UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Cellular Pathophysiology

2627-1-F0602Q085

Aims

1. Knowledge and understanding: The course aims to provide students with a solid conceptual framework for understanding the molecular basis of disease, enabling the identification of relevant molecular targets for diagnosis and therapy, as well as the critical interpretation of current scientific literature.
2. Applying knowledge and understanding: The course aims to integrate the multidisciplinary knowledge acquired throughout the degree program and apply it to the analysis of disease mechanisms at the cellular and molecular levels.
3. Making judgements: The course provides students with the tools required to critically evaluate scientific evidence and research literature, fostering independent and informed scientific judgement.
4. Communication skills: The development and assessment of communication skills are not a specific objective of the course, although such skills may be indirectly evaluated during the examination.
5. Learning skills: Students are expected to possess the learning skills appropriate for a Master's Degree program; these skills will be assessed through their performance in the examination.

Contents

The course explores the mechanisms by which alterations at the cellular and molecular levels contribute to the onset and progression of human disease in different physiological systems. Both hereditary defects, including disorders associated with ion channel dysfunction, and pathological conditions arising from cellular adaptation to stressful stimuli will be discussed. Since students may come from heterogeneous educational backgrounds, the pathophysiological topics will be introduced through a concise presentation of the physiological processes required for their understanding.

Detailed program

The course is organized into two complementary sections.

The first section introduces fundamental concepts of cellular physiology and pathophysiology, providing the conceptual framework required for the subsequent topics. Subjects covered include:

1. General principles of membrane and transepithelial transport
2. Review of selected physiological concepts relevant to cellular pathophysiology
3. Cellular responses to stress
4. Intracellular pH homeostasis
5. Cell volume homeostasis and regulatory volume responses
6. Cellular adaptation to acute and chronic hypoxia/ischemia

The second section focuses on proteins that play essential roles in cellular function, including ion channels, transporters, water channels, and proteins involved in intracellular calcium homeostasis. Their physiological roles in different organ systems will be examined through selected examples of human diseases associated with genetic mutations or functional alterations. For these topics, the discussion will generally follow a common framework: protein structure and function; physiological role at the cellular, tissue, and organism levels; mechanisms of dysfunction; cellular and clinical consequences; and current therapeutic approaches.

Topics covered in this section include:

1. Chloride channels and transporters (cystic fibrosis, Dent disease, congenital myotonia)
2. Aquaporins and water homeostasis (nephrogenic diabetes insipidus)
3. Voltage-gated and epithelial sodium channels (Long QT syndrome type 3, Liddle syndrome)
4. Potassium channels and membrane excitability (Long QT syndrome, Short QT syndrome, Andersen–Tawil syndrome, Bartter syndrome, Leber congenital amaurosis)
5. Proteins involved in intracellular calcium homeostasis, including ryanodine receptors, calmodulin, and phospholamban (CPVT, CRDS, Long QT syndrome, ACM/DCM).

Prerequisites

A solid background in General and Systems Physiolog (graduation course in Biological Sciences) is strongly recommended. The depth of the introductory review of physiological concepts will be adjusted according to the students' prior knowledge and academic backgrounds. Consequently, the time devoted to these preliminary aspects may influence the breadth of pathophysiological topics that can be addressed during the course. Given the interdisciplinary nature of the course and the absence of a single textbook covering all the subjects discussed, regular attendance is strongly encouraged.

Teaching form

The course will be delivered through 21 lectures of 2 hours each, in English. While the lectures will provide the core theoretical framework, students will be encouraged to actively participate in discussions, formulate hypotheses, and establish connections between concepts from different disciplines. Selected scientific articles may be presented and discussed to promote critical thinking and to illustrate how current research contributes to our understanding of physiological and pathophysiological mechanisms. Although classroom interaction is encouraged throughout the course, the extent of discussion will depend on students' interests and participation.

Textbook and teaching resource

A cell Physiology textbook (e.g. Cell Physiology Sourcebook, N. Sperelakis ed., 4th edition, Academic Press) may serve as a reference for basic concepts. However, due to the multidisciplinary and research-oriented nature of the course, no single textbook adequately covers all the topics discussed. Supplementary learning materials, including review articles and selected research papers, will be provided throughout the course. Lecture slides and additional resources will be made available through the e-learning platform. Regular attendance is therefore strongly encouraged to facilitate a comprehensive understanding of the subjects addressed during the course.

Semester

First semester

Assessment method

Assessment will consist of an oral examination. Students will be evaluated on their understanding of the physiological and pathophysiological mechanisms discussed during the course, their ability to integrate concepts across different topics, and their capacity to critically interpret experimental evidence and scientific literature. Appropriate use of scientific terminology and clarity of exposition will also be taken into account. No formal mid-term assessments are planned.

Office hours

Appointment by e-mail

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | REDUCED INEQUALITIES