Universidad de Navarra

Omics Technologies for Biomedical Research and Precision Medicine

Guía docente 2026-27

INTRODUCTION

Brief description

This course offers an integrative overview of **high-throughput omics technologies**—genomics, transcriptomics, epigenomics, proteomics, and metabolomics—and **their application in precision medicine**. Students will acquire a **conceptual and practical understanding** of how **omics** data are *generated*, *analyzed*, and *interpreted* to tailor medical decisions to individual patients and populations. The course emphasizes **real-world clinical applications** and a comprehensive understanding that enables the selection of the most appropriate methodologies for disease characterization.

- **Créditos**: 3 ECTS
- **Titulación**: Máster en Investigación Biomédica
- **Módulo**: Módulo II – Especialidad en Biotecnología Biomédica
- **Departamento y Facultad**: Departamento de Bioquímica y Genética
- **Clase y horarios**: especificados en el calendario del máster
- **Tipo de asignatura**: obligatoria en la especialidad de Biotecnología Biomédica y optativa para el resto de las especialidades.
- **Idioma**: inglés / español

LEARNING OUTCOMES (Competences)

Basic Competences

- **RA1** - To possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context.
- **RA2** - For students to be able to apply the knowledge acquired and their problem-solving skills in new or unfamiliar environments within broader, or multidisciplinary, contexts related to their field of study.
- **RA4** - For students to be able to communicate their conclusions, as well as the knowledge and underlying reasons supporting them, to specialist and non-specialist audiences clearly and unambiguously.
- **RA5** - For students to possess the learning skills that enable them to continue studying in a manner that will be largely self-directed or autonomous.
- **RA6** - To address a biomedical challenge in depth, from different perspectives, identifying the current state of the art.
- **RA7** - To identify a significant question or hypothesis regarding a biomedical topic or problem and propose the steps needed to address it.
- **RA8** - To possess the creativity and originality required to answer the questions raised by biomedical research.
- **RA9** - To know how to select and use the appropriate techniques to carry out biomedical research effectively and accurately.
- **RA10** - To have the technical capacity to obtain precise and reproducible results from which valid and objective conclusions can be drawn in the field of biomedicine.
- **RA11** - To possess critical thinking skills, both in reading biomedical scientific literature and in interpreting experimental results.
- **RA12** - To communicate orally and fluently, in both Spanish and English, a biomedical research topic or data, taking into account the audience for whom the presentation is intended.
- **RA13** - To write different types of biomedical research papers correctly, precisely, and with a well-structured text.

Specific Competences

- **RAO22** - To acquire an in-depth understanding of omics technologies and their application in the comprehensive study of pathophysiological processes and in the development of personalized medicine strategies.
- **RAO23** - To understand the principles of drug design and development, including the identification of therapeutic targets, compound screening, functional validation, and optimization of bioactive candidates.
- **RAO24** - To use different in vitro, ex vivo, and in vivo experimental models employed in preclinical research with scientific judgment, assessing their suitability, limitations, and application to different contexts.
- **RAO25** - To critically analyze data derived from omics studies and preclinical experimentation, integrating bioinformatics tools and advanced statistical analysis for the interpretation of results in biomedical research.
- **RAO26** - To understand the principles of biotechnological innovation and technology transfer in the biomedical field, including legal, regulatory, and intellectual property aspects linked to the development of biotechnological products and procedures.
- **RAO27** - To develop skills for identifying business opportunities in biomedical biotechnology through the analysis of real entrepreneurship cases, management models, and assessment of the technical and commercial feasibility of innovative projects.
- **RAO28** - To foster a translational approach in biomedical research, promoting the integration of knowledge generated through biotechnological tools into clinical practice, with particular attention to improving disease diagnosis, prognosis, and treatment.

PROGRAM

Title: **Introduction**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Sequencing Technologies I**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Sequencing Technologies II**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Genomics**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Genomic Analysis**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: In-person practical class

Title: **Epigenetics**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

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Title: **Epigenetic Analysis**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: In-person practical class

Title: **Transcriptomics**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Transcriptomic Analysis**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: In-person practical class

Title: **Proteomics**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Metabolomics**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Multi-omics in Microbiome Science**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Lecture

Title: **Metagenomic Analysis**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: In-person practical class

Title: **Paper Presentation**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Article discussion

Title: **Project Presentation**

- Instructor: Rafael Valdés
- Duration: 2 hours
- Session type: Project discussion

EDUCATIONAL ACTIVITIES

This is a course of 3 ECTS (75 hours). The work is distributed as follows:

1. Class activities (1.28 ECTS, 32 hours)

- **Lecture sessions**: *0.72 ECTS, 18 hours*

    - These sessions are based on the presentation of key concepts by the professor, following the course syllabus. PowerPoint slides will be made available to students in advance through ADI. In addition to the lectures, students will participate in guided visits to selected core facilities where they will gain first-hand insight into the technologies and workflows discussed in class.
    - *9 sessions, 2 hours each*
- **In-person practical classes**: *0.32 ECTS,* 8 hours (4 sessions, 2 hours each).
- **Paper presentation**: *0.08 ECTS, 2 hours*
    - These sessions aim to train students in the critical reading and synthesis of scientific literature on **emerging omics methodologies**. After the theoretical content has been covered, each student will select a relevant paper (from a set provided by the instructor), analyze it, and present the main findings in a **15-minute oral presentation**.
    - *1 session, 2 hours*
- **Project presentation**: *0.08 ECTS, 2 hours*
    - These sessions focus on applying course knowledge to real-world scenarios. Students will choose a proposed project topic, **develop a plan outlining objectives, and describe the omics methodologies required**—taking into account practical constraints such as a limited budget. They will then present their proposal in a **15-minute oral presentation**.
    - *1 session, 2 hours*
- **Final examination**: *0.08 ECTS, 2 hours*
    - The final exam will consist of short questions assessing the fundamental aspects of the course.

2. Personal work (1.72 ECTS, 43 hours)

Independent study is a critical component of the learning process. It includes:

- Reviewing lecture content in depth
- Consulting scientific sources
- Preparing the assigned paper and project presentations
- Studying for the final examination

ASSESSMENT

ORDINARY CALL

To pass the course, students must obtain a **final grade of 5.0 (50%) or higher**. Additionally, students must score **at least 35% of the final examination grade** to be eligible to pass, regardless of their performance in the other components.

The evaluation is distributed as follows:

· **Paper presentation**: **25%**

· **Project presentation**: **25%**

· **Final examination**: **50%**

RE-SIT EXAMINATION

Students are entitled to an extraordinary call. In this extraordinary call, the grades obtained for the Paper presentation (25%) and the Project presentation (25%) will be retained, and students will have the opportunity to retake the final examination (50%) to improve their overall mark.

GRADING SCALE

Final grade	Description
10.0 – 9.0	**SB – Sobresaliente**
8.9 – 7.0	**NT – Notable**
6.9 – 5.0	**AP – Aprobado**
4.9 – 0.0	**SS – Suspenso**

Students who achieve a final grade of **9.0 or above** may be eligible for **Honors (Matrícula de Honor)**, depending on course policy and faculty approval.

OFFICE HOURS

Dr. Rafael Valdés Mas

- To contact with the professor ask for an appointment by e-mail: rvaldesmas@unav.es

BIBLIOGRAPHY AND RESOURCES

- Integrative Omics for Health and Disease (10.1038/nrg.2018.4) **Find it in the Library**
- Methods and applications for single-cell and spatial multi-omics (10.1038/s41576-023-00580-2) **Find it in the Library**
- Best practices for analysing microbiomes (10.1038/s41579-018-0029-9)