Project/Course teaching guide

Subject	CELL AND MOLECULAR PHYSIOLOGY		
Field	Biomedical research		
Module			
Degree	Grado en Biomedicina y Terapias Avanzadas		
Program	710	**Code**	47928
Teaching period	1º Quarter	**Type/Character**	Optional
Level/Cycle	Degree	**Curse**	Fourth
ECTS credit	3		
Language of instruction	English		
Responsible Professor(s)	Javier Casas Requena José Ramón López López Omar Motiño Lucía Núñez Llorente Roberto Palacios Laura Senovilla Sendoa Tajada Esteban (Coordinator)		
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Department	Biochemistry and Molecular Biology and Physiology		
Date reviewed by the title committee	July 4th, 2024		

1. Situation / Purpose of the subject

1.1 Contextualization

The course Cell and Molecular Physiology focuses on the detailed study of physiological processes at the cellular and molecular level, exploring how cells function and communicate with each other to maintain equilibrium in the organism. The course, an elective in the fourth year of the “Biomedicina y Terapias Avanzadas” Degree, is important for understanding the normal function of the cells and their possible alterations in pathological conditions.

1.2 Relationship with other subjects

Cell and Molecular Physiology is closely related to several subjects in the Degree of “Biomedicina y Terapias Avanzadas”, as it provides advanced and up-to-date knowledge of cellular and molecular function, which is essential for understanding many other aspects of biomedicine. Some of the key relationships with other subjects are Medical Biology and Histology, Biochemistry and Molecular Biology I and II, Medical Genetics, Human Physiology I and II, Pharmacology and Human Immunology.

1.3 Prerequisites

The necessary requirements to enroll in the 4th-year courses of the Bachelor's Degree in “Biomedicina y Terapias Avanzadas”, including basic knowledge of biology, histology, molecular biology, physiology, and immunology.

2. Competencies

2.1 General

G.1. Ability to analyze basic problems related to Biomedicine and Advanced Therapies, solve them using the scientific method, and communicate the solutions efficiently.

CG.2. Understand the scientific and technical foundations of Biomedicine and Advanced Therapies, facilitating the learning of new methods and technologies, as well as developing versatility to adapt to new situations.

CG.3. Acquire the ability to solve problems with initiative and creativity, as well as to communicate and transmit knowledge, skills, and abilities, understanding the ethical, social, and professional responsibility of the biomedical professional's activities.

CG.4. Work proficiently in a laboratory, including aspects of safety, material handling, and waste disposal.

CG.5. Acquire, analyze, interpret, and manage information.

CG.9. Write, represent, and interpret scientific and technical documentation

2.2 Specific

CE.1. Know and understand the biochemical, molecular, and genetic changes that occur in various human pathologies, and be able to explain the molecular mechanisms involved in these changes.

CE.2. Understand the cellular and molecular mechanisms responsible for signaling, transport, trafficking, and cellular communication in different tissues and their regulation.

CE.3. Demonstrate a good understanding of the molecular mechanisms controlling intracellular calcium levels.

CE.4. Demonstrate understanding of the cellular and molecular mechanisms responsible for cell division, mobility, differentiation, and apoptosis.

CE.5. Develop oral and written communication skills in English.

3. Objectives

- Achieve a solid foundation in the cellular and molecular bases related to cellular physiology.
- Understand the molecular mechanisms that mediate cellular responses to both external and internal physiological stimuli.
- Know the main signal transduction mechanisms used by eukaryotic cells at the cell membrane level and describe the function of endogenous mediators involved in cellular signaling.
- Detail the main pathophysiological consequences resulting from functional alterations in inter- and intracellular signaling systems.
- Understand the different intracellular trafficking routes and their functions, as well as the structure and function of the involved organelles, and comprehend the basic principles involved in all intracellular trafficking processes.
- Have an in-depth understanding of the mechanisms and molecular basics of intracellular calcium homeostasis.
- Understand in detail the eukaryotic cell cycle and its regulation.
- Understand the basics of cell mobility and adhesion, and the role that different types of movement play in the processes of communication, differentiation, and cellular development.
- Understand the cellular and molecular mechanisms that control the processes of cell division, cell proliferation, cell differentiation, apoptosis, and senescence.
- Stay updated on the latest advances in the field of cellular and molecular physiology.

4. Contents and/or thematic blocks

Block 1: “Cell and Molecular Physiology”

Workload in ECTS credits: 3

a. Contextualization y justification

Described in section 1.1

b. Learning objectives

Described in section 3

c. Contents

- **Topic 1. Cellular communication.** Acquire relevant knowledge of the structure and function of membrane receptors that recognize extracellular signals and the endogenous mediators involved in cellular signaling.
- **Topic 2. Ion channels**. Acquire knowledge of the function of the various ion channels present in cell membranes. Study the activation and modulation mechanisms associated with physiological and pathological states. Acquire knowledge of the basic principles of biophysics to comprehend ion and solute transport processes across membranes. Learn about the main intracellular trafficking routes, with a particular emphasis on the molecular mechanisms responsible for protein and lipid trafficking.
- **Topic 3. Intracellular signaling.** Understand the mechanisms of cellular transduction and intracellular signaling under physiological conditions, as well as the alterations of these receptors or the signaling pathways they participate in, associated with different pathologies.
- **Topic 4. Calcium-mediated signaling.** Gain an in-depth understanding of the mechanisms and molecular foundations of intracellular calcium homeostasis. Understand the calcium entry from the extracellular media through voltage-regulated channels, agonists, or second messengers, and the release from intracellular reservoirs. Additionally, learn about the mechanisms of action and function of calcium-sequestering, sensing, and transporting proteins in various cell membranes.
- **Topic 5. Cell division and cell cycle.** Describe in detail the eukaryotic cell cycle and its regulation, as well as the molecular mechanisms involved in cell cycle control: components and checkpoints.
- **Topic 6. Mobility and adhesion.** Understand the bases of cell mobility and adhesion, and the role that different types of movement play in the processes of cellular communication, differentiation, and development. Acquire specific knowledge about the molecular bases of the organization and dynamics of microtubules, microfilaments, and intermediate filaments.
- **Topic 7. Differentiation and apoptosis.** Acquire detailed knowledge of the molecular mechanisms that control the process of cell division and proliferation in eukaryotes, as well as the mechanisms that regulate the outcome adopted by a cell: differentiation, senescence, and cell death.

PRACTICAL CONTENT

- **P1. Cellular Communication.** Real-time fluorescence imaging for study dynamics of intracellular calcium signaling in T cells.
- **P2**. **Patch-clamp**. Single-channel recordings using the patch-clamp technique to determine ion channel properties.
- **P3**. **Cytometry and cell death**. Evaluate cell death alterations induced by different agents in cell cultures using viability markers.
- **P4**. **Cell Mobility**. Evaluate the effect of different substances on cell migration capacity in a wound healing assay.

- **P5**. **Cytometry and cell cycle**. Evaluate alterations in the cell cycle induced by different agents in cell cultures using DNA markers.

d. Teaching methods

- **Lectures:** In-person classes will be take place according to the scheduled timetable for the subject (Wednesday and Thursday, from 18:00 to 19:00) in the usual spaces provided by the Faculty of Medicine (Classroom B.10).
- **Classroom practices:** Various tasks will be performed (result analysis, problem-solving, and/or questions). Active participation of all students will be encouraged in open discussions on the topics presented.
- **Laboratory practices:** Work in the laboratory using real-time fluorescence imaging techniques, patch-clamp, and flow cytometry in small groups to achieve the proposed practice objectives (see section c. Contents)

e. Work plan

Two hours per week of theoretical classes will be given during the 1st quarter until the theoretical contents are finished. Laboratory practices will take place on Wednesday mornings from 9:00 to 11:00 with two student groups.

f. Evaluation

The final grade will correspond to the result obtained in the written exam (50%) and continuous evaluation (50%), which includes scores from classroom practices and laboratory practices.

g Teaching material

g.1 Basic bibliography

You can consult the "Reading List" for the subject on the UVa library's Leganto platform via the following link:

https://buc-uva.alma.exlibrisgroup.com/leganto/public/34BUC_UVA/lists/8216893800005774?auth=SAML

g.2 Supplementary bibliography

g.3 Other online resources (knowledge pills, blogs, videos, digital journals, Massive Open Online Courses (MOOCs), ...)

More details during the course of the subject.

h. Necessary resources

Access to the UVa Virtual Campus (Moodle platform). The practical sessions will take place at the IBGM (Benito Herreros Building and the 5th floor of the Faculty of Medicine).

i. Timing

CREDIT LOAD (ECTS)	PROJECTED DEVELOPMENT PERIOD
3,0	1st quarter

5. Teaching methods and methodological principles

Lectures: the theory classes will consist of participative and open formats sessions, allowing students to engage their own learning by raising questions related to the subject taught.

Classroom practices: include student-guided and supervised work by the professor on case studies, problems, exercises, etc.

Laboratory practices: The practices will take place in various research laboratories equipped with the necessary tools, where the practical content of the subject will be developed while learning to work in that specific environment. A booklet with the required protocols and exercises will be provided. The deliverable tasks of these practices will be part of the continuous assessment.

Individual or group tutoring sessions: These sessions will be available to students to discuss specific issues and/or resolve any questions or concerns related to the subject whenever needed. The schedule and date of the tutoring sessions will be arranged with the professor.

Finally, non-presential training activities correspond to the individual work that the student carries out without the presence of the teacher. These work hours include studying, expanding and synthesizing information, reading related documentation, completing tasks and assignments and preparing for exams.

6. Student time commitment table for the course

IN-PERSON OR REMOTE IN-PERSON ACTIVITIES (1)	HOURS	NON-PRESENTIAL ACTIVITIES	HOURS
Lectures	18	Study and independent work	36
Classroom practices	6	Study and independent work	3
Laboratory practices	6	Study and independent work	6
Total In-person	**30**	Total Non-presential	**45**
		TOTAL In-person + Non-presential	**75**

(1) Remote In-Person Activity refers to when a group participates synchronously in a videoconference of the class taught by the instructor.

7. Assessment system and characteristics

INSTRUMENT/PROCEDURE	WEIGHT IN FINAL GRADE	OBSERVATIONS
Continuous assessment	50 %	Completion of quizzes and submission of assignments
Final Exam	50 %	Questions and problems about the theoretical and practical contents

A minimum score of 5 out of 10 will be required to pass the subject.

GRADING CRITERIA
• **Regular examination session:** ○ The final exam represents the 50% of the overall grade, with the remaining 50% coming from continuous assessment. ○ A minimum overall score of 5 (5/10) must be obtained to pass the course ○ The assignments submission is mandatory to take the exam. • **Extra examination session(*):** ○ The criteria are the same as in the regular exam session. The continuous assessment exams are only considered if they are favorable.

(*) A special session is understood to be the second examination session.
Article 35.4 of the ROA 35.4: Participation in the special session will not be subject to class attendance or presence in previous tests, except in cases of external practices, laboratories, or other activities whose evaluation would not be possible without having completed the aforementioned tests.
https://secretariageneral.uva.es/wp-content/uploads/VII.2.-Reglamento-de-Ordenacion-Academica.pdf

8. Final considerations