# 63103 - Molecular Biotechnology: instrumental techniques

**Información del Plan Docente**

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| **Academic Year** | 2018/19 |
| **Subject** | 63103 - Molecular Biotechnology: instrumental techniques |
| **Faculty / School** | 100 - Facultad de Ciencias |
| **Degree** | 572 - Master's in Quantitative Biotechnology |
| **ECTS** | 4.0 |
| **Year** | 1 |
| **Semester** | Second semester |
| **Subject Type** | Optional |
| **Module** | --- |

## 1.General information

## 1.1.Aims of the course

Learn how to apply and use different common biophysical techniques for studying and characterizing biomolecules in relevant research Biomedical and Biotechnological fields.

Be able to select the most appropriate technique, methodology, and protocol for each specific study case.

Describe, quantify, analyze, integrate, and assess critically the results obtained from different techniques within in terms of the biological properties of the system under study.

In particular:

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 - Students should be able to 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 - Students are able to 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 - That the students know how to communicate their conclusions and the last knowledge and reasons that support them to specialized public and non-specialized services in a clear and unambiguous manner

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

## 1.2.Context and importance of this course in the degree

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This course will allow the students to learn about:

- Thermodynamics of macromolecular equilibria: conformational and binding equilibria

- Basic and advance concepts and methodologies in spectroscopy

- Basic and advance concepts and methodologies in calorimetry

- Basic and advance concepts and methodologies in mass spectrometry, surface plasmon resonance, and ultracentrifugation

- Characterization of protein conformational landscape and interactions with ligands

- Basic concepts on screening validation, target engagement and hit validation

- Methodologies for drug optimization

- Basic and advance data analysis

## 1.3.Recommendations to take this course

To benefit from this course, it is advisable to have experience on lab work on protein purification and isolation, as well as basic knowledge on protein structure. Basic knowledge on spectroscopic and calorimetric techniques is also desirable. Minimum English level is required (B2 or equivalent).

## 2.Learning goals

## 2.1.Competences

Basic and general competences:

1 - Collect, analyze critically, interpret and synthesize information

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

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

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

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

6 - Be able to work in multidisciplinary and international teams

7 - Develop capacity for criticism and self-criticism

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

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

Specific competences:

Employ different instrumental techniques for the quantitative determination of parameters defining the behavior of biomolecules.

Plan, design and implement the appropriate methodologies and experimental procedures.

Design experiments and/or applications requiring instrumental infrastructure in Biochemistry, Biotechnology, Biomedicine, etc.

Analyze quantitatively the experimental results in order to determine the thermodynamic and kinetic parameters for the different biomolecular equilibria (e.g., conformational, binding...) under study.

Interpret the experimental results in terms of the biological, biochemical, and physico-chemical properties of the system under study. Perform a critical analysis of the obtained information.

Search and analyze specific information and communicate basic concept son the methodologies employed and results obtained from the point of view of Quantitative Biotechnology.

Select the most appropriate experimental technique for each particular case.

Transversal competences:

1 - Manage in an adequate way the resources and the available time for the resolution of a problem or the development of a draft

2 - Communicate own conclusions and the latest knowledge and reasons that support them - to specialized audiences

3 - Transmit information in an oral, written or graphic form using appropriate presentation tools and with the limitations imposed by time or space

4 - Communicate fluently in English (understanding scientific texts, writing reports, lectures, colloquiums, exhibitions, etc.)

5 - Use Information and Communication Technologies (ICT) as a tool for expression and communication

6 - 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

7 - Develop technological applications of biochemical processes and transfer solutions to the industry in the food, chemical, cosmetic, pharmaceutical or health sector

## 2.2.Learning goals

This is not a compulsory course within the master, but it will allow extending the scope and deepen on the knowledge covered by other courses.

## 2.3.Importance of learning goals

The structural and functional information derived from the different experimental techniques is relevant across different fields with broad application; not only in Structural Biology, but also in Biochemistry and Molecular and Cell Biology, with applications in biomedicine and biotechnology.

## 3.Assessment (1st and 2nd call)

## 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Problems and practical cases (30/100): The lab reports will be prepared individually or in groups of two students, containing a detailed description of the experimental procedures, the results, the data analysis, the interpretation, and the integration within the knowledge gathered about the experimental system. They will be evaluated evaluate according to the structure in sections (introduction, methodology, results, discussion, conclusions and references), considering how the student describes in a clear way the problem statement, the methodology and the results in a logic and sequential way, gives original ideas in the description, provides justified and plausible conclusions, and reports the appropriate the references in literature.

Written Test (60/100): It will comprise of questions requiring short or long answers. Short ones will allow performing a comprehensive sampling of the student knowledge, and long ones will allow students to exhibit their expression capabilities in presentation and sustain argumentations, and critical judgments. This written test will be based on the learning activity program.

Seminars (10/100): Report preparation and public presentation and defense about a topic related to the course. This report will be individual or in two group student. The presentation sessions will have seminar format. 10-15 minutes for presentation and defense. The work will be evaluated according to its structure (coherent) and appropriate literature references; clarity and tidiness during the presentation; maturity during debate.

## 4.Methodology, learning tasks, syllabus and resources

## 4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. It favors the understanding of the different chemical processes that occur in the environment. A wide range of teaching and learning tasks are implemented, such as theory sessions, laboratory sessions, assignments, and tutorials.

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Although the course starts with a highly theoretical approach, it develops into a more practical and applied perspective. Theory and practice sessions will alternate, in order to optimize the learning process.

Students are expected to participate actively in the class throughout the semester.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class.

## 4.2.Learning tasks

The course includes 4 ECTS organized according to:

- Theory sessions: 16 hours.

- Laboratory sessions: 14 hours.

- Seminars and debates: 10 hours.

## 4.3.Syllabus

The course will address the following topics:

**A) Theory sessions**

1. Topic 1. Differential scanning calorimetry.
2. Topic 2. Isothermal titration calorimetry.
3. Topic 3. Foundations of spectroscopy.
4. Topic 4. UV-Vis absorption spectroscopy.
5. Topic 5. Circular dichroism and optical rotatory dispersion.
6. Topic 6. Emission spectroscopy.
7. Topic 7. Infrared spectroscopy.
8. Topic 8. Light scattering.

9. Topic 9. Mass spectrometry.
10. Topic 10. Surface plasmon resonance.
11. Topic 11. Ultracentrifugation.
12. Topic 12. Task-specific equipment.

**B) Laboratory sessions**

Session 1. Protein unfolding: chemical and thermal denaturation through spectroscopy and calorimetry.

Session 2. Protein-ligand interaction: spectroscopy and calorimetry.

Session 3. Ligand-induced protein stabilization: Thermal-shift assay through spectroscopy and calorimetry.

## 4.4.Course planning and calendar

This course runs during the second semester. Theory sessions will take place on Wednesday 11:30-13:30; Thursday 11:30-13:30.

Lab practice sessions, written assignments, oral presentations and written tests will be announced and planned after each theory session.

For further details concerning the timetable, classroom and further information regarding this course, please refer to the "Facultad de Ciencias" website.

Exam calls, exam dates and academic calendar in general can be checked at the webpage: http://ciencias.unizar.es/web/horarios.do

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Theory sessions: Wednesday 11:30-13:30; Thursday 11:30-13:30

Lab practical classes, written jobs, oral presentations and written tests will be announced and planned after each theoretical lesson.

## 4.5.Bibliography and recommended resources

Introduction to protein structure / C Branden, J Tooze, 2nd ed., Garland, 1999

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Lehninger Principles of Biochemistry / DL Nelson, MM Cox, 6th ed., WH Freeman & Co, 2013

Principles of Physical Biochemistry / KE van Holde, C Johnson, PS Ho, 2nd ed., Prentice Hall, 2005

Biophysical Chemistry: Parts I-II-III / CR Cantor, PR Schimmel, 1st ed., WH Freeman, 1980

Proteins: Structures and molecular properties / T.E. Creighton, 2nd ed., WH Freeman & Co, 1994