.- Biochemistry

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***Text under revision. Not yet approved by academic staff.***

***COURSE AIMS*** ***AND INTENDED LEARNING OUTCOMES***

The course aims to provide the tools for knowing and understanding the theory behind the main biosynthetic, catabolic and energy biochemical processes of higher organisms. Particular attention will be devoted to the biochemical aspects of nutrition. At the end of the course, students will be able to autonomously carry out theoretical and practical exercises related to the topics covered, and will be able to analyse and explain the phenomena examined by demonstrating their ability to apply knowledge and understanding. The aim of the course is to equip students with a simple language for expressing the evolution of a biochemical process clearly and with the necessary scientific rigour, and linking it to its relative theoretical concept.

Knowledge and understanding

Students will have to demonstrate their knowledge and understanding of the basic chemical principles of biological systems and the biochemical mechanisms underlying the metabolic processes and life. They should be able to recognise and interpret basic molecular structures and know the key concepts of enzymatic catalysis and fundamental metabolic cycles.

Ability to apply knowledge and understanding

Students will have to demonstrate their ability to apply the theoretical concepts to practical examples by showing that they are able to independently search for the relevant scientific information, with a critical approach.

Communication skills

Students must be able to clearly communicate their knowledge and possess the learning skills that will allow them to continue studying independently.

Learning skills

Being able to collect, organise and interpret scientific information correctly.

COURSE CONTENT

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|  | ECTS |
| Biochemical transformations |  |
| Introduction to the course. Fundamentals of biochemistry. Basics of biology, chemistry and physics.  Enzymatic catalysis; enzyme-catalysed reactions: thermodynamics, kinetics, and substrate-level regulation and biosynthesis.  Integration of metabolic networks (function of metabolism, metabolic compartmentation; ATP role, NAD(P)H, concept of cycle and metabolic pathway).  Biological membranes and solute transport: thermodynamics, kinetics and transport specificity.  Communications within the organism. | 1 |
| Carbohydrate metabolism |  |
| Carbohydrates: generalities, classification, properties (main monosaccharides, polysaccharides, plant cell walls). Glycolysis and its regulation. Aerobic and anaerobic fate of pyruvate. Pentose phosphate pathway. Krebs cycle. Mitochondrial electron transport and oxidative phosphorylation and coupling.  Digestion and absorption of carbohydrates, glycaemia. Gluconeogenesis. | 1.5 |
| Nitrogen metabolism |  |
| Amino acids: generalities, classification, properties. Proteins. Structure and functions of proteins. Digestion and absorption of proteins. Metabolism of amino acids. Catabolism of amino acids, the urea cycle. Energy metabolism. The Cori cycle. Glucose-alanine cycle. | 1.5 |
| Lipid metabolism |  |
| Lipids: generalities, classification, properties. Complex lipids. Digestion, absorption and utilisation of lipids. Ketone bodies. Catabolism and biosynthesis of fatty acids. The regulation of lipid metabolism. The metabolism of cholesterol, phospholipids and glycolipids. Plasma lipoproteins. | 1 |
| Genetic information and expression |  |
| Biosynthesis and catabolism of nitrogenous bases. Nucleotides. DNA structure and variability of genetic information. DNA replication and transcription. Genetic code. Features and functions of RNA. mRNA translation. Polypeptide synthesis. | 1 |
| Practicala activities | 2 |

READING LIST

**Nelson DL, Cox MM, *Introduzione alla biochimica di Lehninger*, Sixth edition, Zanichelli, Bologna, 2018.**

**Campbell MK, Farrell SO, *Biochimica*. EdiSES, Naples, 2019.**

**Brown TA. *Conoscere la biochimica*, First edition, Zanichelli, Bologna, 2018.**

TEACHING METHOD

Frontal lectures and practical activities. There are 6 ECTS of frontal lectures (48 hours) in the classroom, and 2 ECTS (12 hours) of compulsory practical activities in the laboratory (12 hours) and in the classroom (12 hours). The lectures are theoretical in nature, interspersed with application examples, and will be held with the help of slides and/or the whiteboard.

Classroom practical activities:

6 hours during which examples and calculations on thermodynamics associated with reactions in cellular biochemistry are addressed: calculation of real ΔG in glycolysis reactions, calculation of ΔE in the main redox of agricultural biochemical interest (respiration, alcoholic and lactic acid fermentation), calculation of ΔG associated with membrane transport and oxidative phosphorylation.

2 hours dedicated to exercises related to reactions, such as the n-factor calculation for iodine, saponification, determination of molecular weight through colligative properties, and hypotheses of the best structure of a complex lipid.

1 hour for exercises in determining the structure of a protein using cutting enzymes

1 hour dedicated to calculating the energy value of foods using thermodynamic calculations and comparing it against the energy value on the nutritional label

2 hours dedicated to depicting the Vmax and KM enzymatic kinetic constants graphically using the Lineweaver-Burk diagram method (or reciprocal double diagram)

Once the explanations are over, students are invited to give examples on the blackboard similar to those dealt with, in order to strengthen their understanding of the topics covered.

Laboratory practical activities.

Laboratory practical activities will take place in which students work in small groups (2-3 people) to carry out the following activities:

- Determination of free proline in wine by UV-Vis spectrophotometry

- Analysis of lactose in milk

- Determination of the peroxide number

- Determination of the glucose-oxidase KM

At the end of each practical activity, students will have to write down all the information from the practical activity in a lab notebook and be able to repeat the experience later.

ASSESSMENT METHOD AND CRITERIA

The assessment will be both written and oral. To access the oral exam, students will need to have previously taken a written part covering the classroom practical activities and a preliminary Blackboard test on the entire course programme. The written assessment will focus exclusively on the subjects covered in the practical activities and will be preparatory to admission to the oral exam. The paper will involve solving 4 problems linked to the classroom practical activities. Each problem is worth 10 marks, 5 for the demonstration of theoretical knowledge and 5 for the calculation itself; a minimum mark of 24/40 is needed to pass the test. The oral exam will be preceded by a Blackboard test containing 10 closed questions, on the entire programme, with a minimum assessment of 18/30. The oral part will consist of three questions on the topics covered in each of the 6 course ECTS. The assessment will take into account students' ability to understand the topic being discussed, their ability to contextualise it within the course programme, their ability to analyse and explore the topics in depth, and their presentation skills. The final mark will be based one third on the mark obtained in the preliminary tests and two thirds on the answers given to the oral questions.

NOTES AND PREREQUISITES

Participation in the laboratory practical activities is compulsory. Passing the organic chemistry exam is preparatory to the oral exam.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at <http://docenti.unicatt.it/>.