Universidad Zaragoza

Academic Year/course: 2024/25

68456 - Molecular Biotechnology: instrumental techniques

Syllabus Information

Academic year: 2024/25
Subject: 68456 - Molecular Biotechnology: instrumental techniques
Faculty / School: 100 - Facultad de Ciencias
Degree: 626 - Máster Universitario en Biofísica y Biotecnología Cuantitativa / Master in Biophysics and Quantitative Biotechnology
ECTS: 6.0
Year: 01
Semester: Second semester
Subject type: Optional
Module:

1. General information

Students will learn about standard and advanced biophysical techniques (methodologies and protocols) employed in biomolecular target characterization (e.g., protein structure-function relationship) and validation, screening validation and optimization, target engagement and hit confirmation, drug optimization, and quality control in biologics manufacture, among other tasks. Special emphasis will be placed on the common and unifying mathematical foundations underlying all techniques and the description of the basic concepts for each experimental technique, the advantages and disadvantages of each technique, and in appropriate data analysis procedures. The students will acquire specific capabilities and skills for a future career in Molecular Biophysics and Structural Biology within different fields in Biomedicine and Biotechnology (pharmaceuticals, health, food, cosmetics, textiles, cleansing…).

1 - Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a context of research.

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

3 - Integrate knowledge and confront the complexity of making judgments from information that, incomplete or limited, includes reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

4 - Analyze critically information and communicate conclusions and the last knowledge and reasons that support them to specialized public and non-specialized services in a clear and unambiguous manner.

5 - Acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

2. Learning results

By the end of this course, students will have learned to:

- Order, analyze critically, interpret and synthesize information

- Obtain information from different types of sources and evaluate their reliability

- Learn efficiently through autonomous study and acquire a significant degree of independence

- Apply acquired knowledge and solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the area of study

- Formulate, analyze, evaluate and compare new or alternative solutions to different problems

- Be able to work in multidisciplinary and international teams

- Develop capacity for criticism and self-criticism

- Make decisions taking into account social, ethical and legal responsibilities

- Be able to develop a project, participating in the stages of bibliographic search, experiment planning, obtaining results, interpreting, and disseminating them

Basic, general and transversal competences:

- Gather, order, critically analyze, interpret, and synthesize information from different types of sources, evaluating its reliability.

- Learn efficiently through autonomous study and acquire a significant degree of independence.

- Apply the knowledge acquired and solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the area of study.

- Formulate, analyze, evaluate, and compare new or alternative solutions for different problems.

- Be able to work in multidisciplinary and international teams.

- Develop the capacity for criticism and self-criticism.

- Make decisions taking into account social, ethical and legal responsibilities.

- Be able to develop a project, participating in the stages of bibliographic search, planning of experiments, obtaining results, interpretation, and dissemination of the same.

- Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

- Apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

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

- Communicate the conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way.

- Acquire the learning skills that allow to continue studying in a way that will be largely self-directed or autonomous.

- Properly manage the resources and time available for solving a problem or developing a project.

- Communicate own conclusions and the knowledge and ultimate reasons that support them - to specialized and non-specialized audiences in a clear and unambiguous way.

- Transmit information orally, written or graphically using appropriate presentation tools and with the limitations imposed by time or space.

- Communicate fluently in English (understanding scientific texts, writing reports, talks, colloquia ...

Specific competences:

- Understand the intimate relationship between the structure of a biomolecule (conformation, stability, etc.) and its function (interaction, activity, etc.), within its physiological or pathological context, and when it is used in other contexts for research or biotechnological purposes.

- Learn and apply the concepts and tools of Statistical Thermodynamics to describe the equilibrium properties and analyze experimental results obtained with molecular biophysical techniques.

- Understand the principles for basic and advanced experimental biophysical techniques for the study of biomolecules.

- Select the appropriate experimental technique to obtain structural and functional information on biomolecules.

- Plan the experimental work appropriately, collect experimental information, critically analyze the experimental results, draw the relevant conclusions, and communicate the results to a specialized or a lay audience.

3. Syllabus

1. Statistical thermodynamics and biological macromolecules

2. UV-Visible absorption spectroscopy.

3. Circular dichroism spectroscopy.

4. Emission spectroscopy.

5. Spectroscopy and fast kinetic techniques.

6. Light scattering.

7. Differential scanning calorimetry.

8. Isothermal titration calorimetry.

9. Mass spectrometry.

10. Optical biosensors based on surface plasmon resonance.

11. Analytical ultracentrifugation

4. Academic activities

- Theoretical classes (30 hours): Sessions that will address the principles, concepts, protocols and any relevant issues related to basic and advanced experimental biophysical techniques.

- Problems and laboratory practical classes (24 hours): Sessions where students will perform biophysics experiments with biological macromolecules. These sessions are designed to develop technical and analytical skills in a controlled environment, covering from planning the experimental, collecting the information, analyzing the data, drawing the conclusions, and communicating the results.

- Seminars (6 hours): Sessions that will allow students to explore advanced topics.

5. Assessment system

Problems and Practical Classes (30/100):

The resolution of these exercises constitutes an individual or group work of the students. Students must submit a report following the guidelines and the presentation format that will be marked.

The attendance to practical classes is compulsory. Students will be split in groups for the laboratory practical classes. Laboratory sessions will be complemented with data analysis sessions.

Written Test (60/100):

There will be a written exam at the end of the semester, which will evaluate the learning process covering all the contents of this course. The exam will contain a multiple-choice section and a short-question section.

Seminars (10/100):

Evaluation of individual or group presentations made in seminars, as well as active and constructive participation in discussions, reflecting the student's ability to analyze, integrate, apply and communicate knowledge.

Additional Criteria:

- In order to pass the course, it is necessary to obtain a minimum of 5 out of 10 in each component of the assessment.

- If any component of the assessment is failed and the final grade is equal to or higher than 5, a 4.9 grade will appear on the transcript.

- If practical classes are failed, a practical exam will be held on the day of the final exam.

- The final grade will be calculated by adding the contributions of each component, provided that each part has been passed according to the established criteria.

- Students enrolled for 2nd time or subsequent are not required to attend the practical activities, provided that they have been successfully completed and passed them (after evaluation of the report and questionnaire) previously.

- The evaluation of the second call will be carried out by means of a theoretical exam with the same characteristics of the first call, which will be averaged in the same way as the rest of the evaluations.

6. Sustainable Development Goals

3 - Good Health & Well-Being
4 - Quality Education
9 - Industry, Innovation and Infrastructure