BIOMEDICAL SCIENCES II

Corso integrato/ Integrated course

Inglese/English

Indicare i seguenti dati:

Coordinatore/Coordinator: Prof. Barbara

Tavazzi

Anno di corso/Year Course: 1

Semestre/Semester: 2
CFU/UFC: 13

Moduli e docenti incaricati /Modules and lecturers:

Cellular biology II: Wanda Lattanzi
Cellular biology II practicals: Marta Barba/
Lorena Di Pietro Biochemistry: Alessandro
Arcovito/ Barbara Tavazzi
Biochemistry practicals: Giuseppina Nocca, Francesca
Sciandra, Manuela Bozzi Human Genetics: Giuseppe
Marangi /Pietro Chiurazzi
Molecular Biology: Andrea Urbani

CELLULAR BIOLOGY II

Karp G, "Cell and Molecular Biology – Concepts and Experiments" 8th edition, Wiley, 2016
(latest available edition)
For additional consultation: Alberts B, et al. Essential Cell Biology, 4th Edition, Garland
Science - Taylor & Francis Group, 2013.

BIOCHEMISTRY

Voet D, Voet JG, Pratt CW Principles of Biochemistry (international student version) IV

edition – John Wiley and Sons Inc. MOLECULAR BIOLOGY
David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry, VII edition, McMillan
Learning

HUMAN GENETICS
Essential Medical Genetics (Tobias, Connor, Ferguson-Smith) – 6th edition, Wiley-Blackwell
2011 (ISBN: 9781405169745)

Additional material will be provided (i.e. scientific articles and appropriate telematic
sources) to complete, elaborate and update the contents discussed in each module.
The whole course is aimed at giving the student a deep knowledge of the main metabolic and
molecular processes that occur in the human organism along with the basics of heredity and
the principles of human and medical genetics. Moreover, insights into the modern molecular

biology techniques and their relevance for modern medicine will be provided.

At the end of the integrated course the student must demonstrate that he/she has reached the following objectives:

Knowledge and understanding abilities – demonstrate the know-how of the different metabolic and molecular processes occurring in the eukaryotic cells enabling intercellular communications and homeostasis, along with their implication in genetic disorders.

Applied knowledge and understanding skills – demonstrate to adequately interpret the importance of molecular mechanisms and hereditary patterns that may be altered in human diseases.

Personal judgement – the student must properly integrate the knowledge and skills learned to develop autonomous abilities to identify the fundamental pathways associated with physiological mechanisms, relevant for the application in the medical field.

Communication skills – be able to communicate scientific and applicative content in a clear and unambiguously way, using an appropriate technical language and explaining their personal conclusions, as well as the knowledge and rationale underlying them, to specialists and non-specialist interlocutors.

Learning ability – be able to keep up-to-date and expand their knowledge by autonomously drawing on scientific texts and articles, and scientific databases (NCBI/PubMed, MedLine,).

In order to better understand the topics of the course and to formally register for the exam session, students must have attended and passed the exam of Basic Sciences.

The course is organized into lectures and practical sessions covering the topics included in all the teaching modules to provide the basic elements of Cell Biology, Biochemistry, Human Genetics and Molecular Biology. The teaching methods implement active learning activities, such as problem-based learning, self-learning, case studies and experimental activities.

The adopted teaching methods allow students to pursue the learning objectives:

Knowledge and understanding abilities – all the topics listed in the program will be treated during frontal lectures and carefully explained with tutorials and exhaustive explanations, in order to provide students the appropriate knowledge and learning method.

Applied knowledge and understanding skills – the interactive teaching methods, including "case study", practical examples and laboratory practice exercises, will allow students to learn the applicative potential of the treated topics.

Personal judgement – the active learning modalities will enable students to independently formulate ideas and use critical reasoning.

Communication skills – the active learning modalities will stimulate active and constant interaction with the instructors, towards the progressive development of focused communication skills for the presentation of treated topics through a correct scientific language.

Learning ability – additional material (i.e. scientific articles and appropriate telematic sources) will support students in their individual and autonomous study.

The instructors are available for further clarifications and discussions regarding the learning modules' topics and any possible related issue, also beside the classes timetable by appointment.

The exam is composed of a written test comprising 50 multiple-choice quizzes divided into 2 blocks:

1. Biochemistry (26 quizzes)

2. Molecular Biology (4 quizzes), Cellular Biology II (8 quizzes), Human Genetics (12 quizzes), for a total of 24 quizzes

For each quiz a single correct answer is possible. Each correct answer correspond to a score= 1, wrong/no answer correspond to score= 0. To pass the written test the student needs to answer correctly to at least 13 quizzes in module 1 and 13 quizzes in module 2.

The score obtained in the written test is calculated according to the following scale:

26/50 = 18
27/50 = 18
28/50 =19
29/50 =19
30/50 =20
31/50 =20
32/50 =21
33/50 =21
34/50 =22
35/50 =22
36/50 =23
37/50 =23
38/50 =24
39/50 =24
40/50 =25
41/50 =25
42/50 = 26
43/50 =26
44/50 = 27
45/50 = 27
46/50 =28
47/50 = 28
48/50 = 29
49/50 = 30
50/50 =30 with honors

The minimum score that needs to be achieved to pass the written test is 18. Passing the written test will give access to a brief oral examination. During the oral test the students will be asked an overall number of 4 questions, each scoring in the -1/+1 range. The final score achieved in the oral part will be then -4/+4 and will be added to the score achieved in the written test to calculate the final score. The student will be able to obtain the maximum final score (30/30 with honors) only if he/she achieved a minimum score of 27/30.

The objective of the evaluation system is to verify:

- the knowledge and understanding of the different aspects that are discussed in each module during the course (knowledge and understanding);the ability to connect theoretical concepts and practical problems regarding the different aspects discussed during the course (Applied knowledge and understanding);
  - the ability to integrate the themes treated in the different modules of the course (Personal judgement);
- the development of communication skills for the presentation of treated topics through

a correct scientific language (Communication skills);
- the ability to autonomously delve into specific biomedical topics (Learning ability).

CELLULAR BIOLOGY II

DNA and the genetic code, DNA
replication and repair. The cell cycle
and its regulation. Meiosis and mitosis.
The RNA world. RNA transcription, post-transcriptional modifications, noncoding RNAs, mechanisms of regulation of gene expression.
Protein translation, post-translational regulation of protein expression and function.
Signal transduction and intracellular signaling. Receptors and messengers, introduction to main signaling cascades and biological pathways.

CELLULAR BIOLOGY II PRACTICALS:

The Cellular Biology II Practicals are based on laboratory practice exercises to study gene expression in in vitro models:

1) cDNA synthesis: reverse transcription reaction;
2) Polymerase Chain Reaction (PCR);
3) Real-Time PCR.

BIOCHEMISTRY

Enzymes. Enzymatic catalysis and regulation. Passive and active transport across membranes. Introduction to metabolisms. Glycolysis and its regulation. The pentose phosphate pathway and the additional pathways in carbohydrate metabolism. Glycogen synthesis and breakdown. Gluconeogenesis and other carbohydrate biosynthetic pathways. The citric acid cycle and its regulation. Mitochondrial ATP synthesis and electron transport. Oxidative Phosphorylation. Metabolism of nucleic acid, anabolism and catabolism of purines and pyrimidines. Synthesis and degradation of lipids. Regulation of fatty acid metabolism. Synthesis of other lipids. Cholesterol metabolism. Synthesis and degradation of amino acids. Urea cycle. Nitrogen metabolism, anabolism and catabolism of glutathione, creatine, active amine, NO and heme groups. Hormones and signal transduction. Bioenergetics and regulation of fuel metabolism.

BIOCHEMISTRY PRACTICALS:

Determination of the protein concentration in a cellular extract using the Bradford Method. Determination of the enzymatic activity in vitro.

MOLECULAR BIOLOGY

Nucleotides and Nucleic Acids structures: Nucleic Acid Structure, Nucleic Acid Chemistry, Other Functions of Nucleotides; DNA- Based Information Technologies: DNA Cloning: The Basics, From Genes to Genomes, From Genomes to Proteomes, Proteomics investigations; Structure to function analysis: from gene to protein structures, bioinformatics analysis of gene and protein sequences, developing and screening expression libraries, recombinant protein expression and purification.

HUMAN GENETICS

Inherited variants and "de novo" mutations, germinal and somatic mosaicism, frequency of genetic variants. Mendel's laws (recessive and dominant inheritance, allele segregation, independent assortment), Genealogical data and family trees, (Mendelian inheritance of

monogenic disorders (autosomal dominant/recessive, X-linked). Exceptions to Mendel's laws (codominance, random monoallelic expression (RME) and parental-specific monoallelic expression (imprinting), X-inactivation, linkage and crossing-over). Genetic markers and Linkage studies, Techniques of DNA and RNA analysis, Next-Generation Sequencing, Genetic Databases and homology searches. Human chromosomes and Copy-Number Variants (CNVs). Anatomy of the human genome, regulating gene expression.