COURSE DATA

Data Subject	
Code	34068
Name	Biochemistry I
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1201 - Degree in Pharmacy	Faculty of Pharmacy and Food Sciences	2	First term
1211 - D.D. in Pharmacy-Human Nutrition and Dietetics	Faculty of Pharmacy and Food Sciences	2	First term

Subject-matter

Degree	Subject-matter	Character
1201 - Degree in Pharmacy	11 - Biochemistry	Basic Training
1211 - D.D. in Pharmacy-Human Nutrition and Dietetics	1 - Asignaturas obligatorias del PDG Farmacia-Nutrición Humana y Dietética	Obligatory

Coordination

Name	Department
ESTORNELL RAMOS, ERNESTO	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry I is a second year (first semester) basic subject of the Degree in Pharmacy (University of Valencia). This subject accounts for a total of 6 ECTS in the curriculum.

The aim of the course is to provide an overview of the fundamentals of biochemistry. The course is focused on provide a basic knowledge about the fundamental characteristics of living matter from a molecular point of view.

The course is organized in a total of 6 blocks, which are summarized below:

- Part I. Introduction to Biochemistry
- Part II. Structure and function of proteins.
- Part III. Enzymology.
- Part IV. Structure of important biomolecules.
- Part V. Introduction to metabolism and bioenergetics.
- Part VI. Intermediary metabolism.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is recommended to have studied the subjects of General Chemistry, General Biology and Physical Chemistry. Basic knowledge of general chemistry: basic thermodynamics, chemical equilibrium, acid-base and redox reactions, functional groups, major interactions in aqueous solution and structure of biomolecules. Basic knowledge of cell biology: main organelles of eukaryotic cells.

OUTCOMES

1201 - Degree in Pharmacy

- To possess and to understand the knowledge in the different areas of study included in the formation of the pharmacist.
- To know how interpret, value and communicate relevant data in the different aspects of pharmaceutical activity, making use of information and communication technologies.
- Skill to communicate ideas, analyze problems and solve them with a critical mind, achieving team-working abilities and assuming leadership whenever required.
- Development of skills to update their knowledge and undertake further studies, including pharmaceutical specialization, scientific research and technological development, and teaching.

- Ability to collect and transmit information in English with a level of competence similar to the B1 of the Council of Europe.
- Develop know-hows for their professional career.
- Know how to apply the scientific method and acquire skills for managing the main bibliographic sources.
- Recognize the limitations and the need to maintain and update the professional competence, giving special importance to the self-learning of new knowledge based on scientific evidence.
- Understand and manage basic scientific terminology in the area of Biochemistry and Molecular Biology.
- Learn about the structure and properties of biomolecules and their relationship with the role, as well as their transformations in the cell.
- Understand the functioning of enzymes and their regulation.
- Learn about the mechanisms of production and transformation of energy.
- Know the major metabolic pathways and obtain an integrated view of the metabolism and its regulation.
- Know and understand the processes essential for the transmission of genetic information from DNA to protein.
- To carry out works of collection, preparation and conservation of plants, fungi and algae samples in order to study and identify these organisms by keys.

LEARNING OUTCOMES

- Know the structure and properties of biological macromolecules, and their relationship with the function they perform.
- Understand the functioning of enzymes and their regulation.
- Know the mechanisms of obtaining and transforming energy.
- Know the main metabolic pathways and obtain an integrated view of metabolism and its regulation.
- Apply the scientific method in solving experimental work.
- Get acquainted with the literature and sources of information of Biochemistry.
- Understand the multidisciplinary nature of Biochemistry and its relationship with other sciences, focusing on the applications of Biochemistry in the health sciences.
- Achieve the Sustainable Development Goals (SDGs), especially in the optimization of resources, savings in slow-regenerating natural materials and waste reduction that can be harmful to the environment.

DESCRIPTION OF CONTENTS

1. Introduction

Concept and historical perspective. Biochemical research today.

2. Amino acids and primary structure of proteins

Amino acids: structure, properties and classification. Peptide bond: characteristics and properties. Primary structure: sequence determination and evolutionary relationships

3. Three-dimensional structure of proteins

Secondary structure: alfa helix and beta sheet. Supersecondary structures. Tertiary structure. Domains. Quaternary structure. Folding and stabilization of proteins. Denaturation and renaturation of proteins. Structural classification of proteins: fibrous proteins and globular proteins.

4. Isolation, purification and characterization of proteins

Concept. Physicochemical properties of proteins. Chromatographic methods. Dialysis and ultrafiltration. Electrophoresis. Isoelectric focusing. Electrophoresis.

5. Enzymes: Basic Concepts and enzyme kinetics

Nomenclature and classification of enzymes. Enzyme Kinetics: Factors affecting the rate of an enzymatic reaction. Effect of substrate concentration. Concept of steady state. Michaelis-Menten equation. KM Concept. Turnover number. Catalytic efficiency. Transformations of the Michaelis-Menten equation. Effect of enzyme concentration, pH and temperature. Kinetics and mechanism of bisubstrate reactions.

6. Enzymes: catalytic mechanisms

Active center: concept and general characteristics. Identification of functional groups essential for enzymatic catalysis. Factors contributing to the catalytic efficiency of enzymes. Factor proximity and orientation. Distortion and destabilization factor: Preferential transition state binding. Metal-ions catalysis. Covalent catalysis. General acid-base catalysis. Coenzymes: an overview.

7. Regulation of enzyme activity

Reversible and irreversible enzyme inhibition. Different types of reversible inhibition: competitive, uncompetitive, and mixed inhibition. Enzymatic regulation by covalent modification. Activation of zymogens. Isoenzymes: concept, features and clinical applications. Allosteric enzymes. Concept of cooperativity. Hill equation. Models of cooperativity.

8. Carbohydrates

General classification of carbohydrates and their function. Major monosaccharides and their derivatives. Disaccharides and homopolysaccharides. Complex carbohydrates.

9. Lipids

Importance, functions and general characteristics. Classification. Storage Lipids. Membrane lipids.

10. Nucleotides and Nucleic Acids

Chemical structures of the nucleotides. Chemical composition of nucleic acids.

11. Introduction to metabolism

Basic concepts of metabolism. Thermodynamic principles applied to living systems. Potential transfer of phosphate groups. Reducing potential.

12. Organization and control of metabolic pathways

Characteristics of the metabolic pathways. Overview of the metabolic pathways. Intertissue relationships.

13. Hormonal regulation of metabolism: basic concepts

Role of hormones in metabolism. Hormone receptors. Hormonal Mechanisms of action.

14. Glycolysis

Introduction to the metabolism of carbohydrates. Glucose transporters. React sequence: preparatory phase and phase of benefits. Some glycolytic enzyme reaction mechanisms. Key regulatory enzymes and their control. Metabolism of other hexoses: fructose, galactose and Mannose.

15. Metabolic fates of Pyruvate

Lactic and alcoholic fermentations. Entry of pyruvate into aerobic metabolism: conversion to acetyl-CoA.

16. The citric acid cycle

Overview. Reaction sequence and energy conservation. Control mechanisms of the citric acid cycle. Amphibolic nature role and anaplerotic reactions.

17. Electronic transport and oxidative phosphorylation

Overview. Mitochondrial electron transport chain. Chemiosmotic theory and mechanisms of electrochemical proton gradient generation. Oxidative phosphorylation. Inhibitors and uncouplers. Mitochondrial transport systems. Energy efficiency of oxidative phosphorylation. Integrated control of the ATP synthesis. Free radicals.

18. Practicals

Isolation and purification of the enzyme invertase. Determination of enzymatic activity and protein concentration. Evaluation of the purification process. Enzyme kinetics.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	15,00	100
Tutorials	3,00	100
Seminars	2,00	100
Development of group work	2,00	0
Study and independent work	58,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	5,00	0
TOTAL	**148,00**	

TEACHING METHODOLOGY

Lectures. The teacher will develop the essential concepts of the subject.

Group tutorials. They will be held in groups of 16 students, according to the established time-table. These sessions should reinforce the concepts presented in the lectures and should encourage the active participation of students. To do this, the teacher will propose questions to be discussed during the session. Also, it is the ideal means for students to raise questions or issues that may arise during the course. This will reveal how students assimilate concepts, identify any gaps or failures in the learning system and directly assesses the student's work.

Practicals. They will be held in groups of 16 students. They should allow students to become familiar with some basic techniques of biochemistry and molecular biology, to acquire some skills in lab work and to critically analyze the results, as well as to complement the concepts learned during the lectures. Attendance will be compulsory. There will be 3 laboratory sessions in groups of 2 students. Once finished, each working group should elaborate and present a written results report.

Seminars. Will be conducting mandatory and versaran on issues raised by the teachers responsible for the subject, within the General objectives of the matter and trying to bring in as much as that's possible in current topics or perspectives of contextualization of content developed in theoretical classes. The students will be distributed in different groups in a number indicated by teachers for attending to the size of each group of theoretical classes. Each group of students will have to submit in writing a report on the proposed topic, including bibliography used for the preparation and the appropriate graphic material, within the deadline indicated by the teaching staff.

EVALUATION

For the evaluation of the learning carried out is considered fundamental to the realization of the direct level that the student acquires, which can be carried out in a number of classroom hours, especially and primarily with regard to the observation of the work the newspaper carried out. This should allow the teacher to establish directly a dynamic image of the evolution of each student throughout the course. However, the numerical rating of the knowledge and skills acquired must be set on the basis of methods that permetan a measure comparable and objective of the same, with registry of results, which means the grade of evidence written. In this respect, and through theoretical and practical examination of the subject, which will include both multiple-choice questions, questions, questions of development and of practical cases, the student must demonstrate the knowledge acquired. Taking into account the different aspects assessed the distribution of the score, on a total of 100 points which will be necessary to get **50 points** in order to pass the course, will be done in the following way:

1. Theory, 70 points. Written final exam developed by short multiple-choice questions and conceptual issues fundamentally more punctual. It will be necessary to get **35 points** or more in order to pass the test.

2. Practices, 20 points. This score is divided into:

a) Writing test, 15 points. Final exam written on a practical course and multiple-choice questions about the procedures carried out during the practical sessions. It will be necessary to get **7.5 points** or more in order to pass the test.

b) Laboratory work, 5 points. It will assess the attitude and the proper execution of practical procedures as well as a report of the results that will be delivered to the corresponding teacher a week after completion of the practical sessions of each subgroup. There is no minimum score of cutting, but is not calculated if the sum of the two written exams doesn't come to 42.5 points.

3. Work seminar, 10 points. To evaluate the written work submitted by each group of students on the date fixed term by the teachers of the subject, especially the ability of students to extract information from bibliographic sources of recognized prestige and team work. There is not a minimum score of cutting, but also will add to the overall score if the sum of the two written examinations, theory and practice, get to 42.5 points.

Very important: to pass the subject must obtain a score equal to or greater than **50 points** taking into account the limitations before you specify. If you do not reach the minimum indicated in any of the parties, the subject will be described as a "fail" with a numeric value corresponding to the sum of the written tests and in any case always lower than 5.0 points on 10. In case of not reaching scores of cut on any of the written tests, theory or practice, will be accepted for a minimum of 30 points in the test of theory or a minimum of 6.0 points in the text on practices such as to compensables ratings as long as the sum total of all two written tests is 42.5 points.

Students who do not exceeds the subject in the first call will be able to keep just for the second call of the same academic year the theoretical exam note when this is greater than or equal to **35 points** or the practical examination, when this is greater than or equal to **7.5 points**. In addition, keep the note obtained at work seminar and the note of the work of the laboratory. If you do not pass the course, the laboratory practices will be optionally convalidable, as long as they have been carried out, for the next academic year, as well as the qualifications of the laboratory work and seminar, but not the scores of the written tests.

REFERENCES

Basic

- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. Con Aplicaciones Clínicas. 7a ed., Editorial Reverté, Barcelona, 2015 (9a ed. anglès 2019)
- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica: Curso Básico. Ed. Reverté, Barcelona, 2014 (4a ed. anglés 2019).

- VOET, D.; VOET, JG. and PRATT, CW. Fundamentos de Bioquímica. La vida a nivel molecular. 2a ed., Ed. Panamericana. Madrid, 2007 (4a ed. en inglés, 2011).
- FEDUCHI E., ROMERO C., YÁÑEZ E., GARCÍA-HOZ C. Bioquímica: Conceptos Esenciales. 3a ed., Ed. Panamericana, Madrid, 2021.
- NELSON, D.L. y COX, M.M.: Lehninger. Principios de Bioquímica. 5ª ed. Ediciones Omega, Barcelona, 2009 (6a ed. en inglés, 2013).
- VOET D.; VOET JG.; PRATT CW. Fundamentos de Bioquímica. La Vida a Nivel Molecular. 4a ed., Editorial Panamericana, Madrid, 2016 (5a ed. anglés 2016).
- WATSON JD. Biología Molecular del Gen. 7a ed., Editorial Panamericana, Madrid, 2016.
- DEVLIN, T.M.: Bioquímica: libro de texto con aplicaciones clínicas. 4a ed., Ed. Reverté, Barcelona, 2004. (7a ed. en inglés, 2011).

Additional

- ALBERTS, B. Biología Molecular de la célula. 6a ed. Ediciones Omega, Barcelona, 2016.
- HORTON HR., MORAN LA., SCRIMGEOUR KG., PERRY MD., RAWN JD. Principios de Bioquímica. 4a ed., Editorial Pearson Education, Nuevo México, 2008.
- LODISH H., BERK A., KAISER CA., KRIEGER M., BRETSCHER A., PLOEGH H., AMON A., SCOTT MP. Biología Celular y Molecular. 7a ed., Ed. Panamericana, Madrid, 2016
- MATHEWS C.K., VAN HOLDE K.E., CAHILL, SJA. Bioquímica. 4a ed., Ed. Pearson Education (Addison Wesley), Madrid, 2013.
- McKEE T., McKEE JR. Bioquímica. Las Bases Moleculares de la Vida. 7a ed. McGraw-Hill/Interamericana, Madrid, 2020.
- PERETÓ, J., SENDRA, R., PAMBLANCO, M. i BAÑÓ, C.: Fonaments de bioquímica. Servei de Publicacions de la Universitat de València, Valencia, 2005.
- STRYER, L.; BERG, J.M.; TYMOCZKO, J.L. Bioquímica. 6a ed., Ed. Reverté, Barcelona, 2013 (versió en català).