Universidad de Navarra

Fundamentals of instrumental techniques

Guía docente 2026-27

PRESENTACIÓN

Breve descripción: The course Fundamentals of Instrumental Techniques aims to provide students of the Degree in Biochemistry with fundamental theoretical knowledge of the most crucial instrumental techniques used in the analysis of biomolecules and related substances in the healthcare sector.

Students will acquire basic concepts of the analytical process, the interpretation of results, as well as the study of quality parameters of the employed method. Additionally, students will study the principles and applications of molecular UV-visible absorption and emission spectroscopic techniques, separation methods (chromatography and electrophoresis), and thermal methods.

- **Titulación**: Fundamentals of Instrumental Techniques
- **Módulo/Materia**: Instrumental and Computational Methods in Research/ Instrumental Methods (in Biomedical Research)
- **ECTS**: 3 ETCS
- **Curso, semestre**: First Year, Second Semester
- **Carácter**: Compulsory
- **Profesorado**: Dr. Bianca Menchicchi
- **Idioma**: English
- **Aula, Horario**:

RESULTADOS DE APRENDIZAJE (Competencias)

- RA1: Describe the scientific methods and principles for studying and analyzing the organization and function of biological systems at the molecular level, as well as the technological applications of biochemical processes
- RA2: Apply mathematics, statistics, and computer science to obtain, analyze, and interpret data and to develop models of biochemical systems and processes
- RA3: Explain the fundamentals of Physics and Chemistry relevant to understanding biological and biochemical processes
- RA13: Apply the techniques and instruments of experimentation and molecular analysis in the field of Biomedicine with rigor and safety

PROGRAMA

1. The Analytical Process: Introduction. Calibration curves. Interpretation of results and quality parameters of an analytical method.

2. Introduction of Spectroscopic Techniques to Biochemical Analysis: Basic principles of electromagnetic radiation (EMR). The electromagnetic spectrum. Absorption and emission spectra of radiation. Instrumental setup.

3. UV-Visible Molecular Absorption Spectroscopy: Theoretical foundation. Absorption Law - Beer-Lambert Law: quantification. Application to molecules of biochemical interest: proteins and nucleic acids.

4. UV-Visible Molecular Emission Spectroscopy (Luminescence): Types of luminescence: Photoluminescence and Chemiluminescence. Fluorescence and phosphorescence. Jablonski diagram. Fluorescence quenching (deactivation). Application of fluorescence to the analysis of proteins and nucleic acids.

5. Introduction to Chromatographic Separations: Principles of chromatography and types of chromatography. Principles of separation by adsorption, partition, ion exchange, molecular exclusion, and affinity.

6. Planar Chromatography & Column Chromatography: Chromatogram and chromatographic parameters.

7. High-Performance Liquid Chromatography (HPLC): Instrumentation and applications.

8. Electrophoresis: Principles. Electrophoretic mobility. Polyacrylamide gel electrophoresis (PAGE). Agarose gel electrophoresis. Applications.

9. Introduction to thermal Methods: Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). Applications in biomolecules.

ACTIVIDADES FORMATIVAS

1. In-Person Theoretical Lectures: 22 Hours (2.2 ECTS)

Methodology: In-class lectures where the professor will present the fundamental concepts of each instrumental technique and their potential applications in the biochemical field. Power Point presentations will be used, as well as the blackboard for certain explanations.

Competencies Acquired: Students will learn the fundamentals and applications of some spectroscopic instrumental techniques as well as substance separation techniques of application in biochemistry.

2. Problem Solving and Proposed Activities: 8 Hours (0.8 ECTS)

• **Methodology:** At the end of each theoretical topic, the professor will propose problems and practical cases related to the studied technique, which students should attempt to solve before the professor works them out in class. These exercises will be available on the course website (ADI). These problem seminars are intended to help students deepen their understanding of the contents acquired in theoretical sessions. Active participation will be encouraged, with students answering questions raised by the professor during problem-solving and being motivated to ask any doubts that may arise during the resolution of exercises.

• **Competencies Acquired:** This activity provides students with skills in the practical application of the different studied techniques and develops critical thinking regarding the results obtained from the resolved exercises

3.Tutorials (0-0.2 h): Upon student request, personal interviews will be conducted for resolving potential doubts

EVALUACIÓN

CONVOCATORIA ORDINARIA

The final grade for the course is determined by:

1. Theory Exam Score (80% / Up to 8 points): The theory exam will be held at the end of the course and will consist of two parts: theory (multiple-choice questions and short questions) and problem-solving. Multiple-choice questions will have 4 options and incorrect answers will receive negative points.

Important: To average the grades and pass the course, students must achieve a minimum score of 4 out of 10 in each of the two parts of the final exam (theory and problems). If this minimum is not reached, the student's grade will be capped at the score of the part in which they failed to reach the 4.0 minimum.

2.Continuous Evaluation (20% / Up to 2 points): Throughout the course, several short classroom tests (10-15 minutes) or solved-exercises to upload, will be conducted to assess student monitoring and proper assimilation of the taught concepts.

CONVOCATORIA EXTRAORDINARIA

The same evaluation criteria and weighting as the ordinary call are maintained

Important: Please note that the classroom test is a continuous assessment component and **cannot be repeated** during the extraordinary evaluation call. For the extraordinary call, the original mark obtained in the classroom tests will be retained and factored into the final grade alongside the extraordinary exam score.

EVALUACIÓN DE LOS RESULTADOS DE APRENDIZAJE

	Theory Exam	Practicals Evaluation	Written report	Oral Presentations	Continuous Evaluation	Others
BQ-C1b (RA1)	x				x	
BQ-C2b (RA2)	x				x	
BQ-C3b (RA3)	x				x	
BQ-H2b (RA13)	x				x	

HORARIOS DE ATENCIÓN

Dr Bianca Menchicchi (bmenchicchi@unav.es)

- Despacho 1232, Edificio de Investigacion, First floor
- Tutoring time: according meeting request

BIBLIOGRAFÍA Y RECURSOS

- Skoog, D. A., Holler, F. J., y Crouch, S. R. (2017). *Principles of instrumental analysis* (7.ª ed.). Cengage Learning. (Previous versions are also available) Find it here