UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

*Scuola di Medicina*

# Bari English Medical Curriculum

## FIRST YEAR

## BIOCHEMISTRY

| **General information** | |
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| Year of the course | *First year* |
| Academic calendar | *Second semester* |
| Credits (CFU/ETCS): | 8 CFU |
| SSD | *BIO/10 Biochemistry* |
| Language | *English* |
| Mode of attendance | *Attendance is governed by the Course Teaching Regulations* |

| **Professor/ Lecturer** | |
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| Name and Surname | Luigi Leonardo Palese |
| E-mail | luigileonardo.palese@uniba.it |
| Telephone | |
| Department and address | *Dipartimento di Biomedicina Traslazionale e Neuroscienze (DiBraiN)*<br>*Nuovo Complesso delle Scienze Biomediche Policlinico, Piazza G. Cesare, 11 - Bari* |
| Virtual room | *Teams channel (the code will be communicated in class)* |
| Office Hours | Every day between 12pm and 4pm at the teacher's office (by email appointment only) |

| **Work schedule** | | | |
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| **Hours** | | | |
| Total | Lectures | Hands-on (laboratory, workshops, working groups, seminars, field trips) | Out-of-class study hours/ Self-study hours |
| *200* | *80* | | 120 |
| **CFU/ETCS** | | | |
| *8* | 8 | | |

| **Learning Objectives** | *The central objective of the course is to provide students with a method of critical reasoning about the biochemical-metabolic aspects of Medicine. Specifically, this course provides an overview of the major metabolic pathways and their functional correlations in the human organism. Biochemical processes that characterize the specialized function of different tissues and organs will also be described. The theoretical knowledge gained from this Biochemistry course will provide an essential basis for* |
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| | *subsequent applications at the professional level.* |
| **Course prerequisites** | *The correct understanding of the principles of biochemistry presupposes a good knowledge of the basics of physics, of general, inorganic and organic chemistry and of cellular biology, in order to appreciate the relationships (even quantitative) between the different biochemical pathways and their integrated regulation in the same cell. To be admitted to take Biochemistry the student must have passed the Chemistry and Propaedeutic Biochemistry exam.* |

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| **Teaching strategie** | *The training activity is carried out through frontal lessons in the classroom with the use of audio-visual systems with interactive methodology based on the interaction between teacher and student. It also includes the analysis of "scientific cases" on specific topics, as a moment of in-depth study and application of biochemical knowledge and professional skills, consistently with the training objectives.* |
| **Expected learning outcomes in terms of** | |
| ***Knowledge and understanding on:*** | *The student will have to acquire a good knowledge and understanding of the main biological molecules, metabolic pathways and their regulation, also at the level of tissues, organs and systems. Particular attention will be given to the ability to grasp the fundamental aspects of bioenergetics and the integration of metabolic flows, both catabolic and anabolic, and the role of coenzymes, vitamins and energy-rich compounds in cellular and tissue homeostasis.* |
| ***Applying knowledge and understanding on:*** | *The student will have to acquire skills and competences aimed at being able to translate the theoretical information and operational skills acquired in the field of biochemistry to the scientific and technological contexts of the medical profession. The student will therefore be able to appreciate the professional applications deriving from the knowledge of biochemistry.* |
| ***Soft skills*** | *Autonomy of judgement:*<br>*The student should be able to independently deepen the notions learned, in order to progressively acquire full maturity and autonomy of judgment, according to the relevant ethical principles. Independence of judgment will be stimulated through the guided development of the analysis and individual interpretation of technical-scientific papers.* |

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| | *Communication skills*<br>*The student should be able to transmit the knowledge learned in a clear and comprehensible way to everyone, having acquired adequate communication-relational skills and social skills useful for building communication between different subjects. The student will be stimulated to develop communication skills through the organization of group work in which some scientific articles will be analyzed and presentations structured as technical-scientific reports will be discussed, to be presented in the classroom to colleagues in the presence of the teacher. Therefore, the student will be able to use all the technical and IT methods and tools for managing communication and will have to know the processes and logic to guarantee its effectiveness.*<br><br>*Ability to learn*<br>*The student must have acquired not only adequate skills and knowledge to pass the exam, but above all adequate learning skills and methods for the continuous updating and improvement of their skills in the field of biochemistry necessary for the medical profession.*<br>*The learning ability will be stimulated with appropriate tools and argumentative techniques during the lectures.* |
| ***Syllabus*** | |
| **Content knowledge** | *INTRODUCTION TO METABOLISM*<br>*Anabolism and catabolism. Oxidative metabolism. Main metabolic pathways: degradative and biosynthetic pathways. Regulation of metabolic pathways.*<br><br>*CARBOHYDRATE METABOLISM*<br>*Glycolysis. Metabolic fate of glucose-6-P. Pyruvate in aerobic and anaerobic conditions. Metabolism of fructose and galactose. Glycogen metabolism: glycogenosynthesis and glycogenolysis. Gluconeogenesis. Cori cycle. Pentose phosphate pathway.*<br><br>*TRICARBOXYLIC ACID CYCLE*<br>*Pyruvate dehydrogenase complex. Krebs cycle. Amphibolic function and anaplerotic reactions.*<br><br>*MITOCHONDRIAL BIOENERGETICS*<br>*Oxidation-reduction reactions of biological interest. Transfer of reducing equivalents from the cytoplasm to the mitochondria: shuttle systems. Structure and function of the mitochondrial respiratory chain complexes. Regulation of respiratory activity. Coupling mechanism and oxidative* |

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| | *phosphorylation. Respiratory control index. P/O ratio.*<br><br>*REACTIVE OXYGEN (ROS) AND NITROGEN (RNS) SPECIES*<br>*Physiological role of ROS. Oxidative damage to biological macromolecules. Scavenger systems. Role of ROS in human aging. Nitric oxide (NO) metabolism: NO synthases and their tissue-specific functions.*<br><br>*METABOLISM OF LIPIDS*<br>*Cytoplasmic activation of fatty acids and role of carnitine. Beta oxidation of saturated and unsaturated fatty acids. Metabolism of propionyl CoA. Metabolism of ketone bodies. Biosynthesis of saturated and unsaturated fatty acids.*<br><br>*METABOLISM OF AMINO ACIDS*<br>*Glucogenic and ketogenic amino acids. Catabolic fate of the amino group. Transamination. Oxidative and non-oxidative deamination. Transport of ammonia from extra-hepatic tissues to the liver. Urea cycle.*<br><br>*NUCLEOTIDE METABOLISM*<br>*De novo synthesis of purine and pyrimidine nucleotides. Purine nucleotide recovery pathway. Synthesis of deoxyribonucleotides. Biosynthesis of thymidylate.*<br><br>*BIOSIGNALING*<br>*Biochemical classification of hormones and receptors. Kinetics of hormone-receptor binding. Biosynthesis of steroid and thyroid hormones. Second messengers.*<br><br>*INTEGRATION OF METABOLISM*<br>*Metabolic interrelationships. Branch points of energy metabolism. Hormonal control of energy metabolism: insulin, glucagon. Glucose homeostasis: feeding-fasting cycle. Biochemical effects of hyperglycemia: glycation reactions, methylglyoxal, polyol pathway, PARP.*<br><br>*BIOCHEMISTRY OF THE GASTRO-INTESTINAL SYSTEM*<br>*Digestion and absorption of carbohydrates, lipids and proteins. Bile acids and bile pigments.*<br><br>*LIVER BIOCHEMISTRY*<br>*The metabolic peculiarities of the liver. Detoxification reactions. Cytochromes P-450. Ethanol metabolism.* |

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| | *BIOCHEMISTRY OF ADIPOSE TISSUE*<br>*Adipose tissue metabolism. Adipokines and regulation of energy metabolism. Thermogenesis and uncoupling proteins.*<br><br>*BLOOD BIOCHEMISTRY*<br>*Plasma proteins. Lipoproteins: structural and metabolic characteristics. Cholesterol metabolism and homeostasis. Metabolism and function of vitamin D. Iron homeostasis. Heme metabolism. Metabolism and function of vitamin K.*<br><br>*BIOCHEMISTRY OF MUSCLE TISSUE*<br>*Muscle carbohydrate, lipid and protein energy metabolism. Creatine and creatine kinase. AMP cycle. Branched-chain amino acids.*<br><br>*BIOCHEMISTRY OF NERVOUS TISSUE*<br>*Metabolism of the nervous system. Structure and function of ion channels. Metabolism of the main neurotransmitters and structure of the receptors. Biochemical mechanisms of the sensory and visual system.* |
| **Texts and readings** | *Baynes, Dominiczak: Medical Biochemistry 6th edition, Elsevier.*<br><br>*Voet, Voet: Biochemistry, International Adaptation, 4th Edition, Wiley.*<br><br>*Nelson, Cox: Lehninger Principles of Biochemistry International Edition, 7th Edition, W.H.Freeman & Co Ltd.* |
| **Notes, additional materials** | *Lecture notes and additional material will be made available on the dedicated Teams channel.* |
| **Repository** | *Course Team channel; the access code will be communicated to students at the beginning of the course.* |

| **Assessment** | |
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| Assessment methods | *The exam includes an oral interview during which the acquisition of the expected knowledge will be verified. The student will also be asked to represent the schemes of the main metabolic reactions on the blackboard (or equivalent).* |
| Assessment criteria | *The oral exam includes questions on the topics covered during the course; each answer is evaluated based on the correctness, exhaustiveness and ability to explain the topic covered by the question. The transversal skills foreseen in the learning outcomes will be verified and will contribute to the evaluation of the final grade. Honors can be awarded when the student has demonstrated full* |

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| | *mastery of the subject during the interview.* |
| Final exam and grading criteria | *The exam is considered passed when the grade is greater than or equal to 18/30. The awarding of maximum marks with honors (30 honors) is possible* |
| **Further information** | |
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