICAL MEMBRANES

Types of lipids and their functions. Storage lipids. Structural membrane lipids. Other lipids with specific biological activity. Lipoproteins. Structure and properties of biological membranes. Membrane proteins. Transport across membranes.

PROBLEMS

This section will be developed based on the problem set delivered at the beginning of the semester, consisting of a specific number of problems related to the topics covered in Theory. The nature of the different parts of the Theory syllabus means that the problem statements are concentrated on certain specific aspects, which are:

- Topic P1. Chemical equilibrium and buffer systems
- Topic P2. Free energy and equilibrium constant
- Topic P3. Protein purification and analysis methods
- Topic P4. Enzyme kinetics
- Topic P5. Recombinant DNA

LABORATORY PRACTICALS

Two four-hour lab sessions will be carried out:

1. Spectrophotometry as a method for determining the concentration of biomolecules. Preparation of buffer solutions.

- Liquid chromatography and SDS-polyacrylamide gel electrophoresis as methods for biomolecule analysis and purification.

Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|--------------------------------|-------|------|------------------------------------|
| Type: Directed | | | |
| Laboratory practicals | 8 | 0.32 | CM17, SM27, CM17 |
| Problem sessions | 10 | 0.4 | CM17, CM18, SM27, CM17 |
| Theory sessions | 32 | 1.28 | CM17, CM18, KM30, KM31, KM32, CM17 |
| Type: Supervised | | | |
| In-class tutorials | 6 | 0.24 | SM27, SM27 |
| Self-learning exercises | 5 | 0.2 | CM17, CM18, KM32, SM27, CM17 |
| Type: Autonomous | | | |
| Deliveries through the CV | 7 | 0.28 | CM17, CM18, KM32, SM27, CM17 |
| Group work for problem solving | 14 | 0.56 | CM17, CM18, SM27, CM17 |
| Individual or group study | 60 | 2.4 | CM17, CM18, KM30, KM31, KM32, CM17 |

The learning activities are divided into three parts: theory classes, problem-solving classes, and laboratory practicals, each with its own specific methodology. These activities may be supplemented by a series of additional tutorial sessions, which can be scheduled by mutual agreement between students and faculty.

Theory Classes

The instructor will explain the course content with the support of audiovisual materials, which will be available to students on the Virtual Campus of the course at the start of each topic. These lecture-based sessions will constitute the main component of the theoretical part. It is recommended that students print the materials published on the Virtual Campus to follow the classes more comfortably and complement the syllabus by regularly consulting the recommended bibliography.

The theory classes will mainly take the form of lectures and exercises or microprojects proposed in class. These will be submitted either in class or via the Virtual Campus, following the instructor's guidelines and within the specified deadline.

Problem-Based Learning

The class will be divided into two subgroups. The student lists for each subgroup will be made public at the beginning of the course, and each student will attend the scheduled sessions for their assigned group.

At the start of the semester, a problem set dossier will be provided via the Virtual Campus. These problems will be addressed throughout the course. During a limited number of sessions scheduled across the semester, instructors will present the experimental and calculation principles required to tackle the problems, offering guidance on how to solve them and covering complementary content to the lectures.

Problems will be prepared outside class hours in work groups of four to five students, which will remain the same throughout the course. Non-lecture in-person sessions will be used for discussing and solving previously prepared problems, which will be presented on the board by members of the working groups. The instructor will ensure that all groups have the opportunity to present their solutions during the semester, and on some occasions, will collect the written solutions.

Additionally, new problems may be introduced during class for group work. These will need to be solved and submitted by the end of the session. At the end of the course, group members must also complete a questionnaire via the Virtual Campus, assessing their own contribution and that of their group.

Attendance at problem-solving classes is mandatory, except in cases of justified and documented absence.

Laboratory Practicals

The class will be subdivided into four lab groups, and the lists will be announced in advance. To ensure smooth operation of the sessions, group changes will only be allowed with clear justification and prior approval from the practical instructors. As a general rule, only one-to-one student swaps between groups will be accepted.

Students must attend the lab sessions with the following items:

- Lab coat
- Safety goggles for splash protection
- Printed and pre-read lab protocol (available on the Virtual Campus)
- Notebook for recording observations and experimental data

On the dates set in the academic calendar, students enrolled in the Biochemistry laboratory will carry out basic experiments focused on the determination of properties and analysis of biomolecules. The practical sessions and their assessment will be carried out in pairs. After each session, a questionnaire must be submitted with the experimental results and answers to the assigned questions.

Attendance at the lab sessions is mandatory, except in cases of duly justified and documented absence.

Tutorials

These sessions will be scheduled at the students' request, through their representatives, or at the initiative of the instructor, as they are not explicitly scheduled in the academic calendar. The purpose of these sessions is to:

- Resolve doubts
- Review basic concepts not covered in class
- Guide students in the use of information sources
- Foster discussion and debate on topics requiring autonomous learning or proposed by the instructors

These sessions will not be lecture-based and no new syllabus material will be introduced. Instead, they will be discussion-based. The scheduling of these sessions will be agreed upon with the class to ensure they are evenly distributed throughout the course.

Materials Available on the Course Virtual Campus

- Course syllabus
- Slide presentations used in theory classes
- Problem set dossier
- Lab protocols
- Additional self-study materials complementing the theory classes (if needed)
- Academic calendar with all activities (classroom sessions, lab sessions, tutorials, assessments, submission deadlines, etc.)

Note: A 15-minute period will be reserved in one class session, as established in the official academic calendar, to allow students to complete teaching and course evaluation surveys.

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 |
|--|-----------|-------|------|------------------------------|
| Delivery of dossiers / practical sessions questionnaires | 15% | 0.5 | 0.02 | CM17, CM18, SM27 |
| Delivery of home-solved problems and in-class resolution of problems | 5% | 2 | 0.08 | CM17, CM18, SM27 |
| Delivery of self-learning exercises | 15% | 0.5 | 0.02 | CM17, CM18, KM32, SM27 |
| Mixed partial tests: multiple answer/short questions | 50% | 4.5 | 0.18 | CM17, KM30, KM31, KM32, SM27 |
| Problems examination | 15% | 0.5 | 0.02 | CM17, CM18, KM31 |

This course follows a continuous assessment format with several types of evaluations: midterm tests with multiple-choice and short-answer questions, in-class resolution of online mini-tests, assignments via the Virtual Campus, presentation and submission of problems in class, and laboratory sessions.

The goal of continuous assessment is to encourage consistent effort throughout the course and to monitor the students' progress, understanding, and integration of the subject matter.

The following sections describe the assessment methodology in detail.

Theory

Individual assessment includes:

- Two midterm exams with multiple-choice and short-answer questions.
Multiple-choice questions will focus on the content covered in each respective part of the course. Short-answer questions will also relate to the respective part, although answering questions on the second exam may require referencing concepts from earlier in the course.
This structure allows evaluation of conceptual integration and encourages viewing the subject as a unified body of knowledge.
The short-answer section in the second midterm will have greater weight than the earlier exams and will act as a comprehensive assessment.
- Each midterm exam will count for 25% of the final grade.
- In each midterm, multiple-choice questions will account for 75% of the exam grade, and short-answer questions for 25%.
- Alongside the second midterm, students will be asked to solve a problem previously worked on in class as a complementary evaluation for that methodology (see the *Problems* section).
- Midterm tests are eliminatory: students who pass the theory midterms do not need to take further exams.
- There are no prerequisites for taking the scheduled exams.

- The minimum grade required for a midterm exam to be considered is 4.0 out of 10.
See the *Overall Assessment and Recovery Process* section for details on grade calculation, passing requirements, and the recovery process.
 - Assignments and questions must be submitted only to the instructor or via the Virtual Campus. This part will count for 15% of the final grade.
The average grade for this section will only be calculated if all assignments are submitted on time.
 - In total, the theory section accounts for 65% of the final grade:
 - 50% from the midterms
 - 15% from assignments
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Problems

Group-based assessment with an additional individual component:

- Resolution of group-assigned problems during the course and presentation in class, with all groups given the opportunity to present at the board.
 - In-class group resolution of proposed problems.
 - The grade from these two components will initially be the same for all group members, but may be adjusted if any student fails to submit required work.
 - An individual written exam including problems not previously covered in class will be held alongside the second midterm.
A minimum grade of 4.0/10 is required to pass this exam.
 - The problems section accounts for 20% of the final grade:
 - 5% from group work
 - 15% from the individual problem exam
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Laboratory Practicals

Group-based assessment:

- Evaluation of results obtained during the sessions, including a questionnaire.
Attitude, participation, and lab conduct will also be considered.
 - Attendance is mandatory. Changes to group assignments will be allowed only in exceptional cases with documented justification.
 - If a student misses a session for a justified reason and cannot attend with another group, that session will not be included in the practicals grade.
 - The practicals section accounts for 15% of the final grade.
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Overall Assessment and Recovery Process

The three components - theory, problems, and practicals - are inseparable. Students must participate in and pass all three to pass the course.

Final grades will be calculated using the following weights:

- Theory: 65%
- Problems: 20%
- Practicals: 15%

To pass the course, all three of the following conditions must be met:

1. A minimum grade of 4.0 in each individual exam is required to include it in the final grade calculation.
2. A minimum average of 5.0 on the two theory midterms is required to be considered for final averaging.
3. A minimum final score of 5.0/10 must be achieved from the sum of the theory, problems, and practicals sections.

Recovery Exam

Students who do not meet the conditions above will be required to sit a recovery exam, scheduled after the second midterm.

To be eligible, the student must have been previously assessed in activities representing at least two-thirds of the total course grade.

The recovery exam will include:

- Multiple-choice questions from both midterms
- Short-answer questions covering the entire course
- An optional problem, whose grade may replace the second midterm problem score

Students must:

- Answer the multiple-choice section for any midterm where they scored below 4.0
- Complete the short-answer section
- Optionally answer previously passed sections - doing so means forfeiting the previous grade

If no recovery is needed for a particular exam, the original multiple-choice score will be retained.

To calculate the final grade, the theory grade after the recovery exam must be at least 4.0/10.

If not, and if the total grade is below 5 or marked "Not evaluable," the course will be considered failed and will appear as such in the student record.

The recovery exam is also open to students who want to improve their grade.

These students must notify the instructor in advance, and doing so implies forfeiting their previous grade and accepting the recovery rules.

Additional Considerations

- The dates of midterms and the recovery exam listed in the course calendar cannot be changed.
- Students unable to attend an exam for a justified and documented reason (illness, death of a first-degree relative, accident, etc.) must submit official documentation to the Degree Coordination and to the instructor. In such cases, they will be allowed to take the exam on another date.

- From the second enrollment onward, repeat students will not need to repeat the learning activities or evaluations for competencies already passed (e.g., group work, practicals, assignments via the Campus Virtual, and in-class online tests).
A section will be considered passed if the student earned at least 50% of the corresponding grade.
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Important

If plagiarism is detected in any submitted work, the grade will be zero, and the student may fail the entire module.

Single (Final) Assessment Option

Students who choose the single assessment must:

- Attend and pass the lab practicals (mandatory attendance), which will count for 15% of the final grade
- Take a comprehensive final exam with multiple-choice and short-answer questions covering all content from theory and problems
- On the day of the exam, they must submit the problems assigned in class (5% of the grade)

The final grade will be composed of:

- 80%: grade from the final comprehensive exam
- 15%: grade from lab practicals
- 5%: grade from problem set submission

The single assessment exam will take place on the same date as the second midterm for continuous assessment, and the same recovery process will apply.

To pass the course, the student must score at least 5 out of 10 on the final exam to allow the grade to be averaged with the other components.

Bibliography

Basic bibliography and links:

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Software

PyMol: <https://pymol.org/2/>

JMol: <http://jmol.sourceforge.net/>

AlfaFold

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 | 111 | Spanish | second semester | morning-mixed |
| (PAUL) Classroom practices | 112 | Spanish | second semester | morning-mixed |
| (PLAB) Practical laboratories | 111 | Catalan/Spanish | second semester | morning-mixed |
| (PLAB) Practical laboratories | 112 | Catalan/Spanish | second semester | morning-mixed |
| (PLAB) Practical laboratories | 113 | Catalan/Spanish | second semester | morning-mixed |
| (PLAB) Practical laboratories | 114 | Catalan/Spanish | second semester | morning-mixed |
| (TE) Theory | 11 | Catalan | second semester | morning-mixed |