Biochemistry

Code: 100999
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500502 Microbiology	FB	1

Contact

Name: Carlos Barcia Gonzalez

Email: carlos.barcia@uab.cat

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are not mandatory requirements. However, basic knowledge on Chemistry and Cell Biology is expected (for example, those acquired in the Biology and Life Science courses in the 1st and 2nd courses of high school). Propaedeutic courses on Chemistry are recommended.

Objectives and Contextualisation

Biochemistry subject is divided in two sections, the first is dedicated to structural and functional properties of biomolecules from a general perspective, emphazaising enzymes and proteins. In the second part, metabolism pathways and the bases of biosignaling and bioenergetic are studied. The objective is to provide the molecular and metabolic bases needed for the correct understanding of other subjects of the Microbiology bachelor.

The specific objectives are:

- Identify and distinguish the general structural bases of biological molecules.
- Asscoating and understanding the kinetics and function of enzymes in the biological context and their regulation.
- Reconginze the main molecular mechanism of signal transduction.
- Describe the main metabolic pathways of carbohydrates, lipids and nitrogen compounds and their regulation.
- Applying knowledge solving problems and exercises with quantitative and qualitative features.

Learning Outcomes

1. CM07 (Competence) Critically evaluate, in the field of biochemistry, experimental procedures and data analysis, as well as their results, with a gender perspective and with ethical responsibility and respect for fundamental rights and duties, diversity and social and democratic values.
2. CM08 (Competence) Integrate knowledge and analysis techniques for the study of biomolecules and their functions, working individually and in groups, to elaborate and present in writing or orally and publicly a scientific work.
3. KM12 (Knowledge) Define the basic structure and biological functions of biomolecules and biochemical processes that regulate the vital functions of living beings and their adaptability to the environment.

4. KM13 (Knowledge) Indicate the theoretical foundations and equipment of the main instrumental techniques to isolate, quantify, characterise and detect biomolecules and metabolites.
5. SM10 (Skill) Relate the physicochemical characteristics and structure of biological molecules with their stability, functionality, capacity for replication of structures and energy transformation.

Content

THEORETICAL CONCEPTS

BASIC CONCEPTS

Chapter 1. Essential concepts.

Biochemistry: definition and objectives. Chemistry elements of living beings. Type of biomolecule bonds. Free energy or Gibbs energy. The importance of weak interactions in biology. Water structure and properties. Concepts of pH and pKa.

BIOMOLECULES: STRUCTURE AND FUNCTION

Chapter 2. Amino acids and peptide bond.

Type of protein and function. Amino acids classification and properties. Peptide bond. Amino acid sequence and protein composition: primary and secondary structure. Sequence comparison and protein evolution.

Chapter 3. Proteins.

Level of protein structure. Secondary structure: Alpha helix, beta strands, beta turn. Tertiary structure: fiber and globular proteins. Quaternary structure. Protein folding and determinant factors. Conformational diseases.

Chapter 4. Carbohydrates.

Monosaccharide: aldose, ketose and isomers. Glycosidic bond. Disaccharide and polysaccharides. Glycoconjugate: proteoglycans, glycoproteins, and glycolipids. Carbohydrate as Information molecules. The sugar code.

Chapter 5. Nucleic acids.

Nucleotides. Primary structure of nucleic acids. Secondary structure of DNA: Watson and Crick model and alternative structure. Nucleic acid ternary structure: tRNA and DNA supercoil. Chromosome organization.

Chapter 6. Function and protein evolution: oxygen transport proteins.

Oxygen store: myoglobin. Oxygen transport: hemoglobin: Allosteric and cooperative binding. Protein evolution examples. Different hemoglobin shapes: physiologic adaptation and molecular pathology.

Chapter 7. Enzymes, enzymatic kinetics, and regulation.

Nature and function. Classification and nomenclature of the enzymes. Catalytic effect in chemistry reactions. Enzymatic mechanism. Enzymatic cofactors. Enzymatic inhibition: allosteric, covalent modification. Biomedical and biotechnological applications.

Chapter 8. Lipids and biological membranes.

Lipid types and function. Structure and function of lipoprotein. Biological membranes.

METABOLISM

Chapter 9. Introduction to metabolism.

Metabolism: concept, organization and types. Biochemistry and thermodynamic reactions: Free energy in the biological process. ATP and other rich energy compounds. Oxidation-reduction biological reactions and electrons transporter. Metabolic process regulation.

Chapter 10. Biosignaling.

Properties of the transduction signal mechanism. Eukaryotic signal transduction system: main receptors. Introduction to signal transduction in prokaryotic.

Chapter 11. Carbohydrates metabolism.

Glycolysis. Lactic and alcoholic fermentation. Pentose phosphate pathway. Gluconeogenesis. Synthesis and degradation of glycogen. Carbohydrate Metabolism regulation.

Chapter 12. Principal path Oxidant metabolism.

Acetyl-CoA synthesis. Acid citric cycle. Anaplerotic reactions. Glyoxylate cycle.

Chapter 13. Energy transduction: oxidative phosphorylation and photosynthesis.

Chemiosmotic coupling. Mitochondrial electron transport chain and oxidative phosphorylation. Photosynthetic transport chain and phosphorylation. CO2 assimilation (Calvin cycle). Introduction to respiratory chain in bacterial photosystems.

Chapter 14. Lipid catabolism and nitrogen compounds bases.

Triacylglycerol and lipoprotein mobilization. Beta-oxidation of fat acids. Ketogenesis. Nitrogen cycleand urea cycle.

PROBLEM-BASED CONCEPTS

During seminars, we will solve different problems from the following topics previously studied in the subject:

- pH and buffer systems (Part 1),

- Macromolecules purification and characterization (Part 2),

- Kinetic enzymology (Part 3),

- Gibbs energy and equilibrium constant (Part 4),

- Reduction potential and redox reactions (Part 5).

The problems and exercises will be delivered through Campus Virtual during the course.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Exercises/problems Seminars	10	0.4	CM07, CM08, KM13, CM07
Lectures (Theoretical concepts)	35	1.4	KM12, SM10, KM12
Type: Supervised			
Tutoring	3	0.12	CM07, CM08, SM10, CM07
Type: Autonomous			
Solving exercises/problems	28	1.12	CM07, CM08, KM13, CM07
Study	65	2.6	KM12, SM10, KM12

Teaching methods

The teaching content is divided in two sections: theoretical concepts and problems. Each part with different methods. These activities could be complemented with tutorials previously appointed with the professor.

Theoretical concepts

The professor will explain the content of the program with the support of slide presentations that will be available in advance (Prior to the start of each unit) to students on the subject's Virtual Campus.

These sessions will constitute the most important part of the theoretical section. It is recommended that students download the material posted on the CV, printed or in computer/tablet to follow the lectures properly.

Problems-based lessons

Throughout the course, 10 hours will be dedicated to problem-based class sessions.

The group will be divided into two subgroups, the lists of which will be made public at the beginning of the academic year. Students will attend scheduled sessions for their group.

At the beginning of the semester, the dossier with the problems of the subject to be solved during the course will be delivered through the Virtual Campus.

The dossier will contain 5 blocks, the exercises will be solved and discussed during the problems sessions.

Tutorials

The professor will be available for individual or small groups consultations when previously agreed.

Available material in Campus Virtual

Subject guide
Calendar for educational activities
Power point slides used during the lectures
Exercises list and complementary material
Evaluation description

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
First Test (Theoretical concepts)	37,5%	3	0.12	CM07, KM12, KM13, SM10
Second Test (Problems)	25%	3	0.12	CM07, CM08, KM13
Second test (Theoretical concepts)	37,5%	3	0.12	CM07, KM12, KM13, SM10

CONTINUOUS ASSESSMENT

The evaluation of this subject will be continuous, and it is based on the grade of the following elements:

There are two segments to be evaluated, theoretical concepts and exercises,

1. Theoretical concepts: Individual evaluation in two partial exams (evaluations 1 and 2 in the calendar) with 30 multiple choice questions. The minimum qualification to pass this part should be equal or higher than 3.5 points out of 10. The qualification of the theoretical concepts corresponds to 75% of the final assessment.

2. Exercises/problems: Individual evaluation in one exam (evaluation 2 in the calendar) with several exercises, similar, but not the same, as those performed during the lessons. Qualification of exercises/problems corresponds to the 25% of the final assessment.

Students must be evaluated of a minimum of 2/3 or 67% of the activities to complete this subject. Any student with less than 67% of the activities evaluated will be designated as "non evaluable".

Make-up test: students who did not pass one of two of the sections of the course, could be reassessed for those segments or the entire topic with a new test scheduled in the calendar.

Improving previous qualification: Every student has the right to repeat a test for reassessing for any segment of the evaluation to improve the previous qualification. However, the new qualification will be the final one. Previous qualification will no longer be considered.

To pass the subject, the final average qualification must be 5 or higher (out of 10) following this calculation: Final theoretical test qualification (75%) and exercises (25%): Final qualification = (Average Theoretical test qualification x 0,75) + (Average exercises qualification x 0,25).

All the partial exams must reach at least 3.5 points (out of 10) in the qualification to be considered for calculating the average.

FINAL SINGLE EVALUATION SYSTEM

The final evaluation system will be a single test to evaluate all the program of the course. This test will have a theoretical section with 30 multiple choice questions and a section to solve exercises/problems. The grade of

this test will be the 100% of the assessment. This test will be performed at the same time and in the same place than the last test described for the continuous assessment.

Bibliography

Bibliography

Theoretical concepts (alphabetical order)

- Feduchi E., Blasco I., Romero C. & Yáñez E. (2011) Bioquímica. Conceptos esenciales. 1ª ed. Ed. Médica Panamericana.

- McKee, T. y McKee, J.R. Bioquímica. Las bases moleculares de la vida. (2014). 5a ed. Mc Graw Hill Editores. http://global.oup.com/us/companion.websites/9780199316700/

- Murray, R.K. et al. Harper Bioquímica Ilustrada. (2013) 29a ed. Mc Graw Hill Editores.

- Nelson, D.L. and Cox, M.M. Lehninger-Principios de Bioquímica. (2014) 6a ed. Ed. Omega.

- Nelson, D.L. and Cox, M.M. Lehninger-Principles of Biochemistry. (2017) 7a ed. Ed. W.H. Freeman.

- Tymoczko, J.L., Berg, J.M. Stryer L. Bioquímica. Curso básico. (2014) Ed. Reverté.

- Voet D., Voet J.G. and Pratt C.W. Principles of Biochemistry. (2012) 4a ed. Wiley.

Exercises and Problems

- Lehninger, Mathews, Stryer books contain problems at the end of each chapter.

- Stephenson F.H. (2012) Cálculo en Biología molecular y Biotecnología. 2ª ed. Ed. Elsevier España.

Software

There are no specific sofware associated to this course.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	711	Spanish	first semester	afternoon
(PAUL) Classroom practices	712	Spanish	first semester	afternoon
(TE) Theory	71	Spanish	first semester	afternoon