Universitat Autònoma de Barcelona

2023/2024

Biochemistry I

Code: 100877
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	FB	1	2

Contact

Name: Maria Rosario Fernandez Gallegos

Email: rosario.fernandez@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

It is recommended that students have done the subjects from the first semester, in particular the subject of Basic Instrumental Techniques.

Objectives and Contextualisation

The subject Biochemistry I constitutes the first part of a main subject "Biochemistry" in the Degree of Biochemistry. Biochemistry I is focused on the study of the structural and functional characteristics of the biomolecules. This knowledge will be useful in the second part of the subject, named "Biochemistry II". Moreover, the topics worked in this subject will be also relevant in most of the subjects from this Degree.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Be able to self-evaluate.
- Define the structure and function of proteins and describe the biochemical and molecular bases of their folding, intracellular traffic, post-translational modification and replacement.
- Demonstrate understanding and use of the mechanisms of biological catalysis based on the structure of biological catalysts and chemical reactions.
- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.

- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and one's own language.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
- Use ICT for communication, information searching, data processing and calculations.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Be able to self-evaluate.
3. Calculate and interpret the kinetic and thermodynamic parameters that define enzyme reactions.
4. Correctly use the terminology of biochemistry and its text and reference books.
5. Describe the basic structural and functional characteristics of amino acids, proteins, glucids, lipids and biological membranes, nucleotides and nucleic acids.
6. Describe the catalytic mechanisms of enzyme reactions and their inhibition and regulation mechanisms.
7. Describe the structure, function and regulation of proteins involved in oxygen transport and provide examples of deficiencies in these that are involved in pathologies.
8. Identify structural protein domains and motifs and their functional and evolutionary relationships.
9. Interpret experimental results and identify consistent and inconsistent elements.
10. Interpret the parameters that define the binding of ligands to macromolecules.
11. Introduce changes in the methods and processes of the field of knowledge to provide innovative responses to the needs and demands of society.
12. Manage information and the organisation and planning of work.
13. Read specialised texts both in English and one's own language.
14. Select the most suitable experimental approaches to studying the structure and function of biomolecules.
15. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
16. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.
17. Use ICT for communication, information searching, data processing and calculations.

Content

SYLLABUS:

Topic 1. ELEMENTS, MOLECULES AND PHYSICAL ENVIRONMENT.

Levels of structural organization of biomolecules. Types of bonds in molecules. The biological importance of water. Non-covalent interactions. Ionization of water. Acid-base. Ion balance and buffering systems.

Topic 2. PRINCIPLES OF BIOENERGETICS.

The transformations of energy to living organisms and thermodynamics. Free energy and equilibrium constant. Coupled reactions. Transfer of phosphate groups, and ATP paper. Oxidation reactions.

Topic 3. PROTEINS 1: PRIMARY STRUCTURE AND BIOLOGICAL FUNCTIONS.

Protein classes and their functions. Structure and properties of amino acids. Stereoisomers. Peptides and the peptide group. Analysis of the composition of amino acids and the sequence of proteins.

Topic 4. PROTEINS 2: THREE-DIMENSIONAL STRUCTURE OF PROTEINS.

Structuring levels of proteins. Secondary structure. Fibrous proteins. Globular proteins Protein folding: factors that determine it. Molecular Chaperones. Introduction to conformational diseases. Prediction of the protein structure. Quaternary structure. Determination of the three-dimensional structure of macromolecules by means of nuclear magnetic resonance and X-ray diffraction.

Topic 5. PROTEINS 3: RELATION STRUCTURE-FUNCTION AND EVOLUTION OF PROTEINS

Storage and transport of oxygen: myoglobin and hemoglobin. Myoglobin and hemoglobin as examples of protein evolution. Use of protein sequences for the analysis of evolutionary relationships. Allosterism and cooperativity of hemoglobin. Different forms of hemoglobin: physiological adaptation and molecular pathology.

Topic 6. BIOLOGICAL CATALYSIS

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

Topic 7. SUGARS AND POLYSACCHARIDES

Monosaccharides: description and properties. Classification. Monosaccharide derivatives. Disaccharides and Oligosaccharides. Structural and reserve polysaccharides. Glycoproteins, proteoglycans, and glycolipids. Oligosaccharide Markers

Topic 8. NUCLEIC ACIDS

Nature and function. Nucleotides. Primary structure of nucleic acids. Secondary structure: Watson and Crick model and alternative structures. Tertiary structure: overlap of DNA and transfer RNA. Complex DNA-proteins: organization of the chromosome.

Topic 9. RECOMBINANT DNA TECHNIQUES.

DNA cloning materials and methodology. Construction of DNA libraries. Selection and search for DNA sequences: hybridization. The sequence of DNA. Genome projects Some applications of genetic engineering. Genomics and proteomics.

Topic 10. LIPIDS AND BIOLOGICAL MEMBRANE

Types of lipids and functions. Membrane structural lipids. Other lipids with specific biological activity. Lipoproteins Structure and properties of biological membranes.

PROBLEMS

The content of this section, which will be presented in the form of a dossier at the beginning of the semester. It will include a with a selection of problems to be solved and defended "in situ". Those sessions will focus on certain aspects as: acid-base, chemical equilibrium, free energy and constant equilibrium, methods of purification and analysis of macromolecules and enzyme kinetics.

Methodology

The training activities are divided into two sections: lectures and problem-based learning sessions, each of them with their own specific methodology.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	37	1.48	3, 6, 7, 5, 8, 10, 14, 4
Problem-based sessions	8	0.32	17, 3, 6, 5, 14, 2, 4
Type: Supervised			
Autonomous problem resolution	23	0.92	17, 14
Type: Autonomous			
Research of information and autonomous study	64	2.56	6, 7, 5, 12, 8, 10, 13, 2, 4

Assessment

ASSESSMENT:

Continuous assessment

Midterm exams:

The total weight of the two midterm exams will be 70%. The minimum mark is 4.0 points out of 10. If someone obtains a mark lower than 4.0, they will need to retake the exam.

Problems

The problems will have a continuous assessment. The weight of the problem assessment will be 30% of the total. This will be split into two parts: 1) Resolution of problems and their oral defense in groups of 4 people (10%); 2) *In situ* resolution and delivery of problem (10%). 3) problem-resolution exam (10%). The lack of attendance at problem sessions will penalize the individual mark.

The problems will not be reassessed.

Additional points:

This subject will be passed when the sum of the different parts weighted by their specific weight in the subject equals or exceeds 5.0 out of 10 points. If one, or more, midterm exam(s) obtain less than 4,0 points the subject won't be passed, even when there is a good qualification in the problem resolution part.

In order to be eligible for performing the remedial exam, according to UAB regulations, students must have done a set of activities, the weight of which equals a minimum of two-thirds of the total mark in the subject. Therefore, the students will get a "Not assessable" qualification when the sum of activities carried out have a weight lower than 67% of the total.

Those students who must take the final exam will not be eligible for the maximum honor grade. It will not be possible to take the remedial exam only to improve the grade when the mid-term examen was already passed (with a minimum grade of 5.0 points).

Those students who couldn't attend a midterm exam due to a relevant reason(such as illness, the death of a first-degree relative, an accident ...etc), and provide the corresponding proof to the degree coordinator, will have the opportunity to perform their assessment in a different date.

Unique assessment

This kind of assessment consists of a single synthesis test in which the contents of the entire theory program of the subject will be evaluated. The test will consist of development questions and/or short questions. The grade obtained in this synthesis test will account for 70% of the final grade of the subject. Simultaneously, the problem-solving skills of the course will be evaluated (30% of the final grade). The single evaluation test will be held on the same date as the one scheduled for the second partial of the continuous evaluation, and the same recovery system as the continuous evaluation will be applied.
The subject will be considered passed when the overall grade of the theory and problems exceeds 5.0 out of 10 points. However, a minimum of 4 points out of 10 in theory will be required in order to average it with the grade of problems. Otherwise, the subject will not be considered passed.
This kind of assessment should be demanded at the beginning of the course.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Defense of resolved problems	10%	8	0.32	17, 3, 6, 12, 9, 14, 2, 4
Deliveries of problems resolved in the classroom	10%	4	0.16	1, 16, 15, 3, 6, 5, 12, 8, 10, 9, 11, 14, 2, 4
Problem exam	10	1	0.04	17, 3, 6, 12, 9, 14
Theory examinations	70%	5	0.2	3, 6, 7, 5, 12, 8, 10, 9, 13, 14, 2, 4

Bibliography

Basic Bibliography:

- Lehninger. Principles of Biochemistry. Nelson, D. and Cox, M., 8th ed. W.H. Freeman (Macmillan Learning), 2021.
- Biochemistry. Voet D, Voet JG, Charlotte WP, 5th ed. John Wiley & Sons Ltd, 2018.

Software

-