COURSE DATA

DATA SUBJECT

Code: 46490
Name: Cytomics in research and diagnosis
Cycle: Master's Degree
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2254 - Master's Degree in Molecular Approaches in Health Sciences	Facultat de Medicina i Odontologia	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2254 - Master's Degree in Molecular Approaches in Health Sciences	Molecular technologies for research in health sciences	COMPULSORY

COORDINATION

O'CONNOR BLASCO JOSE ENRIQUE

SUMMARY

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

No enrollment restrictions have been specified with other subjects in the curriculum.

COMPETENCES / LEARNING OUTCOMES

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Aprender a identificar, manejar y presentar adecuadamente en informes y exposiciones públicas, conocimientos existentes sobre Citómica, usando como vehículo la lengua inglesa.

Conocer, comprender y aplicar en la práctica instrumentos de Citómica en situaciones relacionadas con la investigación básica y clínica.

Conocer, comprender y aplicar en la práctica la Metodología y Técnicas Inmunológicas de Investigación en situaciones relacionadas con la investigación básica y clínica.

Conocer en profundidad y comprender la organización a nivel molecular de células, sistemas y procesos de relevancia en las Ciencias de la Salud.

Conocer en profundidad y comprender las bases moleculares de la enfermedad.

Conocer en profundidad y comprender las metodologías de investigación básica aplicables a las Ciencias de la Salud.

Conocer y comprender los conceptos básicos y las aplicaciones en investigación básica y clínica de la Citómica.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

Tener capacidad de analizar y sintetizar un problema.

Tener capacidad de comunicación oral y escrita en una segunda lengua científica.

Tener capacidad de desarrollar un trabajo interdisciplinar.

Tener capacidad de localizar información.

Tener capacidad de trabajar en equipo

DESCRIPTION OF CONTENTS

Topic 1. Presentation of the Subject. Cytomics as a technology for the study of the individual cell: Definition and distinctive characteristics.

1. THE TECHNOLOGICAL BASES OF CYTOMICS

Topic 1. Presentation of the Subject. Cytomics as a technology for the study of the individual cell: Definition and distinctive characteristics.In this unit Cytomics is presented as a set of technologies and strategies based on the structural and functional analysis of individual cells.
Topic 2. From Cytometry to Cytomics: Origin and evolution.
This unit describes the origin and technical evolution of Cytometry and Cytomics methodologies and their applications.
Topic 3. Fluorescence: Molecular Bases, Tools and Applications
This unit describes the concept of fluorescence, its molecular bases and its implications in Cytomics methodologies.
Topic 4. Cytomic Technologies based on fluidics.
This unit describes the technical characteristics of Flow Cytometry. The cell separation capacity associated with some Flow Cytometry systems (Cell Sorters) is also described.
Topic 5. Cytomic Technologies based on image analysis.
This unit describes the technical characteristics of the technologies for high-content analysis by bioimaging, on solid support or in flow.

2. APPLICATIONS OF CYTOMICS IN BASIC RESEARCH AND BIOTECHNOLOGY

Topic 6. Cytomics in Genomics and Transcriptomics:
Cytomics applications in the study of nucleic acids and their functions in cells and tissues.
Topic 7. Cytomic Analysis of Cellular Proliferation:
Cytomics applications in the study of the mechanisms, regulation and consequences of cell proliferation.
Topic 8. Cytomic Analysis of Cell Death:
Cytomics applications in the study of the mechanisms, regulation and consequences of cell death.
Topic 9. Cytomic Analysis of Metabolism and Bioenergetics in Individual Cells: Applications of Cytomics in the study of dynamic processes that characterize different cell populations.
Topic 10. Real Time Flow Cytometry (In Fluxo Analysis):
Cytomics applications in the real-time study of cellular dynamic processes and their alterations induced by bioregulators or xenobiotics.
Topic 11. Cytomic Analysis of Intercellular Communication:
Cytomics applications in the study of the communication systems that the individual cells of the organism integrate with each other.
Topic 12. Cytomic Analysis of Signal Reception and Transduction:
Cytomics applications in the study of the processes of reception and transduction of external signals and their consequences.
Topic 13. Flow cytomics in Mechanistic and Regulatory Toxicology:
Cytomics applications as an alternative method to the animal for the detection and characterization of toxic effects of xenobiotics.
Topic 14. Cytomics in Preclinical Pharmacology and Drug Discovery:
Preclinical applications of Cytomics, with special emphasis on the validation of therapeutic targets, drug discovery and the improvement of their safety and efficacy.
Topic 15. Applications of Cytomics in Biotechnology and Ecology:
In this lesson, the growing role of cytomics in applications of industrial and environmental relevance is reviewed in a panoramic way.

3. CLINICAL APPLICATIONS OF CYTOMICS

Topic 16. Panoramic of Clinical Applications of Cytometry.
In this lesson, the fundamental role of Flow Cytometry in the different clinical areas of current Medicine is reviewed, in a panoramic way.
Topic 17. Flow cytometry in Oncology of Solid Tumors:
In this lesson, the fundamental role of Cytomics in the different clinical areas of Oncology is reviewed in a panoramic way.
Topic 18. Flow cytometry in Immunology:
In this lesson, the fundamental role of Cytomics in the different clinical areas of Immunology is reviewed in a panoramic way.
Topic 19. Flow cytometry in Hematology:
In this lesson, the fundamental role of Cytomics in the different clinical areas of Hematology is reviewed in a panoramic way.
Topic 20. Flow Cytometry in Haemostasis: In this lesson, the fundamental role of Cytomics in the different clinical areas of Haemostasis is reviewed in a panoramic way.
Topic 21. Flow cytometry in Microbiology:
In this lesson, the fundamental role of cytomics in the study of pathogenic microorganisms is reviewed in a panoramic way.

4. ADVANCES IN CYTOMICS

Topic 22. Advances in Cytomics I: Nanocytometry.
This unit describes the biological bases and applications of flow cytometry and cell separation in the study of Extracellular Vesicles and subcellular biological particles.
Unit 23. Advances in Cytomics II: Cytometry Based on Spectral Analysis: Fluorescence and Masses.
This unit describes the technical characteristics and applications of the most recent cytometric methodologies, based on spectral analysis using fluorescence (Multispectral Cytometry) or mass spectroscopy (Mass Cytometry or CyTOF).
Topic 24. Advances in Cytomics III: Cytomics in Multiomics Strategies
This unit addresses the growing relevance of cytomics in research and diagnostic strategies based on omic methodologies applied to the individual cell (Single-Cell Omics).
Topic 25. Bioinformatics and Cytomics: This unit addresses the complex problem and advanced strategies in the analysis of cytomic data.

5. METHODOLOGICAL SEMINARS

Seminar 1. Components, systems and operation of flow cytometers
Seminar 2. Design and optimization of experiments-Pre-analytical phase
Seminar 3. Design and optimization of experiments-Analytical phase
Seminar 4. Analysis, interpretation and management of data.

Practical 1: Start-up, calibration and cleaning of a flow cytometer.
Practical 2: Learning specialized software for data analysis.

6. PRACTICALS: LABORATORY AND COMPUTES

Practical 1: Start-up, calibration and cleaning of a flow cytometer.
Practical 3: Analysis of mitochondrial function and oxidative stress by flow cytometry.
Practical 4: Analysis of ploidy, cell cycle and cell death by flow cytometry.
Practical 5: Analysis of the immunophenotype by flow cytometry.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	10,00
Seminar	15,00
Laboratory	6,00
Group work	10,00
Computer classroom practice	4,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**0,00**

TEACHING METHODOLOGY

EVALUATION

The evaluation of student learning will be carried out by evaluating the following sections:
1. Evaluation of the theoretical and practical contents of each one of the blocks of the subject, with short development questions and multiple choice questions. This test will be worth up to 50% of the final mark and will be carried out through a written test at the end of teaching the subject.
2. Evaluation of Laboratory Practices, with exercises and questions of different formats. This test will be worth up to 40% of the final mark and will be carried out through an online test at the end of teaching the subject.
3. Student interest in the subject, expressed as their participation in organized discussions, answers to questions asked by the teacher during face-to-face sessions, attendance at personal tutorials and/or any other type of activity carried out by the student in relation to the subject. From the evaluation of these concepts it will be possible to get up to 10% in the final grade of the subject

REFERENCES

- Schmid, I, Ed. (2012) Flow Cytometry Recent Perspectives. InTech Open Science. http://www.intechopen.com/books/editor/flow-cytometry-recent-perspectives Schmid, I, Ed. (2012) Clinical Flow Cytometry-Emerging Applications. InTech Open Science. http://www.intechopen.com/books/clinical-flow-cytometry-emerging-applications Schmid, I, Ed. (2016) Flow Cytometry - Select Topics. InTech Open Science. http://www.intechopen.com/books/editor/flow-cytometry-select-topics Cossarizza A. et al. (2018) Guidelines for the use of flow cytometry and cell sorting in immunological studies (Second Edition) Eur J Immunol. 2017 Oct;49(10):1457-1973. https://onlinelibrary.wiley.com/doi/full/10.1002/eji.201970107 Cossarizza A., et al. (2021) Guidelines for the use of flow cytometry and cell sorting in immunological studies (third edition). European Journal of Immunology 51, 2708-3145. https://doi.org/10.1002/eji.202170126

- Cascales, M., Gómez-Lechón, M.J., OConnor, J.E., Eds. (2005) Las Omicas Genómica, Proteómica, Citómica y Metabolómica: Modernas Tecnologías Para el Desarrollo de Fármacos. Real Academia Nacional de Farmacia, Madrid. http://www.analesranf.com/index.php/mono/issue/view/112 Molecular Probes (2010) A Guide to Fluorescent Probes and Labeling Technologies. http://www.thermofisher.com/it/en/home/references/molecular-probes-the-handbook.html?CID=flhandbook