



**Code: BIO-10**

**Credits: 6**

**Course: Biochemistry**

**Main language of instruction: Italian**

**Other language of instruction: English**

## **Teaching Staff**

### **Head instructor**

**Prof. Erika LUNETTA – erika.lunetta@unicusano.it**

## **Introduction**

### *1. Objective of the course:*

The biochemistry course aims to provide students with the necessary tools to recognize organic compounds in general, with a particular focus on biological macromolecules, through the study of their structural and functional characteristics. Within this course, the properties of different functional groups in organic compounds will be illustrated, helping students understand the various properties of biological macromolecules and the criteria for their classification. Special attention will be given to the relationship between protein structure and function. Additionally, the course aims to provide fundamental knowledge of carbohydrate, lipid, and protein metabolism. The structural and functional characteristics of the cell will also be presented to enable students to identify the cellular localization of the biochemical processes under study.

## **Objectives**

### 2. The biochemistry course has the following educational objectives:

- a) Introduce the concept of biological molecules and functional groups.
- b) Illustrate the characteristics of biological macromolecules.
- c) Explain the importance of the correlation between protein structure and function.
- d) Present the fundamentals of macromolecule metabolism and the possible connections between different metabolic pathways.

## Pre-requisites

Participation in the course requires successful completion of the **General Chemistry** course. The student must have a solid understanding of atomic structure, the concepts of chemical bonding, molecules, reversible chemical reactions, irreversible chemical reactions, and the difference between exergonic and endergonic reactions.

## Competencies:

### A. Knowledge and understanding

At the end of the course, the student will have demonstrated knowledge of the characteristics of different carbon compounds with particular attention to the functional groups that characterize biological macromolecules.

The student will also have acquired knowledge of carbohydrate, lipid and protein metabolism and understand the possible connection points between different metabolic pathways. He will also have understood the structure and characteristics of the cell.

### B. Application of knowledge

The student will be able to use the knowledge gained on the structural and functional characteristics of different carbon compounds in order to describe and identify them by indicating and describing the metabolic pathway of each individual class of compounds.

### C. Making judgements

The student will be able to classify organic molecules.

### D. Communication skills

The student will be able to describe and hold conversations on biochemistry-related topics with an appropriate language property.

### E. Learning skills

At the end of the course, the student will have knowledge of the basic concepts necessary to understand metabolism. This will enable him to pursue engineering studies with greater maturity.

## Syllabus

### 3. *Programme of the course:*



### **Subject 1 – The chemistry of carbon**

Electronic configuration of carbon, orbital hybridization and carbon bonds, classification of carbon compounds, overview of isomerism.

### **Subject 2 – Carbon compounds**

General structural characteristics of aliphatic and aromatic hydrocarbons. Functional group concept.

General structural characteristics of alcohols, aldehydes, ketones, carboxylic acids, amines, esters, anhydrides and amides.

### **Subject 3 - Biological macromolecules**

Carbohydrates: functional and structural characteristics, classification, glycoside binding, difference between simple and complex carbohydrates, the stock polysaccharides starch and glycogen.

Lipids: functional and structural characteristics, classification, fatty acids, triglycerides, phospholipids and cholesterol. Proteins: functional and structural characteristics, classification, the peptide bond and its geometric characteristics. The covalent structure of proteins: primary, secondary (alpha strand and beta strand) and tertiary (motifs and domains). Fibrous proteins. (the collagen helix). Globular proteins. Quaternary structure. Structure-function relationships. Structure of myoglobin and haemoglobin. The binding of oxygen.

Overview on enzymes and enzymatic kinetics. Overview on antibodies.

Nucleic acids: functional and structural characteristics, classification, nitrogen bases. Nucleosides. Nucleotides. RNA. DNA. Overview on the process of duplication, replication, translation and post translation modifications.

### **Subject 4 – The cell**

Structure and organization of the cell, cell compartments, cell organelles.

### **Subject 5 – Hormones**

Classification and general mechanisms of action.

### **Subject 6 – Metabolism**

Concept of metabolism and anabolism.

Carbohydrate metabolism: Anaerobic and aerobic glycolysis. Energy balance. Glycolysis control. Glycogen demolition and synthesis. Gluconeogenesis. Hormone regulation of glycaemia. Citric acid cycle: Production of acetylCoA from pyruvate. Citric acid cycle reactions. Electron transport chain.

Lipid metabolism: Fatty acid metabolism, beta-oxidation. Formation and fate of acetylCoA. Ketone bodies and ketosis. Energy balance sheets.

Amino acid metabolism: Transamination, deamination, decarboxylation. Formation, transport and fate of ammonia. The urea cycle.

### **Evaluation system and criteria**

The examination consists of a 60-minute written test designed to assess the student's ability to analyse and review the acquired concepts. The test is graded on a scale from 0 to 28 and can be taken in writing either at the Rome office or at the teaching centres, provided the student has made a reservation.

The written test includes a combination of open-ended questions, multiple-choice questions, and exercises. Participation in the two E-tivity is not mandatory but can contribute up to a total of 2.5 points. The evaluation of these E-tivity depends on their originality and the accuracy with which they are carried out.

The expected learning outcomes, including knowledge of the subject, ability to apply it, ability to draw conclusions, and proficiency in language, will be assessed through the written test.

During the test, the use of papers, notes, periodic tables, textbooks, or any forms in paper or digital format is NOT allowed.

### **Bibliography and resources**

#### *4. Materials to consult*

Notes written by the instructor are available in Italian.

#### *5. Recommended bibliography*

Suggested readings are:

- Samaja Paroni - Chimica e biochimica per le lauree triennali dell'area biomedical - Piccin-Nuova Libreria-2017.
- David L. Nelson, Michael M. Cox - I principi di biochimica di Lehninger - Ottava edizione italiana a cura di Edon Melloni – 2022.