



Universitat de Lleida

# DEGREE CURRICULUM **BIOCHEMISTRY**

Coordination: MORALEJO VIDAL, MARIA DE LOS  
ANGELES

Academic year 2023-24

**Subject's general information**

<b>Subject name</b>	BIOCHEMISTRY			
<b>Code</b>	100301			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Double bachelor's degree: Bachelor's Degree in Veterinary Medicine and Bachelor's Degree in Science and Production	1	COMMON/CORE	Attendance- based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	0.8	1.2	4
	<b>Number of groups</b>	6	1	1
<b>Coordination</b>	MORALEJO VIDAL, MARIA DE LOS ANGELES			
<b>Department</b>	ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
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## Subject's extra information

### PERSONAL PROTECTIVE EQUIPMENT (PPE) for the practical sessions

It is **MANDATORY** that students have the following personal protective equipment (PPE) in the course of teaching practices.

- Laboratory coat UdL unisex
- Safety glasses
- Chemical / Biological protection gloves

The PPE can be purchased at UdL's ÚDELS store

Center for Cultures and Cross-Border Cooperation - Cappont Campus

Carrer de Jaume II, 67 low

25001 Lleida

<http://www.publicacions.udl.cat/>

For more information, check the product listings: <http://www.bioteconologia.udl.cat/en/pla-formatiu/equipament.html>

For other protection equipment (for example, caps, respiratory masks, etc.), they will depend on the type of practice to be performed. In this case, the responsible professor will inform if the use of these specific PPE is necessary.

Not carrying the PPE described or not complying with the general security regulations detailed below will mean that the student can not access the laboratories or have to leave the same.

### GENERAL SAFETY RULES IN LABORATORY PRACTICES

- Maintain the place of performance of clean and tidy practices. The work table must be free of backpacks, folders, coats ...

- In the laboratory you can not come with shorts or short skirts.
- Bring closed and covered shoes during the performance of the practices.
- Bring long hair always collected
- Keep the cords fit to protect against spills and spills of chemical substances.
- Do not carry wide bracelets, pendants or sleeves that can be trapped by the equipment, assemblies ...
- Avoid wearing contact lenses, since the effect of chemicals is much greater if they are introduced between the contact lens and the cornea.
- Do not eat or drink in the laboratory
- Smoking is prohibited within laboratories
- Wash your hands whenever you have contact with a chemical and before leaving the laboratory.
- Follow the teacher's instructions and consult any questions about security

## Learning objectives

### Knowledge Objectives

- Know the structure of the main biological macromolecules.
- Relate the structural properties of biological macromolecules with the various functions they occupy.
- Recognize and understand the molecular mechanisms used by living beings in the development of the functions that characterize them, mainly: mechanisms of catalysis and enzymatic regulation, of obtaining and transforming energy and of maintenance, replication and processing of genetic information, routes central metabolic factors and their regulation from an integrated perspective.

### Capacity Targets

- Achieve a knowledge of the scientific method, the experimental nature of the subject, the role of theories and proofs.
- Acquire certain learning habits: bibliographic consultation, orderly annotation of notes, preparation of reports and jobs
- Establish basic principles that allow you to understand the themes of other subjects that you will study throughout of his training
- Solve various problems related to the subject that may arise in your professional life
- Handling the laboratory material and knowing the minimum safety and hygiene standards, without forgetting the need to recycle certain material.

## Competences

### Basic Competences

The following basic skills will be guaranteed as a minimum:

CB1: That students have demonstrated to possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects They involve knowledge coming from the cutting edge of your field of study.

CB2: That students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the problem solving within your study area.

CB3: That students have the ability to gather and interpret relevant data to make judgments that include a reflection on relevant social, scientific or ethical issues.

CB4: That students can transmit information, ideas, problems and solutions to an audience both specialized as well as non-specialized

CB5: That students have developed those learning skills necessary to undertake

subsequent studies with a high degree of autonomy.

## General Competences

CG2 Use the knowledge of basic sciences (biology, physics, biochemistry, physiology, mathematics, statistics, economics, ...) to understand animal processes and their implication in the agro-livestock system.

## Specific Competences

CE4. Show that you know and understand the physical, chemical and molecular bases of the main processes that they take place in the animal organism.

CE4.1 Describe the main functional groups of biological interest and their chemical properties.

CE4.2 Recognize the main types of organic reactions and apply these concepts to biological processes.

CE4.3 Explain the fundamentals of the structures of the main biological molecules.

CE4.4 Describe the basic principles of enzyme kinetics and regulation.

CE4.5 Distinguish the transmission and regulation mechanisms of genetic information in the cell.

CE4.6 Explain the main metabolic pathways.

CE4.7 Integrate the different metabolic elements in a global vision of the organism.

CE4.8 Establish the molecular bases of different physiological and pathological processes.

CE4.9 Identify the foundations of the determination of biochemical parameters of diagnostic interest in the laboratory and evaluate its relevance individually and in profiles in the diagnosis.

## Transversal Competences

CT1 Acquire an adequate oral and written comprehension and expression of Catalan and Spanish.

CT3 Acquire training in the use of new technologies and information and communication technologies

CT5 Acquire essential notions of scientific thought

CT6 Analyze specific situations, define problems, make decisions and implement action plans in search of solutions.

CT8 Interpret studies, reports, data and analyze them numerically.

CT9 Select and manage the available written and computerized sources of information related to the professional activity.

CT11 Manage individual and team work

CT14 Know and apply the scientific method in professional practice

CT15 Apply the gender perspective to the functions of the professional field

## Subject contents

**Unit 1:** Amino acids. Protein amino acids. General structure. Properties. Classification. pKas and equilibria dissociation.

**Unit 2:** Peptides and Proteins. Peptide bond. Structure and properties. Oligo and polypeptides. Structure three-dimensional protein. Alpha helix, beta sheet and collagen. Tertiary and quaternary structure. Domains structural. Native conformation and denaturation.

**Unit 3:** Enzymes. Definition, properties and classification. Substrates, cofactors or coenzymes, group prosthetic, active center. Michaelis-Menten kinetics. Km and Vmax Lineweaver-Burk transformation. Inhibition of enzymatic activity .. Competitive, uncompetitive and non-competitive inhibitors.

**Unit 4:** Carbohydrates. Characteristics and classification. Monosaccharides. Monosaccharide families. Properties. Monosaccharide cyclization. Mutarotation. Derivatives formation. Glycosidic bond. Disaccharides. Types. Nomenclature. Polysaccharides: characteristics and types. Glucoconjugates.

**Unit 5:** Lipids. Properties and classification. Fatty acids, triglycerides, waxes, phosphoglycerides, sphingolipids and glycolipids, terpenes and steroids.

**Unit 6:** Nucleic acids. Nucleosides and Nucleotides. The DNA double helix. Propellers A, B and Z. Types structural RNA. DNA condensation and packaging. Histones.

**Unit 7:** Replication of genetic material. Replication mechanisms in prokaryotic and eukaryotic organisms. DNA polymerases, replisomes, okazaki fragments, telomerases. Main mutations during replication. Repair mechanisms.

**Unit 8:** Transcription. Transcription unit. Structure of a gene. RNA polymerases. Mechanisms of transcription in prokaryotic organisms. Control of gene expression. Operons. Transcription in organisms eukaryotes. Transcription factors, mRNA maturation. Control of transcription.

**Unit 9:** Translation. The genetic code. MRNA reading frames. Effect of mutations in m-RNA. The T-RNA as an adapter in protein synthesis. Aminoacyl RNA-t synthetase. RNA-r and polysomes. Mechanisms of protein synthesis in prokaryotic organisms. Polycistronic m-RNA. Translation in eukaryotic organisms. Main post-translational modifications.

**Unit 10:** Metabolism. Basic concepts . Catabolism and Anabolism. Thermodynamic laws. Reactions coupled. ATP. Electron carriers in oxidation-reduction reactions. Group conveyors chemicals. Other carriers of activities. Regulatory mechanisms.

**Unit 11:** Glycolysis and carbohydrate metabolism. Glycolysis: stages, regulation and energy balance. Importance physiological. Incorporation of other carbohydrates to the glycolytic pathway: galactose and fructose. Metabolic destinations of the pyruvate. Anaerobic glycolysis: milk fermentation. Glycogen metabolism. Regulation. Gluconeogenesis: precursors, stages and regulation. Importance of the different organs and tissues. The pentose phosphate pathway: stages and regulation. Physiological importance.

**Unit 12:** Citric acid cycle. Acetyl-CoA formation. The pyruvate dehydrogenase complex. Acid cycle citrus and regulation. Energy performance. Anaplerotic reactions. Anabolic role of the citric acid cycle.

**Unit 13:** Oxidative phosphorylation. Electron transport chain: stages and inhibitors. Hypothesis Mitchell's chemosmotics. The enzyme ATP synthase. Pitchers. ATP-ADP translocase. Energy efficiency. Decoupling. Thermogenesis. Generation of toxic oxygen radicals. Physiological importance.

**Unit 14:** Oxidation of fatty acids. Fat digestion in monogastric animals. Hydrolysis and lipid saturation in the rumen. Mobilization of lipid reserves. Carnitine shuttle. Beta-oxidation of saturated, unsaturated and odd-numbered fatty acids. Energy balance. Ketone bodies.

**Unit 15:** Lipid biosynthesis. Citrate-Pyruvate shuttle. Synthesis of Malonil CoA. Malonil CoA carboxylase as a point of regulation. Structure of fatty acid synthase. Synthesis of palmityl CoA. Triglyceride biosynthesis, phosphoglycerides and sphingolipids. Cholesterol biosynthesis, main plasma lipoproteins and derivatives of cholesterol. Regulation of synthesis.

**Unit 16:** Protein metabolism. Protein catabolism. Protein turnover. Catabolism of amino acids: oxidative transamination and deamination. Metabolic fate of the amino group. Urea cycle. Destination of the carbon skeleton. Fixing the N<sub>2</sub>. Amino Acid Biosynthesis. Essential and non-essential amino acids. Biosynthesis of compounds derived from amino acids.

**Unit 17:** Metabolism of nucleotides. De novo synthesis of purine nucleotides. Hypoxanthine and Inosinate. De novo synthesis of pyrimidine nucleotides. Orotic acid and Orotidylate. Regulation. Nucleoside biosynths triphosphates. Ribonucleotide reductase. Biosynthesis through recovery routes. Purine degradation and pyrimidines.

## Classroom Problems

P1. Amino acid dissociation equilibria

P2. Protein structure.

P3. Kinetics and enzyme inhibition.

P4. Isomerism and stereochemistry of carbohydrates

## Laboratory activities

**Practice 1:** Extraction procedures (2 h).

Basis. Solid-liquid extraction and liquid-liquid extraction. Applications in separation of mixtures.

**Practice 2:** Titration of an amino acid (2 h).

Basis. Construction of titration curves of an amino acid. Determination of pKas and isoelectric point.

**Practice 3:** Thin layer chromatography (2h)

Rationale: Qualitative analysis of Ergosterol

**Practice 4:** Determination of proteins in serum (2h)

Determination of the protein concentration in serum by colorimetric techniques. Curved pattern construction with bovine serum albumin.

## Methodology

Activities corresponding to the 6 ECTS that make up the subject will be carried out:

- Master class
- Laboratory practices
- Problem and question solving classes
- Evaluations

The activities corresponding to the autonomous work of the student are structured in:

Personal study: 50-70%

- Obtaining documentation: 5- 15%
- Problem solving: 5-25%
- Job completion: 20-30%
- Tutorials 0-5%

## Development plan

Type of activity	Description	Face-to Face Activity		Non Face-to Face Activity		Evaluation Hours	Total Time	
		Objetivs	Hours	Work student	Hours		Hours	ECTS
<b>Master Class</b>	Master Class (Big group)	Explanation of main concepts	40	Study. Know, understand and synthesize knowledge	40	4	92	3.7
<b>Problems</b>	Participatory class (Medium group)	Troubleshooting and cases	12	Learn to solve problems and cases	30	3	40	1.6
<b>Laboratorio</b>	Laboratory Practices (Small Group)	Execution of the practice: understand phenomena, Interpret results.	8	Estudio y práctica.	10	1	18	0.7

Total			60		82	8	150	6
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## Evaluation

The **FINAL QUALIFICATION** will come from three blocks:

1. Note of a written test of theory and problems of the **first partial**, corresponding to topics 1-6 (**45%**).
2. Note of a written test of theory of the **second partial**, corresponding to the subjects 7-17 (**45%**).
3. **Laboratory practices (10%)**, resulting from the qualification of a written test and the assessment of the student's achievement and behavior in the laboratory:

Failure to attend any of the practices without justification, will penalize up to 1 point of the overall grade for the subject (0.25 points per practice).

Students who have completed all 4 internships in previous courses will be able to choose between different options:

- Repeat the practices and the exam (the note of previous courses will be discarded).
- Repeat only the exam (the note of previous courses will be discarded).
- Do not repeat the internship or the exam and keep the grade of previous courses.

### **EVALUATION:**

The evaluation of the subject can be **continuous or unique (alternative)**:

1. In order to pass the subject in the mode of **continuous evaluation**, the weighted sum of the marks of the first part, second part and practices must give a **final grade equal to or greater than 5 out of 10**.

- To pass the subject, a **minimum grade of 4 out of 10 will be required in each of the two partials**.

Students who have not passed the subject globally in the first call, but have a partial pass, will be able to choose between:

- Maintain the mark of the approved part and be examined in the second call only of the suspended part (**recovery exams**).
- Examination of both parties in the second call (**recovery exams**).
- In the event of taking the resit exams, the mark obtained in the first call will be discarded.
- The mark of the practice exam will not be recoverable.
- **In the event that the student does not achieve the minimum necessary qualification established in partials 1 and 2 but the average of the subject is approved, the subject will be graded in the minutes with a 4.9.**

2. Students who opt for the **alternative assessment must request it from the head of studies before the start of the second semester**.

Students who do NOT opt for continuous assessment will be entitled to a **single final exam**, with content of theory and practice:

- This single exam will represent **100% of the final grade**.
- Students who have done the internship in a previous year may choose not to take the internship part of this final exam. In this case, the grade obtained in the last year in which they took the internship exam will be taken into account.



## Bibliography

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- Vollhardt, KP, Schore, NE (1996). Química Orgánica. 2ª edición, Ed. Omega
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- Voet D, Voet JG, Pratt CW (2016). Fundamentos de Bioquímica. La vida a nivel molecular. 4ª ed. Ed. Médica Panamericana.