



COURSE DETAILS "INTEGRATED COURSE OF MOLECULAR AND CELLULAR BIOLOGY " SSD BIO/13, BIO/11

DEGREE PROGRAMME: MEDICINE AND SURGERY (P11) COORDINATOR: PROF. SIMONA PALADINO ACADEMIC YEAR 2023-2024

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION about the course <u>TEACHING LANGUAGE</u>: ENGLISH <u>CHANNEL (IF APPLICABLE): 1</u> <u>YEAR OF THE DEGREE PROGRAMME</u>: I <u>SEMESTER</u>: II CFU: 8

REQUIRED PRELIMINARY COURSES

Nothing. It is advisable to have taken the chemistry exam.

PREREQUISITES

For a proper understanding of the topics discussed in the Integrated Course, students should have acquired general knowledge of chemistry.

LEARNING GOALS

The aim of this Course is the understanding of the molecular mechanisms that underlie cellular functions. In particular, the student must learn the link between subcellular components and cellular functions, as well as the link between cellular homeostasis and organism homeostasis in order to understand the link between alterations in cellular structures and the development of human diseases. In addition, it will be provided new advancements on relevant and innovative cellular and molecular technologies necessary for understanding the pathophysiology of cells.

EXPECTED LEARNING OUTCOMES

Students will acquire the fundamental knowledge of the basic biological principles involved in cellular processes. Specifically, the student will learn the molecular mechanisms that regulate cell function and understand how the alteration of these mechanisms results in a pathological condition/disease of the individual.

Knowledge and understanding

The student will learn the molecular mechanisms regulating the homeostasis and functions of cells. In particular, the student will know:

- The theoretical bases and methodologies for the analysis of biological macromolecules, at both structural and functional levels, and the dynamics of biological processes;

- The molecular mechanisms that underlie the transfer and control of genetic information, and regulation of gene expression; cell proliferation, survival and differentiation;

- The molecular mechanisms directing the behaviour of cells in living organism, driving the functions of each cell type: protein transport and targeting, development, differentiation, proliferation, cellular transformation, interactions between cells and the extracellular environment.

Applying knowledge and understanding

Students are also expected to be able to:

i) Use the logical reasoning, understanding the scientific method, including experimental design and critical assessment of the scientific literature, and know the experimental methodologies for biomedical research;

ii) Describe some relevant cellular and molecular technologies and indicate their applications;

iii) Identify biological processes as determinants of the correct regulation of the main cellular functions and understand the link between dysregulation of the biological processes and development of disease.

COURSE CONTENT/SYLLABUS

1. The general plan of cell organization. Biological membranes: structure, compositon and properties. Transport across cell membranes and physiopathological implications. CFU 0,5

2. Nucleic acids structure and DNA topology. Genomic organization. Chromatin structure. CFU 0,75

3. Molecular mechanism of DNA replication. DNA synthesis, DNA repair and DNA recombination and their physiopathological implications. CFU 0, 75

4. DNA transcription in prokaryotes and eukaryotes. Transcripts maturation and their modification. Protein synthesis. CFU 0,5

5. Molecular bases of mitochondria functionality. The role of mitochondria in the maintenance of cellular homeostasis and their pathophysiological implications. The role of mitochondria in apoptosis. CFU 0,75

6. Biogenesis and maintenance of cellular compartments. Properties and functions of cell organelles and diseases associated to their dysfunction. CFU 0,5

7. Secertory pathway. Regulation of vescicular traffic of proteins. Molecular mechanisms of exocytosis and endocytosis and their pathophysiological implications. Autophagy and its physiopathological impact. CFU 0,75

8. The cytoskeleton. Molecular motors. Cell motility. The mechanics of cell division. CFU 0,5

9. Principles of cell signalling and signal transduction. The cell cycle: sequential events in the cell cycle and its regulation. Molecular patwahys regulating cell proliferation and survival. The mitosis. The meiosis . CFU 0,75

10. Cells and their environment: adhesion molecules, extracellular matrix and regulated biological processes. CFU 0,75

ADI (interactive learning activity): critical reading and discussion of scientific publications in the biomedical field; analysis of experimental data; elaboration of audiovisual presentations and public speaking. CFU 1,5

TEACHING ACTIVITIES					
Week	Day / Hour	Lessons/Seminars	Teacher		
2 March $17^{th} - 21^{th}$	21 th 13-14	Introduction of the Course. Role of Molecular and Cellular Biology in medicine. The general plan of cell organization.	Paladino		
3 March 24 th - 28 th	24 th 13-15 25 th 15-17 27 th 13-15 28 th 13-15	Nucleic acids structure and DNA topology. Genomic organization. Molecular mechanisms of DNA replication.	Merla		
4 March 31 th April 1 th 4 ^t	31 th 15-17 1 st 15-17 3 rd 13-15 4 th 13-15	Molecular mechanism of "proofreading" in DNA replication. Telomeres' replication. DNA damage and repair.	Merla		
5 April 7 th 11 th	7 th 15-17 8 th 15-17 10 th 13-15 11 th 13-15	DNA transcription in prokaryotes and eukaryotes. Transcripts maturation and modification. Mechanisms of regulation of transcription and gene expression. Protein synthesis.	Merla		
6 April 14 th - 16 th 23 th - 24 ^{th th}	14 th 15-17 15 th 13-15 16 th 15-17	Biological membranes. Properties of biological membranes. Lipid microdomains: properties and functions. Transport across cell membranes.	Zurzolo		
7 April 28 th - 30 th May 1 st - 2 nd	28 th 15-17 29 th 15-17 30 th 9.30-11.30	Mitochondria: properties of mitochondrial membranes, molecular mechanisms regulating mitochondrial dynamics and their physiopathological impact. Mitochondrial DNA: role and its impact on human diseases. The role of mitochondria in the bioenergetics, in the cellular calcium homeostasis, in apoptosis.	Paladino		
8 May 5 th - 9 th	5 th 15-17 6 th 13-15 8 th 13-15 9 th 13-15	Biogenesis and maintenance of cellular compartments and their physiopathological impact. Biogenesis of mitochondria. Properties, functions and biogenesis of peroxisomes. Nuclear-cytosol transport and their mechanism of regulation. Secretory pathway; protein translocation across the endoplasmic reticulum (ER) membrane; properties and functions of ER.	Paladino		
9 May 12 th - 16 th	12 th 15-17 13 th 13-15 15 th 13-15 16 th 13-15	Protein Glycosylation. Properties and functions of Golgi apparatus. Molecular mechanisms regulating exocytosis. Endo-lysosome system: properties and functions of endosomes and lysosomes. Molecular mechanisms regulating vesicular traffic of proteins between compartments. Endocytosis, macropynocytosis, phagocytosis and their physiological impact for the cells. Autophagy and its physiopathological impact.	Medina		
10 May 19 th - 23 th	19 th 15-17 20 th 13-15 22 th 13-15	The cytoskeleton: properties and functions. Molecular motors. Cell motility. The mechanics of cell division.	Medina		
11 May 26 th - 30 th	26 th 15-17 27 th 13-15 28 th 9.30-11.30 29 th 13-15	Principles of cell signalling and signal transduction. The cell cycle: sequential events in the cell cycle and their main regulators. Cell proliferation, growth factors and proto-oncogenes. Transcriptional regulation of cell cycle. The mitosis. The meiosis.	Barone		
12 June 2 th -6 th	3 rd 13-15 5 th 15-17 6 th 15-17	Adhesion molecules, extracellular matrix and the regulated biological processes.	Medina		

Alberts B, Heald R, Johnson A, Morgan D, Raff M, Roberts K, Walter P, "Molecular Biology of the Cell", WW Norton &CO; seventh edition. Slides, handouts and presentations, available on the Teachers' website.

TEACHING METHODS

The course will be based for the 70% of the course on lectures with the support of power points and on the 25% on interactive discussion of scientific articles in the biomedical field and analysis of experimental data.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type		
written and oral	Х	
only written		
only oral		
project discussion		
other		

In case of a written exam,	Multiple choice answers	X
	Open answers	
	Numerical exercises	

(*) multiple options are possible

b) Evaluation pattern:

A test with multiple choice questions on all arguments listed in the program must be passed to access to the oral examination. The evaluation will be given taking into account the overall result of the written and oral test.