Universidad Zaragoza

Academic Year: 2024/25

66030 - Advanced methods in molecular and cellular biology

Teaching Plan Information

Academic year: 2024/25
Subject: 66030 - Advanced methods in molecular and cellular biology
Faculty / School: 100 - Facultad de Ciencias
Degree: 537 - Master's in Molecular and Cellular Biology
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Compulsory
Module:

1. General information

The subject is designed to offer students a broadening, updating and deepening of knowledge on some of the main techniques and procedures currently used in laboratories of Molecular and Cellular Biology, Biotechnology or Biomedicine. It is intended that students at this level deepen their knowledge acquired from previous degrees, learn about new advances in the state of the art and acquire additional skills , reaching a level of knowledge close to that of a specialist.

2. Learning results

The student, in order to pass this subject, must demonstrate that they is able:

1. -To value the relevance of scientific advances in this field.

2. -To plan the molecular cloning of a gene, perform targeted mutagenesis experiments, genetic analysis of diseases at the DNA and RNA, design protein purification and characterization protocols, carry out metabolite analysis, gene expression analysis, miRNAs analysis and their functional study, propose the methods to be used, carry them out and interpret the results.

3. -To search and analyse specific information and transfer aspects of molecular and cellular biology.

4. -To solve specific problems that may arise in a molecular and cellular biology laboratory.

5. -To present work done individually.

Basic and general competencies:

Upon completion of the subject, the student will be able to:

1. -Develop technological applications of biochemical processes and transfer solutions to industry in the food, chemical, cosmetic, pharmaceutical and healthcare sectors.

2. -Acquire the training, aptitudes, skills and method necessary for the completion of a doctoral thesis in the area of Biochemistry and Molecular Biology.

3. -Develop research or technological activities in Public Organizations related to research.

-(University, CSIC, INIA, and other Research Institutes) as well as in private companies.

4. -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.

5. -Apply acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

6. -Integrate knowledge and face the complexity of making judgments based on information that, while incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

7. -Communicate their conclusions and the ultimate knowledge and rationale behind them to specialized and non-specialized audiences in a clear and unambiguous way.

8. -Achieve the learning skills that will enable them to continue studying in a way that will be largely self-directed or autonomous.

Specific Competencies:

1. Design experiments (and/or applications) independently in the area of Molecular and Cellular Biology.

2. Describe, quantify, analyse, integrate and critically evaluate results obtained by these methods.

3. -Make decisions based on the results obtained, focused on improving the methodological obtaining and interpretation of results.

4. -Search and analyse specific information in the area of Molecular and Cellular Biology.

5. -Know the activity of bodies and regulations related to the quality processes of biochemical laboratories and the transfer of solutions to industry.

6. -Design the most appropriate methodology that can answer the questions posed in the field of Molecular and Cellular Biology.

3. Syllabus

1. -Functional analysis of promoters. Techniques for the study of DNA-protein interaction. Applications.
2. -Bacterial regulons: methods of study.
3. -Two-component regulation systems in bacteria.
4. -Bacterial transcriptional regulators as therapeutic targets.
5. -Methods of gene expression in mammalian cells.
6. -Heterologous expression of membrane proteins in *Xenopus oocytes*.
7. -Organization and dynamics of the OxPhos system: respiratory supercomplexes.
8. -Analysis of the OxPhos function. Generation of mitochondrial DNA mutants. Polarography. Mitochondrial synthesis of proteins (35S).
9. -Techniques for the study of the mitochondrial proteome.
10. Study of the interaction between nuclear and mitochondrial genomes: generation and characterization of complastic mice.
11. Epigenetics: Concepts, analysis techniques and biomedical applications.
12. Methods for studying miRNAs. Applications.
13- Multidimensional optical microscopy.
14- Applications of flow cytometry.
15- Organ on chip: Microfluidic devices to simulate the microenvironment in *in vitro* models of cancer.
16. Organ bioengineering.
17- Study of ion channels by "patch-clamp".
18- The intestinal wall: models and study techniques.
19- Nanoscience for Biotechnology applications.
20- New DNA sequencing techniques.
21- Practical aspects of proteome analysis by mass spectrometry.
22. Vaccines in the 21st century.

4. Academic activities

- **Participative master classes**. They will be taught face-to-face by teachers and researchers of recognized prestige in each of the topics, some of whom are invited specialists, external to the University. Theoretical knowledge is presented and student participation is encouraged through questions, analysis and joint discussion with the teacher.
- **Problem solving and case studies**. Activities carried out in blended mode. Students will be divided into small working groups and will analyse relevant scientific articles where several of the advanced techniques indicated in the lectures are applied to solve current scientific problems.

5. Assessment system

- **Final written exam**. The exam will include development questions and/or multiple-choice questions on the theoretical contents taught in the subject. It will be graded from 0 to 10 (minimum 5 points) and will contribute to **50% of the final grade**.
- **Seminars.** They will be carried out by teams of 1-3 students. Each team must present, expose and discuss the content of a current scientific article (20 minutes of presentation and 10 minutes of debate). It will be graded from 0 to 10 (minimum 5 points) and will contribute to **40% of the final grade**. The evaluation criteria will be as follows:

1. Slide quality.
2. Attitude, coherence and clarity of exposition.
3. Mastery of the subject matter.
4. Ability to respond to the questions posed.

Participation in classes and in the discussion of assignments.

Teachers will evaluate the degree of attention, discipline, performance, participation, initiative, involvement and analysis demonstrated by each of the students, both in the lectures and in the seminars, which will contribute to **10% of the final grade**.

Passing the written exam is a prerequisite for passing the subject. Additionally, the minimum overall grade will be 5 out of 10, taking into account all evaluations and weightings.

6. Sustainable Development Goals

3 - Good Health & Well-Being

9 - Industry, Innovation and Infrastructure
12 - Responsible Production and Consumption