COURSE DATA

Data Subject	
Code	33980
Name	Biochemistry
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1103 - Degree in Food Science and Technology	Faculty of Pharmacy and Food Sciences	1	Second term

Subject-matter

Degree	Subject-matter	Character
1103 - Degree in Food Science and Technology	8 - Biochemistry	Basic Training

Coordination

Name	Department
MARTINEZ GIL, LUIS	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry is a basic first year course (second semester) in the Bachelors Degree in Food Science and Technology that is taught in the Faculty of Pharmacy at the University of Valencia. This course contains a total of 6 ECTS. The theoretical training in this course is complemented with laboratory work.

The main objective of the course is to provide an overview of the fundamentals of biochemistry. It will provide the students with basic knowledge about the characteristics of living cells from a molecular point of view.

SDGs integration

The study of biochemistry can contribute to the achievement of several Sustainable Development Goals (SDGs) through its impact on various areas of science, technology and medicine.

Good health and well-being (SDG 3): Biochemistry plays a vital role in understanding the fundamental processes of life and disease. It contributes to the development of new drugs, diagnostics and treatments for a wide range of medical conditions. Biochemical research helps uncover the molecular mechanisms of diseases, which leads to better prevention and treatment strategies.

Zero Hunger (SDG 2): Biochemistry is crucial to improve agricultural practices and food production. It helps develop biofortified crops with higher nutritional value, biopesticides for sustainable pest control, and technologies for food preservation and storage. Biochemical research also helps to understand the metabolism of plants and animals, which leads to better agricultural yields and more efficient use of resources.

Clean water and sanitation (SDG 6): Biochemistry plays a role in the assessment and purification of water quality. It helps in the development of analytical techniques for the detection of contaminants in water sources, as well as in the design of efficient water treatment processes. Biochemical research also contributes to the development of sustainable methods of wastewater treatment and the removal of contaminants from water bodies.

Clean and affordable energy (SDG 7): Biochemical processes are essential in the production of biofuels and renewable energy sources. Research in biochemistry allows the development of efficient enzymatic and microbial systems for the conversion of biomass into biofuels such as ethanol and biodiesel. It also contributes to the study of photosynthesis and artificial photosynthetic systems for the use of solar energy.

Industry, innovation and infrastructure (SDG 9): Biochemistry provides the foundation for biotechnological advances and innovation. It enables the development of bio-based materials, such as bioplastics and biofibers, which are more sustainable alternatives to conventional materials. Biochemical research also contributes to the production of enzymes, bioactive compounds, and biopharmaceuticals, driving innovation in various industries.

Sustainable cities and communities (SDG 11): Biochemistry can contribute to the development of sustainable urban environments. Help in the design and optimization of bioremediation strategies for the cleanup of contaminated sites, as well as the development of sustainable waste management systems. Biochemical research also helps to understand air pollution and to develop technologies to improve air quality.

Graduates in Food Science and Technology with Biochemical knowledge will play a fundamental role in the development of the SDGs, mainly in objectives 2 and 6.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

v To understand and learn Biochemistry the students must already be competent in a number of basic concepts in chemistry and general biology. These concepts are part of the content of subjects taught in high school and during the first semester of the first year of this Degree.

OUTCOMES

1103 - Degree in Food Science and Technology

- Capacidad de obtener, procesar e interpretar datos e información relevantes en el ámbito de la tecnología de los alimentos, haciendo uso de las tecnologías de la información y la comunicación.
- Capacidad para transmitir ideas, analizar problemas y resolverlos con espíritu crítico, adquiriendo habilidades de trabajo en equipo y asumiendo el liderazgo cuando sea apropiado.
- Desarrollo de habilidades para emprender estudios posteriores y actividades de formación continuada.
- Saber aplicar el método científico y adquirir habilidades en el manejo de las principales fuentes bibliográficas.
- Adquirir la formación básica para la actividad investigadora, siendo capaces de aplicar el método científico a la resolución de un problema, comprendiendo su importancia y sus limitaciones en materia sanitaria y nutricional.
- Capacidad de integrar los contenidos estudiados en las diferentes materias cursadas en un conocimiento interdisciplinar aplicable al ámbito académico y profesional.
- Comprender y manejar la terminología científica básica relacionada con la materia.
- Know the structure and properties of biological macromolecules and their relationship with the function that they perform.
- Understand the operation of enzymes and their regulation.
- Know the mechanisms of production and transformation of energy.
- Know about the major metabolic pathways and obtain an integrated view of metabolism and its regulation..

LEARNING OUTCOMES

With this course, students should acquire the following abilities and scientific and social skills:

- Reasoning, argumentation and memorization of basic biochemical concepts.

- Ability to propose and solve biochemical problems, relating the chemical and structural properties of biological molecules with functionality.

- Understanding the molecular origins of the basic functions of living cells and their main implications in biotechnology.

- Become familiar with the overall infrastructure of a basic biochemistry laboratory.

- Introduction to the main bibliographical sources in the field of biochemistry, allowing the student to find, select and understand the information.

- Ability to work both independently and in teams.

- Ability to prepare, present and defend of a scientific project in public.

DESCRIPTION OF CONTENTS

1. Introduction

Concept and historical perspective. Biochemical research today.

2. Structure and Function of carbohydrates and lipids.

General classification of carbohydrates and their function. Major monosaccharides and their derivatives. Disaccharides and homopolysaccharides. Complex carbohydrates. General characteristics and classification of lipids and their function. Lipids with energetic function. Membrane lipids.Steroids. Chemical structure of nucleotides. Primary and secondary structure of DNA. Watson and Crick model.

3. Amino acids and primary structure of proteins

Amino acids: structure, properties and classification. Peptide bond: characteristics and properties. Primary structure

4. Three-dimensional structure of proteins

Secondary structure: helix and sheet. Tertiary structure. Domains. Quaternary structure. Structural classification of proteins: fibrous proteins and globular proteins. Folding and stabilization of proteins. Denaturation of proteins.

5. Isolation, purification and characterization of proteins.

General concepts. Physicochemical properties of proteins. Purification methods. Precipitation of proteins . Chromatographic techniques. Electrophoresis.

6. Enzymes: basic concepts

Concept and properties. Active center: concept and general characteristics. Enzymatic catalysis. Cofactors. Nomenclature and classification of enzymes

7. Enzyme kinetics

Michaelis-Menten kinetics. Concept of Km. Kcat. Catalytic efficiency. Transformations of the Michaelis-Menten equation. Effect of enzyme concentration, pH and temperature. Enzyme inhibition

8. vThe regulation of enzyme activity

Control of enzyme synthesis and degradation. Reversible and irreversible covalent modification: zymogens activation. Amplification of signals. Isozymes. Regulation of allosteric enzymes. Concept of cooperativity

9. ATP-ADP-System

The thermodynamics of live organisms. Biochemistry of ATP. Coupling between the endergonic and exergonic reactions. Sources of energy and strategies for the generation of ATP. Phosphate transfer potential

10. Transport across membranes. Chemiosmotic theory and ATP synthase

Thermodynamics of transport across the membrane. Classification of the transport systems. Chemiosmotic theory and mechanisms of generation of electrochemical proton gradient. ATP synthase

11. Mitochondrial respiratory chain

Role of respiration. Thermodynamics of redox reactions. Structure of the electronics carriers in the respiratory chain. Organization and operation. Oxidative phosphorylation. Respiratory control. Inhibitors and uncouplers

12. Organization and control of metabolic pathways

Characteristics of metabolic pathways. Overview of intermediary metabolism. Hormonal regulation of metabolism.

13. The citric acid cycle

Overview. Reactions. Stoichiometry and energy efficiency. Mechanisms of control of the citric acid cycle. Amphibolic nature of the citric acid cycle. Anaplerotic reactions.

14. Glycolysis and metabolic fates of pyruvate

Glucose homeostasis. Glucose transporters. Strategy of glycolysis, enzymatic reactions and regulation. Entry of other sugars into the glycolytic pathway: fructose, galactose and mannose. Lactic and alcoholic fermentations. Entry of pyruvate into aerobic metabolism: conversion to acetyl-CoA.

15. Gluconeogenesis, glycogen metabolism and the pentose phosphate pathway

Gluconeogenic substrates, enzymatic steps and regulation. Glycogen metabolism, degradation, synthesis and regulation. Brief description of the pentose phosphate pathway.

16. Lipid Metabolism

Fat digestion and absorption. Transport of lipids to tissues: lipoproteins. Degradation of fatty acids. The -oxidation pathway: Stages and reactions. Energy yield and regulation. Brief description of fatty acid synthesis and its regulation. Biosynthesis and utilization of ketone bodies.

17. Metabolism of nitrogenous compounds

Digestion and absorption of proteins. Overview. Oxidative degradation of amino acids and metabolism of nitrogenous end products. Nucleotide metabolism

18. Integration of metabolism

Metabolic profiles of different organs and tissues. Overview of hormonal regulation of metabolism. Example of metabolic adaptations: Starvation.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Seminars	2,00	100
Tutorials	2,00	100
Development of group work	6,00	0
Study and independent work	30,00	0
Preparing lectures	40,00	0
Preparation of practical classes and problem	14,00	0
TOTAL	**147,00**	

TEACHING METHODOLOGY

The course is structured as follows:

Lectures. During **38 sessions of one hour** each, the professor will highlight the key concepts for understanding each chapter and will indicate the most suitable resources for further in-depth preparation of each chapter. We will use PowerPoint presentations and videos that will be available to the students in the Virtual Classroom. These concepts will be reinforced with the other proposed activities, including individual study, the resolution of questions, preparation of seminars by students and tutorials.

Specialized tutoring sessions in groups. We will perform **2** compulsory sessions in the first registration, of **1 hour**, in groups of 16 students, distributed throughout the semester to cover the main themes of the course. In these sessions, as mentioned, we will reinforce the concepts presented in the lectures and we will encourage the active participation of students. To do this, the teacher will present questions to be discussed during the session. Also, the students will have the opportunity to raise questions or issues that arise throughout the course of class. This system will reveal how students assimilate concepts, identifying any gaps or failures in the learning system and directly assess the student's work.

Laboratory teaching. Attendance is mandatory. There will be three sessions of 5 hours for a total of **15 hours**. These classes will carry out the specific application of the knowledge that the students have acquired during the lectures. Also we will dedicate time to resolve questions, compare data and to comprehensively assess the results.

Seminars. These sessions will be used to develop activities that allow the students to expand their knowledge in Biochemistry and relate it to other disciplines and to promote the acquisition of skills other than those acquired in the lectures and laboratory work. This activity is mandatory and will be organized jointly with the other subjects in the same semester of the degree. The students will be organized into small, randomly selected groups. Each of these groups must submit, prior to the exhibition, a report on the proposed subject, including the bibliography (which may include textbooks, reviews or scientific articles). The preparation will be supervised by the teacher. The seminar will be presented in public during the **two sessions** dedicated to seminars, as discussed and agreed upon by the students and teacher. The approximate duration is 15-35 minutes, and the students will use the kind of presentation that the

group members consider appropriate. The presentation will be the responsilibity of all the components of the group, who will be informed 24 hours before exposure, the order of presentation. After the presentation, there will be an open discussion among participants, moderated by the teacher. Attendance to seminars is mandatory for all the students. Failure to attend the seminars without a cause will generate a zero in the corresponding section of evaluation.

EVALUATION

The theoretical and practical knowledge and the skills acquired by the students will be continuously evaluated throughout the course with a final objective grade obtained from the seminars conducted by students and from the examination of theoretical and practical concepts. The maximum score of 10 points are divided into:

- The evaluation of the contents of the theoretical lectures through a final written exam corresponding to a maximum of 7,5 points.

- Laboratory work: 1,5 points of the total grade for this course. Attendance is mandatory. Comprehension of the concepts presented during the Laboratory exercises will be evaluated by conducting a written examination on the content of these sessions to be held together with the final theory examination (1 points) and a written presentation in the form of a laboratory report of the results obtained in the laboratory plus the attitude displayed during in the laboratory sessions (0.5 points).

To pass the course the student must obtain a minimum score on the written test of 50%.

-Evaluation of the seminar: The evaluation represents the 10% of the final grade for each of the subjects in the corresponding semester participating in this activity. The preparation and presentation of seminars is mandatory for the student. A maximum of 1 point will be awarded in the final grade. The student's ability to extract information from bibliographic sources, work in a group context, and to publicly present and debate with peers and the teacher will be evaluated. Students will keep the grade of the seminar obtained in the semester and course, during the academic year and for 2 more years. Elapsed this period, the student must present the seminars that apply.

- Other considerations: the student's work and attitude in both theoretical classes, laboratory work and in the seminars may be taken into account by the teacher to adjust the final grade of the course. The course is pass or fail in its entirety. The students who do not achieve a passing final grade during the first exam will maintain their partial score in theory, seminar and/or laboratory, if passed individually, until the second exam.

REFERENCES

Basic

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- Mathews, C.K., Van Holde, K.E. y Ahern K.G. Bioquímica. Addison Wesley, 3ª ed., 2002.
- Voet, D. Voet, J.G., y Pratt, C.W. Fundamentos de bioquímica: La Vida a Nivel Molecular. Editorial Médica Panamericana, 2ª ed., 2007.
- Stryer, L., Berg, J.M. y Tymoczko, J.L. Bioquímica. Ed. Reverté, 6ª ed., 2007 (disponible también en edición catalana).

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- Nicholls, D.G. y Ferguson, S.J. Bioenergetics 3. London Academic Press, 2002
- Peretó, J., Sendra, R., Pamblanco, M. y Bañó, C. Fonaments de bioquímica. Servei de Publicacions de la Universitat de València, 5ª ed., 2005 (traducción al castellano, 2007).
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