**. - Biochimica**

Prof. Luigi Lucini

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

The course is aimed to provide a general comprehension of the main biochemical classes, namely proteins and amino acids, lipids and carbohydrates as well as the transformation processes these compounds undergo in vivo (metabolism). Particular attention will be given to the biochemical aspects related to the agri-food chain and nutritional aspects.

At the end of the course the student is expected to achieve a KNOWLEDGE AND COMPREHENSION of the chemical processes underlying biological systems, as well as of the complex metabolic transformation occurring on carbohydrates, lipids and proteins (assimilation, biosynthesis, catabolic degradation).

Concerning the skills TO APPLY KNOWLEDGE AND COMPREHENSION, the student will gain an understanding of the metabolic regulation, including the shunts and interconnections between different metabolisms and the impact on a biological system.

#### *COURSE CONTENT*

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|  | Credits |
| **Biomolecules** |  |
| Cell structure and the metabolism concept. Carbohydrates: main aspects, classification, structure and properties. Main monosaccharide and polysaccharides. Plant cell wall. | 0.5 |
| Amino acids: main aspects, classification, and properties. Proteins and protein structure. | 0.5 |
| Lipids: main aspects, classification, properties. Cell membrane and its functionality. | 0.5 |
| Nucleotides and DNA structure. DNA replication and transcription. RNA structure and functions. The genetic code. mRNA maturation and transduction. Ribosomal synthesis of peptides. | 0.5 |
| **Bioenergetics** |  |
| Potential of membranes and transport: diffusion, partition, and active transport. Water. | 0.5 |
| Enzymatic catalysis: molecular mechanism and regulation. Enzyme kinetics. | 0.5 |
| **Metabolism of carbohydrates and oxidative phosphorylation** |  |
| Bioenergetics. Glycolysis, aerobic and anaerobic fate of pyruvate. Gluconeogenesis. The pentose phosphate pathway. The Krebs cycle, mitochondrial transport of electrons, ATP synthesis. Photosynthesis, CO2 fixation, Calvin cycle. | 1.5 |
| **Metabolism of proteins and amino acids** |  |
| Digestion of proteins. Metabolism of amino acids, the urea cycle. | 0.5 |
| **Metabolism of lipids** |  |
| Catabolism of fatty acids. The ketone bodies. The modulation of lipids metabolism. Cholesterol and plasma lipoproteins. Biosynthesis of fatty acids. | 1 |
| *Exercises.* Classroom and laboratory exercises | 2 |

#### *READING LIST*

D.L. Nelson-M.M. Cox, *Introduzione alla biochimica di Lehninger*, 4a ed., Zanichelli, Bologna, 2011.

M.K. Campbell-S.O. Farrell, *Biochimica*, 4a ed., Edises, Napoli, 2009.

#### *TEACHING METHOD*

The teaching method is mainly based on classroom lectures, during which the active partecipation of students is strongly encouraged. Besides lectures, classroom exercices (where the student practices the drawing of chemical structures for carbohydrates, amino acids and peptides) will be provided together with laboratory exercices (where the student will apply in practical exercices the concepts introduced in lectures.)

***ASSESSMENT METHOD AND CRITERIA***

The method applied to assess the degree of competence acquired includes: a) a written exam (intermediate, mid-term assessment) with open questions on the first 3 credits of the course, taking 1 hour; b) a final exam done orally, with 3-6 questions.

The intermediate assessment is facultative and, in case the test is positive (hence with a score of 18/31 as minimum), the corresponding topics will not be investigated further during the oral examination. However, in case of negative scores, it is still possible to do the oral exam on the whole course contents. The students not carrying out or not passing the intermediate written exam can do the oral exam; in that case, they will be examined on the whole course content (i.e., both macro biomolecules and their metabolism).

The oral exam consists of 3 questions (5-6 in case the written test was unsuccessful). The final score is a weighted average between the (eventual) written and the oral assessments, with a relative weight of 40% and 60% respectively.

During the assessments, the skills regarding (i) the proper drawing of molecular structures for carbohydrates, lipids, amino acids and proteins; (ii) the knowledge of the biological role(s) of biochemical molecules; (iii) the knowledge on the biochemical pathways for biosynthesis and degradation, as well as (iv) the regulation of metabolic processes will be investigated. The student is asked to argument and defend his conclusions regarding the impact of biochemical processes into biological systems.

***NOTES AND PREREQUISITES***

The student is asked to possess previous skills from general chemistry such as atoms structure, Lewis’ structures, resonance and molecular orbitals. Furthermore, the previous concepts of organic chemistry (with main focus on structure, nomenclature and reactivity for carbonyl and carboxy compounds) are essential.

***TEACHER AVAILABILITY***

The teacher is available in the 3 hours following the lectures, at the seat of Cremona. It is advisable to schedule in advance with the teacher (by email), the eventual appointment.