

**COURSE DATA****DATA SUBJECT****Code:** 33138**Name:** Methods in biochemistry**Cycle:** Undergraduate Studies**ECTS Credits:** 12**Academic year:** 2025-26**STUDY (S)**

Degree	Center	Acad. year	Period
1109 - Degree in Biochemistry and Biomedical Sciences	Facultat de Ciències Biològiques	2	Annual

**SUBJECT-MATTER**

Degree	Subject-matter	Character
1109 - Degree in Biochemistry and Biomedical Sciences	Métodos instrumentales	COMPULSORY

**COORDINATION**

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**SUMMARY**

The course of "Methods in Biochemistry" is included within the subject "Methods in Molecular Biosciences", which is compulsory in the second degree course in Biochemistry and Biomedical Sciences. This course has 27 ECTS credits and it is offered through annual length in four courses: "Methods in Biochemistry" (12 ECTS), "Genetic Engineering" (6 ECTS), "Techniques of genetic analysis" (4, 5 ECTS credits) and "Cell analysis techniques" (4.5 ECTS).

The general objectives of the course "Methods in Biochemistry" are: 1) Describe the fundamentals of the methods in the field of Biochemistry and Molecular Biology. 2) Be familiar with techniques to purify, characterize and manipulate biomacromolecules. 3) Analyze the application of the studied methodologies to solve biological problems.

**PREVIOUS KNOWLEDGE**



## RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

## OTHER REQUIREMENTS

## COMPETENCES / LEARNING OUTCOMES

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Acquire skills to use the methodologies of molecular biosciences and to keep an annotated record of activities.

Be able to think in an integrated manner and approach problems from different perspectives.

Be able to use new information and communication technologies.

Capacidad para la asimilación de textos científicos en inglés.

Have capacity for analysis, synthesis and critical reasoning in the application of the scientific method.

Know how to design multidisciplinary experimental strategies in the field of molecular biosciences to solve complex biological problems, especially those related to human health.

Know how to use the different bibliographic sources and biological databases and be able to use bioinformatic tools.

Know how to work responsibly and rigorously in the laboratory, considering the safety aspects in experimentation as well as the legal and practical aspects of the handling and disposal of waste.

Know the usual procedures used by scientists in the area of molecular biosciences and biomedicine to generate, transmit and disseminate scientific information.

Show initiative and leadership for multidisciplinary teamwork and cooperation.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make



judgements that take relevant social, scientific or ethical issues into consideration.

Understand experimental approaches and their limitations and interpret scientific results in molecular biosciences and biomedicine.

## DESCRIPTION OF CONTENTS

### 1. ITEM 1. ABSORPTION SPECTROSCOPY.

Physicochemical fundamentals of spectroscopy. Measure the absorption of radiation. Molecular absorption spectroscopy in the ultraviolet-visible (UV-V). Spectroscopy in the region of infrared (IR). Biochemical applications. (13 hours T, 3 hours P)

### 2. ITEM 2. FLUORESCENCE SPECTROSCOPY.

Dissipation of energy by excited molecules. Fluorescence and chemiluminescence. Fluorescence spectroscopy, generalities. Induced energy transfer by resonance. Biochemical applications: intrinsic and extrinsic fluorescence of proteins, nucleic acids and membranes. Cellular studies. (13 hours T, 4 hours P)

### 3. ITEM 3. CHROMATOGRAPHY.

General fundamentals of chromatography. Partition chromatography. Adsorption chromatography. Ion exchange chromatography. Exclusion chromatography. Affinity chromatography. Biochemical applications. (6 hours T, 3 hours P)

### 4. ITEM 4. ELECTROPHORESIS.

General. Electrophoresis techniques. Free electrophoresis capillary. Zonal electrophoresis in polyacrylamide and agarose. Transfers to other media. Applications. Isoelectric focusing. Two-dimensional electrophoresis. (5 hours T, 2 hours P)

### 5. ITEM 5. CENTRIFUGATION.

The process of sedimentation. Sedimentation coefficient. Preparative sedimentation homogeneous medium. Sub cellular fractions in density gradient sedimentation, and isopycnic zonal. (2 hours T, 2 hours P)

Fundamental principles of the use of isotopes in biochemistry. Radioactive decay. Measurement of



## 6. ITEM 6. ISOTOPIC METHODS.

radioactivity. Applications: in vivo and in vitro. Radioimmunoassays. Autoradiography: autoradiographic methods. (4 hours T, 2 hours P)

## 7. ITEM 7. MASS SPECTROMETRY.

Introduction. Mass spectra and load / mass. Mass spectrometry of high molecular weight compounds. Biochemical applications. (7 hours T, 3 hours P)

## 8. Practical sessions of Laboratory

PRACTICE 1. INTRODUCTION TO THE ABSORPTION SPECTROSCOPY. Management of the spectrophotometer. The Lambert-Beer Law: determination of the extinction coefficient of hemoglobin. Influence of pH on the absorption spectrum. Analysis of mixtures of chromophores. (4h).

PRACTICE 2. STUDY OF ENZYMIC KINETIC BY SPECTROSCOPY. Measurement of alkaline phosphatase activity by spectrophotometry. Determination of kinetic parameters and types of inhibition. Hyperchromic effect. Determination of nuclease activity by hyperchromic effect. Calculation of hyperchromicity of DNA (4h).

PRACTICE 3. MEASUREMENT OF ENZYME ACTIVITY AND METABOLITES BY SPECTROSCOPY. Determination of nuclease activity by hyperchromic effect. Calculation of a DNA hyperchromicity. Determination of ethanol concentration in samples by enzymatic assay. (4h)

PRACTICE 4. INTRODUCTION TO FLUORESCENCE SPECTROSCOPY. STUDY OF PROTEIN-LIGAND INTERACTION. Management of the spectrofluorimeter. Excitation and emission spectra. Influence of solvent polarity on the emission spectrum of a fluorophore. Fluorescence protein. Study of protein-ligand interaction. (4h).

PRACTICE 5. DETERMINATION OF Ca<sup>2+</sup> CONCENTRATION AND pH USING FLUORESCENT PROBES. Determination of intracellular calcium and intracellular pH using permeable fluorophores. (4)

PRACTICE 6. SEPARATIVE TECHNIQUES. Purification of a protein (RUBISCO) using differential precipitation, dialysis, chromatography and polyacrylamide gel electrophoresis. Yield analysis and purification factor. (20h)

## WORKLOAD

### PRESENCIAL ACTIVITIES

Activity	Hours
Theory	61,00
Laboratory	40,00
Classroom practices	19,00
<b>Total hours</b>	<b>120,00</b>

**NON PRESENCIAL ACTIVITIES**

Activity	Hours
Attendance at other activities	2,00
Individual or group project	15,00
Independent study and work	98,00
Preparation of lessons	45,00
Preparation for assessment activities	14,00
Resolution of case studies	6,00
<b>Total hours</b>	<b>180,00</b>

**TEACHING METHODOLOGY**

**Lectures of Theory:** A total of 50 sessions of an hour will be needed to cover this facet of teaching. This course aims to promote active learning by students. The lectures are intended as general introductions to each topic which will present the different research techniques and will try to give a global and co-related them. Prior to the lectures, the students will have bibliographic information and material provided by the teacher.

**Lectures of problems, questions and commentary of papers:** will be held 19 sessions of one hour during the entire course, interspersed with the lectures. They will be proposed to the students to solve some of the problems in the classroom under the teacher's supervision and promote teamwork with colleagues. There will also have comment of some scientific articles. The students will participate in a discussion led by the teacher about a research paper, provided by the teacher, which is related to the topic as well as series of questions about the article.

**Practical laboratory sessions:** The teacher will provide in advance to the student with a booklet containing not only the protocols to follow, but also references and some theoretical questions that students must solve (with the help of the literature) before practice. In the first session of each practice, the teacher will discuss these issues with the students ensuring they have adequate knowledge to perform the practical use. Once the experiments are done, the students must submit a technical report containing the results and conclusions that can be drawn from them. The attendance at the practical sessions is mandatory.

**EVALUATION**

The assessment of learning will be completed according to the following criteria:

a) 80% of the mark will come from written tests where it will be considered the student knowledge and its ability to apply this knowledge to the interpretation of experimental results and to the resolution of questions and problems related to the experimental methodology employed. The exams will consist of one part of theoretical questions and problems.

b) 20% of the mark will come from the evaluation of practical sessions. This mark will value how students developed the practice (provided solutions to theoretical issues outlined above), conducted the experiments (degree of understanding and care in following the protocols) and the final technical report



(presentation, clarity and appropriateness of the conclusions obtained).

There will be two qualifying exams. The first will evaluate the knowledge for the spectroscopy techniques (items 1 and 2). The second examination shall cover the topics of radioactivity, separation techniques and mass spectrometry (items 3 to 7). Each exam is scored on 10 points. The average of the two tests are multiplied by a factor 0.8, to be added the qualification of practical sessions (a total of 2 points) for the overall rating of the subject. The earning of a mark below 4.0 in any of the exams, an average value of the two exams below 4.5, or an overall course mark below 5.0, will force to a re-evaluation in a second annual convocation. The mark of one of the parts can be kept up to the second convocation just if the score is above 4.5.

Exceptionally, the final mark can be enhanced by an outstanding student participation in resolution of the proposed questions solution and in the discussion of research articles that demonstrate, in the opinion of the teacher, an extraordinary level of knowledge. In any case, the contribution of the latter section will not exceed 1 point in the final mark.

## REFERENCES

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- Roca, P., Oliver, J. Y Rodriguez, A.M. Bioquímica. Técnicas y Métodos. Ed Hélice. 2004
- Freifelder, D. "Técnicas de bioquímica y biología molecular" Ed. Reverté, 1991
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- Holme, D.J. y Peck, H. Analytical Biochemistry (3ª edición). Ed. Pearson Education Limited, 1998.
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