Advanced Instrumental Techniques

Code: 100880
ECTS Credits: 3

2024/2025

Degree	Type	Year
2500252 Biochemistry	OB	2

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites for this subject.

Objectives and Contextualisation

This subject is taught in the Degree of Biotechnology and within the topic of Experimental Methods. Corresponds to a compulsory subject of the third year (3 ECTS). It is taught to a group of about 80 students.

Advanced Instrumental Techniques, with exclusively theoretical content, is part of a topic where most of the subjects are eminently practical. Experimental Methods aims to enhance the eminently experimental nature of Biotechnology, accentuating its interdisciplinary nature. Hence, it is necessary to know the theoretical bases of the techniques, as well as their application. It is in this context, where the subject of Advanced Instrumental Techniques, defines its training objectives.

Another important aspect that determines the objectives, and especially the contents of this subject, is the existence of a previous one named Basic Instrumental Techniques, which is taught in the first year. Both subjects are complementary and with both, we aim to cover the set of techniques based on chemistry, biology and physics that a biotechnologist student needs to understand.

The general objective is to know the main advanced instrumental techniques that are used in the laboratory and that the student may need throughout their studies and professional activity. This objective can be further detailed in:

-To acquire and understand the theoretical basis of the main advanced instrumental techniques.

-To understand how to apply these techniques in the field of Biotechnology.

-To enhance the student's self-learning capacity. The student must learn to obtain information and acquire the habit of using this information critically.

-To increase the student's interest in the technical aspects of science.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply the principal techniques used in biological systems: methods of separation and characterisation of biomolecules, cell cultures, DNA and recombinant protein techniques, immunological techniques, microscopy techniques, etc.
- Clearly perceive current advances and possible future developments by reviewing scientific and technical literature in the area of biochemistry and molecular biology.
- Collaborate with other work colleagues.
- Design experiments and understand the limitations of experimental approaches.
- Identify molecular structure and explain the reactivity of the different biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- Interpret experimental results and identify consistent and inconsistent elements.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Collaborate with other work colleagues.
3. Critically interpret the scientific literature
4. Describe strategies for purifying complex mixture biomolecules.
5. Describe the fundamental techniques used in the analysis, purification, and characterisation of biomolecules.
6. Describe the instrumentation used in the different techniques in biochemistry.
7. Design experiments and understand the limitations of experimental approaches.
8. Discuss the principal sources of information in biochemistry and molecular biology
9. Explain the fundamental theory behind basic and advanced techniques in biochemistry.
10. Explain the theoretical foundations of suitable techniques for the structural and functional characterisation of proteins and nucleic acids, and apply these.
11. Interpret experimental results and identify consistent and inconsistent elements.
12. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
13. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Content

1. Microscopy

Introduction to optical and confocal microscopy: physical foundations, microscopes and sample preparation. Energy transfer by resonance. Photobleaching. Evanescent field. Image analysis techniques.

2. Electromagnetic radiation and its interaction with matter

Interaction of radiation with matter: absorption, emission and dispersion. Electronic absorption spectroscopy: spectroscopic analysis of biopolymers and effects of conformation on absorption. Infrared spectroscopy and its application to biological molecules. Fluorescence emission spectroscopy: basic principles and application to the analysis of biomolecules.

3. Flow cytometry

Basic principles of flow cytometry. Compensation of fluorescence. Cell separation Flow cytometry by image.

4. Techniques for the study of molecular interactions

Determination of binding constants between biomolecules. Isothermal calorimetry and differential scanning calorimetry. Resonance of superficial plasmons. Microscale thermophoresis.

5. Nuclear magnetic resonance spectroscopy.

Basic principles. Spectrum measurement. One-dimensional NMR of macromolecules. Two-dimensional NMR.

6. X-ray crystallography.

Crystals. Growth of crystals Principles of X-ray diffraction by crystals. Determination of macromolecular structures by X-ray diffraction.

7. Experimental design and data analysis

Importance of experimental design. Use of control samples. Treatment of experimental errors. Statistical significance and hypothesis validation. Linear and non-linear regression.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical classes	22	0.88	1, 13, 12, 4, 6, 5, 8, 7, 10, 9, 3, 11
Type: Supervised			
Discussion about subject topics	6	0.24	1, 13, 12, 2, 8, 7, 3, 11
Type: Autonomous			
Study	43	1.72	2, 8, 7, 3, 11

Master classes. In some topics, problems interspersed with theoretical concepts will be solved to facilitate their understanding.

Depending on the needs of the development of the subject will be scheduled tutorials for the discussion of specific aspects of the subject.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

Participation in the Moodle virtual class	10	1	0.04	1, 13, 12, 2, 4, 8, 7, 3, 11
Tests	90	3	0.12	1, 13, 12, 2, 4, 6, 5, 8, 10, 9, 3

This subject provides for two individual evaluation systems.

Continuous assessment:

Continuous assessment consists of one tests in the Moodle classroom and two multiple-choice tests in which the contents of the entire theory program of the subject will be evaluated.

- The multiple-choice tests have a retake option and a weight of 9 (5+4) out of 10 of the overall grade. It does not have a minimum grade.

- The participation in the Moodle classroom weight of 1 out of 10 in the overall grade. It has no minimum grade and no retake assessment.

-In the event that you want to improve your grade of the multiple-choice tests, this will be done on the day on which the retake is called. However, retaking the test implies the waiver of the previously obtained qualification.

- To participate in the retake of the multiple-choice tests, students must have previously been evaluated in a set of activities whose weight is equivalent to a minimum of two-thirds of the total grade of the subject or module. Therefore, students will obtain the grade of "Not Assessed" when the evaluation activities carried out have a weighting of less than 67% in the final grade.

- To pass the subject, it is necessary to obtain an overall grade equal to or greater than 5 points out of 10.

Single assessment:

- The single assessment consists of a single multiple-choice test in which the contents of the entire theory program will be evaluated. The grade obtained in this final exam will account for 100% of the final grade of the subject.

- To pass the subject, it is necessary to obtain an overall grade equal to or greater than 5 points out of 10.

- The single assessment test will be held on the same day, time and place as the multiple-choice test of the continuous assessment of the subject.

- The retake consists of a single multiple-choice test in which the contents of the entiretheory program will be evaluated. The retake of the single assessment will be carried out on the same day, time and place as the retake of the continuous assessment.

Bibliography

Principles and Techniques of Biochemistry and Molecular Biology. Andreas Hofmann and Samuel Clokie. Cambridge University Press, 8th Edition (2018)

Biophysical techniques in drug Discovery. Angeles Canales et al. Royal Society of Chemistry, 1st Edition (2017)

Principios de análisis instrumental. Douglas A. Skoog et al. Cengage Learning Editores S.A. de C.V., Sexta edición revisada (2008)

Técnicas de Bioquímica y Biología Molecular. David Freifelder. Editorial Reverté. (2010)

Fluorescence Microscopy: From principles to Biological Applications. Ulrich Kubitscheck. Wiley-Blackwell, 2nd Edition (2017)

Software

There is no software for this course.

Language list

Name	Group	Language	Semester	Turn
(TE) Theory	32	Catalan	first semester	morning-mixed