# COURSE DATA

## DATA SUBJECT

**Code:** 36881
**Name:** Methods in Biochemistry and Molecular Biology I
**Cycle:** Undergraduate Studies
**ECTS Credits:** 7.5
**Academic year:** 2026-27

## STUDY (S)

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1111 - Grado en Biotecnología | Facultat de Ciències Biològiques | 2 | First quarter |

## SUBJECT-MATTER

| Degree | Subject-matter | Character |
|---|---|---|
| 1111 - Grado en Biotecnología | Biochemistry methodology | COMPULSORY |

## COORDINATION

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# SUMMARY

The development of analytical methods in Biochemistry and Molecular Biology has had, and will continue to have, a major impact on the advancement of Biotechnology. This course, together with Methods in Biochemistry and Molecular Biology II, forms part of the subject area Biochemical Methodology, and both courses introduce students to the principles and applications of basic methodologies for the analysis, characterization, and separation of biomolecules and their various associations or complexes. This subject area addresses the need to develop specific tools and skills in an experimental scientific discipline such as Biotechnology. Specifically, the course Methods in Biochemistry and Molecular Biology II introduces students to the fundamental principles and applications of basic analytical methodologies used in this field. The course content presented here is designed to be taught during the first semester of the second year of the Biotechnology degree program and is not intended to be a definitive proposal, as the emergence of new techniques or the modification of existing ones may justify their inclusion in the curriculum. Each topic covers a technique or a group of related techniques. The topics are structured so that, following a brief introduction to the fundamentals of the method or group of methods, their experimental use and applications are discussed. A wide range of examples of applications in different areas of research has been selected based on their practical relevance and educational value.

## PREVIOUS KNOWLEDGE

### RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

## COMPETENCES / LEARNING OUTCOMES

### 1111 - Grado en Biotecnología

Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Adquirir conocimientos de los fundamentos físico-químicos y las bases metodológicas de las técnicas utilizadas en estudios moleculares

Apply analytical, synthetic and critical thinking skills in the application of the scientific method.

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Comprender protocolos de separación, caracterización y análisis de moléculas biológicas

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Design and carry out a complete protocol for obtaining and purifying a biotechnological product.

Diseñar protocolos de separación, purificación y caracterización de moléculas biológicas

Manejar adecuadamente los equipos y el material propio de un laboratorio de bioquímica y biología molecular

Participate in multidisciplinary teams, engaging in teamwork and collaboration.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Use English to write reports and to interpret information from protocols, manuals and databases.

Work in laboratories, including safety procedures, waste management and accurate activity logging.

## DESCRIPTION OF CONTENTS

### Unit 1. Absorption Spectroscopy

Fundamentals of spectroscopy: properties of electromagnetic radiation; structure and energy levels of molecules; concept of chromophore. Absorption spectroscopy. Lambert-Beer's law: analysis of chromophore solutions; deviations from Lambert-Beer's law. Ultraviolet-visible (UV-visible) electronic absorption spectroscopy and its applications: quantification of proteins and nucleic acids; characterization of the secondary structure and thermal stability of proteins and DNA; quantification of metabolites and enzymatic activities by enzymatic assays; etc. Vibrational spectroscopies (infrared absorption (IR) and Raman scattering) and their applications.

### Unit 2. Fluorescence Spectroscopy

Energy dissipation by excited molecules. Fluorescence and phosphorescence. Structural characteristics of fluorescent compounds. Fluorescence spectroscopy. Generalities: parameters that characterize fluorescent emission; measurement of fluorescence. Biochemical applications: intrinsic and extrinsic fluorescence of proteins, nucleic acids and membranes; assessment of enzymatic activities; luminescence; fluorescence polarization; resonance-induced energy transfer (FRET). Cellular studies: fluorescence microscopy; immunofluorescence; fluorescence-activated cytometers and cell sorters; measurements of $Ca^{2+}$ and intracellular pH.

### Unit 3. Nuclear Magnetic Ressonance Spectroscopy

Fundamentals of Nuclear Magnetic Resonance (NMR). Magnetic moment of the nucleus. Quantization under an external field. The NMR experiment: Apparatus. NMR spectra: characteristics and interpretation. NMR applications: *in vitro* and *in vivo* studies; image formation.

### Unit 4. Isotopic Methods

Fundamental principles of the use of isotopes in biochemistry (Radioactive decay, types of emission and decay kinetics). Detection and quantification of radioactivity (Geiger-Muller counters, scintillation counters, Cerenkov counting, surface image detectors). Use of radioisotopes in biochemical research: *In vivo* and *in vitro* studies (metabolite turnover, radioimmunoassay, enzyme titrations, membrane transport).

### Laboratory Sessions

Four laboratory experiments to be developed in six sessions with a duration between 2-4 hours each, up to a total of 20 hours, in different weeks (not intensive)
**Experiment 1:** Introduction to UV-visible spectrophotometry: Colorimetry and spectrophotometry. Absorbance measurements of chromophores in solution. Calculation of the extinction coefficient. Lambert-Beer's law. Limitations of the law. Calculation of solute concentrations in mixtures. Study of the hyperchromic effect.
**Experiment 2:** Quantification of metabolites by spectrophotometry and kinetic analysis of an enzyme by

turbidimetry. Enzymatic and spectrophotometric determination of ethanol concentration. Determination of lipase activity by turbidimetric assay.
**Experiment 3:** Protein-ligand interaction followed by fluorimetry. Handling of the spectrofluorimeter. Excitation and emission spectra. Use of ANS as a polarity sensing fluorophore. Analysis of the protein-ligand interaction.
**Experiment 4:** Fluorescent probes: Determination of $Ca^{2+}$ and pH in solutions. Analysis of the variation of the excitation spectra of QUIN2 and 5-carboxy-4,5-dimethylfluorescein fluorophores with $Ca^{2+}$ concentration and pH, respectively. Determination of $Ca^{2+}$ and pH in problem solutions.

# WORKLOAD

## PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Theory | 40,00 |
| Laboratory | 20,00 |
| Classroom practices | 15,00 |
| **Total hours** | **75,00** |

## NON PRESENCIAL ACTIVITIES

| Activity | Hours |
|---|---|
| Attendance at other activities | 0,00 |
| Individual or group project | 0,00 |
| Independent study and work | 40,00 |
| Preparation of lessons | 55,00 |
| Preparation for assessment activities | 17,50 |
| Resolution of case studies | 0,00 |
| **Total hours** | **112,50** |

# TEACHING METHODOLOGY

**Lecture Classes:** The course is designed to promote active student learning. Lecture classes are designed as introductions to each topic, presenting the most relevant content primarily using audiovisual media. Research techniques will be described, and an attempt will be made to provide a comprehensive and interrelated overview of each topic.

Prior to lecture classes, students will be provided with bibliographic information and materials provided by the lecturer and published in the Virtual Classroom. Active student participation is expected in these classes. This participation will be encouraged through the resolution of questions. The lecturer may request the submission of resolved questions. This activity will allow students to understand how well they assimilate the concepts and thus better assess their work.

**Problem-solving classes.** Problem-solving classes will be posed so that students solve part of the problem in class under the supervision of the professor, occasionally working in teams with other students. Students will be provided with lists of proposed problems related to the different program topics in advance. Discussions of scientific articles may also be held, where students, along with the professor, will comment on a research article proposed by the professor and related to the program topics. A series of questions regarding the objectives, methodology, results, and conclusions of the research work will then be addressed.

**Practical laboratory sessions:** Prior to the practical classes, students will be provided with bibliographic information and materials through the Virtual Classroom. The instructor will provide students with a booklet/guide containing not only the protocols to follow but also bibliographic references and self-assessment questions to be answered throughout the practical sessions. This will ensure that students have the basic knowledge to carry out and use the practical tasks.

The practical sessions will be designed so that students participate in the experiments, including the development of the practice, data collection, and the process of preparing and interpreting the results to ultimately provide conclusions about the experiment. All of this will take place in the teaching laboratory under the instructor's supervision, working in teams with their classmates. At the end of the practical sessions, students will complete and submit a "results questionnaire" with the results obtained and the conclusions drawn, thus demonstrating their ability to formalize and communicate scientific data.

## EVALUATION

A written exam on the course content (theory, problems, and practicals) will account for 80% of the final grade for the subject. This exam must be passed (a minimum score of 5 out of 10) in order to pass the course.

The evaluation of the laboratory practicals will represent 15% of the final grade and will be based on individual monitoring of the student's activities, including the completion of questionnaires and active participation in class. Attendance at all laboratory sessions is mandatory for this component to be assessed and for the student to pass the course.

The final grade will also include a 5% component based on class participation.

To pass the course, students must obtain an overall grade equal to or higher than 5 out of 10, having passed both the written exam and the laboratory practicals. The grades for the laboratory and class participation will only be added once the written exam has been passed.

Second examination session: The same evaluation criteria used for the first session will apply. It will consist of a single exam covering all course content (80%), with the grades for laboratory practicals (15%) and class participation (5%) also included.

If the laboratory practicals are passed but the overall course is not, the practicals grade will be carried over to the following academic year.

## REFERENCES

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