INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Biochemistry			Field of study	Biology and Biochemistry		
Bachelor in	Environmental Engineering			School	School of Agriculture		
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9099-309-1201-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	20	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Rui Miguel Vaz de Abreu, Sandra Sofia Quinteiro Rodrigues

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. To identify the distinct types of macromolecules and understand their biological functions
2. To have knowledge about the different levels of structure in proteins
3. To identify the importance of enzymes as biological catalysts
4. To distinguish the main lipids and carbohydrates
5. To understand and to delineate the main processes involved in the transformation of the energy of carbohydrates, lipids and nitrogen compounds into chemical energy and reducing power.
6. To calculate energetic yields and to explain the importance of metabolic regulation
7. To compare the metabolic profile of organs such as liver, muscle and adipose tissue, integrating the metabolic pathways used by each one

Prerequisites

Not applicable

Course contents

1. Review on structural and functional properties of biological molecules 2. Proteins 3. Enzymes 4. Carbohydrates 5. Lipids 6. Metabolic pathways involved in the degradation and synthesis of carbohydrates, lipids and nitrogen compounds. 7. Integration of metabolism: key-points, metabolic profiles of the most important organs and hormonal regulation.

Course contents (extended version)

1. I. Biochemistry overview
   - The chemical features of the living organisms; Functions of the essencial chemical elements
2. II. Proteins
   - Aminoacids: Structure, nomenclature, classification, chemical properties.
   - Structure and function of proteins. The peptidic bond. Structural levels.
   - Fibrous proteins (silk, keratins, collagen). Globular proteins (hemoglobin).
3. III. Enzymes
   - Classification, function, specificities and cofactors.
   - Importance of vitamins in the synthesis of enzymatic cofactors.
   - Enzyme Kinetics: the Michaelis-Menten and Lineweaver – Burk models.
   - Ways to regulate the enzymatic activity: pH and temperature.
   - Reversible and irreversible inhibitors (competitive inhibition, uncompetitive and non-competitive).
   - Regulatory enzymes: allosteric interactions and covalent modifications.
   - Proteolytic cleavage of enzyme precursors; Isoenzymes and examples of their biological importance.
4. IV. Hydrocarbons
   - Classification. Major classes of sugars and of non-sugars.
   - Monosaccharides (chemical composition, nomenclature, stereochemistry and occurrence).
   - Cyclization of monosaccharides. Glycosidic linkage and disaccharides (maltose, lactose and sucrose).
   - Homopolysaccharides. The relationship between their structure and function.
   - Specific examples of storage (starch, glycogen) and structural (chitin, cellulose) polysaccharides .
   - Aplications of of some homopolysaccharides and heteropolysaccharides.
5. V. Lipids
   - Classification Fatty acids: structure and properties.
   - Simple lipids (terpenes and steroids) and complex (triacylglycerides and phosphoglycerides).
   - Lipoproteins.
6. VI. Introduction to the metabolism
   - Catabolism, anabolism and relation-sheep. Transference of energy in the biological systems.
   - ATP and NADP cycles. Phases and main objectives of metabolism.
7. VII. Metabolism of carbohydrates
   - Reactions, regulation and energetic balance of Glycolysis. Gluconeogenesis. , Glycogen metabolism.
   - Cycle of Cori. Shuttle systems for cytosolic NADH. Pathway of phosphate-pentoses.
   - Oxidative decarboxylation of piruvate to acetyl-CoA: Cycle of citric acid: Individual reactions.
   - Energetic balance; Regulation; Amphibolic character.
   - Electron transport chain and oxidative phosphorylation. Respiration.
8. VIII. Metabolism of lipids
   - Biological sources of lipids: diet, adipocytes and biosynthesis. Catabolism of fatty acids.
   - Degradation of saturated, unsaturated and ramificated fatty acids.
   - Energetic balance. Biosynthesis of saturated and unsaturated fatty acids. Sources of Acetyl-CoA.
   - Regulation. Ketone bodies: synthesis and energetic function.
9. IX. Metabolism of nitrogen compounds
   - Metabolism of amino acids: Hydrolysis of proteins; Glycogenic and ketogenic amino acids.
   - Reactions of transamination, decarboxylation, desamination and desamisation.
   - Metabolism of ammonia: sources, transport in the circulation and elimination pathways.
10. X. Integration of metabolisms
    - Main metabolic pathways and regulation centres. Key-connections: glucose-6-P, piruvate, acetyl-CoA.
    - Metabolic profiles of the most important organs. Hormonal regulation of the energetic metabolism.

Recommended reading

1. Nelson, D. L. , Cox, M. M. (2014). Princípios de Bioquímica de Lehninger (6ª ed.). Artmed Editora.
2. Quintas, A. , Ponces, A. , Halpern, M. J. (2008). Bioquímica, Organização Molecular da Vida. Lidel.
3. Voet, D. (2014). Fundamentos de Bioquímica (4ª ed.). Artmed Editora
4. Campos, L. S. (2008). Entender a Bioquímica (5ª ed). Escolar Editora.

Teaching and learning methods

Theoretical Classes: Lectures of theoretical contents. Practical laboratorial Classes: Realization of experimental protocols in the Strucutral and Metabolic Biochemistry area.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Intermediate Written Test - 30% (Theoretical Component: Frequency (30%))
   - Final Written Exam - 30% (Theoretical Component: Exam (30%))
   - Reports and Guides - 16% (Pratical Component: Diagnostic evaluation of protocols.)
   - Final Written Exam - 24% (Practical Component: Written practical exam. Minimum mark of Practical Component: 8, 5 values.)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 60% (Theoretical Component: Exam (60 %))
   - Final Written Exam - 40% (Practical Component: Written practical exam. Minimum mark of Practical Component: 8, 5 values.)

Language of instruction

1. Portuguese
2. Portuguese, with additional English support for foreign students.

Electronic validation

Rui Miguel Vaz de Abreu, Sandra Sofia Quinteiro Rodrigues	Ana Maria Antão Geraldes	Artur Jorge de Jesus Gonçalves	Paula Cristina Azevedo Rodrigues
19-12-2022	19-12-2022	20-12-2022	20-12-2022