BIOCHEMISTRY

Human Nutrition and Dietary Sciences

ACADEMIC YEAR 2026-27

Code: 803976
Module: 1
Subject: Biochemistry
Type of Subject: Basic
Year: First
Semester: check calendar
Department: Biochemistry and Molecular Biology
Credits: 6 ECTS

TEACHING STAFF

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BRIEF DESCRIPTOR

This course aims to provide the student with precise information on the composition, structure, function, and properties of the various component molecules of living beings and, especially, of the human being.

After studying the molecular structure of water and its functions as a solvent and as a support for biochemical reactions, the structure of proteins and their function will be addressed, as well as their role as biological catalysts and the study of enzymology.

The functional organization of metabolism, and the application of the principles of thermodynamics to biochemical transformations give way to the mitochondrial electron transport chain and oxidative phosphorylation.

A significant part of this subject is targeted to providing the student with a deep and detailed knowledge of the metabolism of the different types of molecules: monosaccharides, lipids, and amino acids.

COMPETENCIES

Competencies corresponding to the module and subject matter are as follows:

General

- C.G.1.1.
- C.G.1.2.
- C.G.1.3.
- C.G.1.4.
- C.G.2.1
- C.G.2.2
- C.G.2.3
- C.G.4.1.
- C.G.8.1

Specific competencies

- CE.M1.1
- CE.M1.2
- CE.M1.5
- CE.M1.7
- CE.M4.03
- CE.M4.06
- CE.M4.08
- CE.M4.11
- CE.M4.22

OBJECTIVES

The student must be able to:

- Know the basic principles that govern the structural and functional organization of living beings.
- Describe the structure and function of the immediate principles: proteins, carbohydrates, and lipids.
- Understand the importance of enzymes in metabolism, analysing their mechanisms of action.
- Know the metabolic routes of carbohydrates, lipids, and amino acids.

THEORETICAL PROGRAM

I. Introduction

Topic 1. Introduction to Biochemistry. Composition of living matter: types of organic and inorganic compounds.

Topic 2. Molecular structure of water. Water as a solvent. Water as a support for biochemical reactions. pH concept. Physiological buffers.

II. Amino Acid and Protein Structure

Topic 3. Amino acids: classification and properties. Proteins: Classification and functions.

Topic 4. Structural levels of proteins. Primary structure: Peptide bond. Secondary structure of proteins.

Topic 5. Tertiary and quaternary structure of proteins. Denaturation and renaturation of proteins.

Topic 6. Plasma proteins. Scleroproteins. Myoglobin and hemoglobin.

III. Enzymology

Topic 7. Enzymes: concept, classification, and general characteristics. Enzyme catalysis mechanisms

Topic 8. Enzyme kinetics: Michaelis-Menten model. Effect of pH and temperature on enzymatic activity.

Topic 9. Enzyme inhibition. Concept and types: modification of the kinetic parameters.

Topic 10. Bisubstrate kinetics.

Topic 11. Regulation of enzymatic activity: Importance and biological significance. Regulatory Mechanisms: Allosterism; Reversible covalent modification; Activation of zymogens. Isoenzyme concept.

Topic 12. Water soluble vitamins: Structure and function as coenzymes

IV. Introduction to Metabolism. Energy Fundamentals.

Topic 13. Functional organization of metabolism.

Topic 14. Thermodynamic analysis of biochemical transformations and their coupling modes. Role of the ATP/ADP system in the transfer and interconversion processes of the different forms of energy.

Topic 15. Biological membranes. Mechanisms of solute transport across the plasma membrane: simple diffusion and mediated transport. Active and passive mediated transport.

Topic 16. The electron transport chain: Structural and functional organization.

Topic 17. Mechanism of oxidative phosphorylation. Coupling with the respiratory chain. ATP synthase complex. Respiration inhibitory and uncoupling agents.

Topic 18. Transport of ions and metabolites through the internal mitochondrial membrane. Cytoplasmic NADH Shuttles.

V. Structure and Metabolism of Carbohydrates

Topic 19. Structure and function of monosaccharides, derivatives of monosaccharides. polysaccharides

Topic 20. Glycolysis: Metabolic pathway, material, and energy balance. The entry of other hexoses into glycolysis: Fructose, galactose, and mannose

Topic 21. Metabolic destinations of pyruvate: Homolactic and ethanolic fermentations. Respiration: Pyruvate dehydrogenase complex.

Topic 22. The tricarboxylic acid cycle. Amphibolic and anaplerotic reactions of the Krebs Cycle. Energy balance of respiration.

Topic 23. Gluconeogenesis. Gluconeogenic precursors. Regulation of glycolysis and gluconeogenesis.

Topic 24. The pentose phosphates pathway. Functional implications.

VI. Lipids: Structure and Metabolism

Topic 25. Lipids: Structure, function, and classification

Topic 26. Beta-oxidation of saturated, unsaturated and odd-chain fatty acids. Energy balance.

Topic 27. Synthesis and use of ketone bodies.

Topic 28. Biosynthesis of saturated and unsaturated fatty acids.

Topic 29. Metabolism of eicosanoids. Metabolism of triacylglycerides, phosphoglycerides.

Topic 30. Cholesterol biosynthesis.

Topic 31. Fat-soluble vitamins: Structure and function.

VII. Metabolism of Nitrogen-containing Compounds

Topic 32. General reactions of amino acid metabolism: Transamination, deamination, and decarboxylation.

Topic 33. Detoxification and ammonium excretion. Urea cycle.

Topic 34. Fate of the carbon skeleton of amino acids: Biological importance.

Topic 35. Biosynthesis of non-essential amino acids.

TEACHING METHODOLOGY

THEORETICAL CLASSES

Oral presentation of the program topics by the teacher.

SEMINARS

The contents of the program will be complemented with various seminar sessions in which specific aspects of the subject will be analyzed.

LABORATORY PRACTICES

Students will develop experimental work to learn basic biochemical techniques.
Students who have missed a practice or have not passed the practices, must take a practical exam.

OTHER ACTIVITIES

The students will be distributed in working groups. The study topics will be related to specific topics proposed by the teacher. Students will present the results obtained in their work. Before the presentation, they must make a summary containing the most relevant points of the presentation and references used, which will be delivered in electronic format.

EVALUATION CRITERIA

The evaluation will consider in a weighted way the different activities of the course:

• Theoretical contents of the subject: The evaluation of the theoretical contents will be carried out through a theoretical exam on the subject included in the programme.

• Course work: The evaluation of the course work will be based on the work done by the student under the supervision of the professors of the subject.

• Continuous assessment during theoretical classes and seminars. The attendance and the contribution of the students to the discussions will be valued.

The final grade will be a weighted average of the grade of all face-to-face and non-face-to-face training activities.

To pass the subject it is absolutely necessary to have approved the laboratory practices.

BIBLIOGRAPHY

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