UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Biochemistry

**2021-2-E3201Q108-E3201Q083M**

## Aims

Course part I

BIOCHEMISTRY

**Aims**

Present the relationship between structure and function of thebiomolecules in order to understand the fundamentals of the biochemical processes that occur in living organisms.

**Knowledge and understanding**
At the end of the course the student knows:
- the methods by which living organisms extract the energy necessary to carry out all the manifestations of life;
- methods for studying the properties of macromolecules, especially proteins, enzymes and nucleic acids;
- the methods used to determine the speed of an enzymatic reaction;
- the catabolic and anabolic pathways and the methods used by living beings to coordinate metabolic pathways.

**Applied knowledge and understanding**
At the end of the course the student is able to:
- calculate the isoelectric point of an amino acid or other metabolite;
- calculate the kinetic constants that govern an enzymatic reaction;
- calculate the molecular weight of a protein.

**Autonomy of judgment**
Knowing how to identify the most appropriate methods for analyzing enzymatic inhibitors.

**Communication skills**

Knowing how to describe in a clear and concise way in written form and to present the objectives, the procedure and the results of the processing carried out orally with language properties.

**Ability to learn**
Be able to apply the knowledge acquired in areas other than those presented during the course and to deepen the topics covered in the scientific literature concerning the aspects of metabolism.

## Contents

Course part I

BIOCHEMISTRY

The teaching is:

1. of the structure and function of simple, polymeric and complex biomolecules;
2. of the ways in which the biochemical reactions occur in the living organisms;
3. the role of the environment in which biochemical reactions take place;
4. of the ways in which biochemical reactions can be controlled both physiologically and artificially.
5. of the description of biochemical reactions and how these develop within pathways called metabolic pathways.
6. of the main techniques for studying biomecules.

## Detailed program

Course part I - BIOCHEMISTRY

Detailed plan

1. Biomolecules: amino acids: structure and properties. The peptide bond and the primary structure of proteins. Secondary, tertiary and quaternary structure of proteins. Respiratory pigments and oxygen transport. Monosaccharides and polysaccharides. Nucleotides and nucleic acids. Lipids: structure and functions. Biological membranes: structure and transport of solutes.
2. Enzymes: classification and catalysis. Coenzymes and vitamins. Enzymatic kinetics: Henri-Michaelis-Menten equation. Enzymatic dosage. Equation of reciprocal doubles.
3. Water: hydrophilic and hydrophobic substances. pH and buffer systems.
4. Enzymatic inhibition: reversible and irreversible inhibition. Allosteric enzymes. Examples of herbicides and insecticides that act as enzyme inhibitors.
5. Principles of bioenergetics and metabolism. Role of ATP and electron transporters. Catabolism. Glycolysis: reactions, enzymes and intermediates. Via dei pentoso phosphates. Lactic and alcoholic fermentation. Krebs cycle and anaplerotic reactions. Glyoxylate cycle. Beta-oxidation of fatty acids.

Degradation of amino acids and urea cycle. Mitochondrial electron flow and ATP biosynthesis. Rotational catalysis. Inhibitors and decouplers of oxidative phosphorylation. Oxidases with mixed function. Biotransformation of xenobiotics. Role of glutathione. Anabolism: gluconeogenesis, biosynthesis of fatty acids and biosynthesis of amino acids. Nitrogen cycle. Carbon organization: Calvin cycle and photosynthesis.

6. Basic biochemical techniques: sample preparation, centrifugation, electrophoresis, immunological and enzymatic techniques. Enzymes as environmental biomarkers.

## Prerequisites

Course part I - BIOCHEMISTRY

To follow the teaching conn profit it is necessary that the student has acquired, without however having to have passed the respective exams:

1. knowledge of general chemistry, in particular on the structure of chemical bonds and on the properties of the elements;
2. knowledge of carbon chemistry and chemical-physical properties of organic molecules in their diversity and complexity;
3. knowledge of thermodynamics;
4. knowledge of cell biology, zoology and botany.

Prerequisites are not required.

## Teaching form

Only frontal lessons for a total of 6 cfu, corresponding to 48 hours. During the Covid-19 emergency period, lessons will take place in a mixed mode: partial presence and all lessons will be videotaped asynchronously.

## Textbook and teaching resource

The teaching material includes:

Slides of the lectures, films and animations projected in the classroom are available on the e-learning website. Videotaped lessons,

The recommended text is: Nelson & Cox, Introduction to the Biochemistry of Lehninger, Zanichelli ed., 2018. It is

available for personal loan in a reduced number of copies at the science library; it can be purchased on paper with a discount on the cover price at all university bookstores or is available as an e-book at the university library.

Some websites are provided on which to deepen useful knowledge to complete the basic preparation.

## Semester

Second semester

## Assessment method

Oral examination. The exam is passed if the student achieves a mark between 18 and 30/30. The test lasts 60 minutes. The oral exam consists in the discussion of two topics chosen by the teacher from those covered during the course, for example the drawing up of a metabolic pathway on paper and discussion of his physiological role, the drawing up of an enzymatic reaction on paper and discussion of the techniques of measurement of the same, the description of a complex biological structure and its relationship with its function also using diagrams drawn on paper at the time. The evaluation of the tests takes into account the efficiency of the methods used, the completeness and accuracy of the answers, as well as the clarity in the presentation. There are no numerical exercises, nor tests with multiple answers. Intermediate evaluations, group tests, workshops or project presentations are not foreseen.

## Office hours

Receive by appointment: please write to paolo.parenti@unimib.it