Universitat Autònoma de Barcelona

2021/2022

Advanced Instrumental Techniques

Code: 100880
ECTS Credits: 3

Degree	Type	Year	Semester
2500252 Biochemistry	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

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

- 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.

Learning Outcomes

1. Collaborate with other work colleagues.
2. Critically interpret the scientific literature
3. Describe strategies for purifying complex mixture biomolecules.
4. Describe the fundamental techniques used in the analysis, purification, and characterisation of biomolecules.
5. Describe the instrumentation used in the different techniques in biochemistry.
6. Design experiments and understand the limitations of experimental approaches.
7. Discuss the principal sources of information in biochemistry and molecular biology
8. Explain the fundamental theory behind basic and advanced techniques in biochemistry.
9. Explain the theoretical foundations of suitable techniques for the structural and functional characterisation of proteins and nucleic acids, and apply these.
10. Interpret experimental results and identify consistent and inconsistent elements.

Content

1. 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.

2. Microscopy

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

3. 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.

4. Flow cytometry

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

5. 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.

6. Nuclear magnetic resonance spectroscopy.

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

7. X-ray crystallography.

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

Methodology

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.

Classes will be taught alternately with 50% of the students present physically in the classroom, while the rest can follow the classes virtually through the TEAMS platform.

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.

Activities

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

Assessment

Individual evaluation by:

- Two partial tests with multiple-choice questions with the option to a referral exam. Each one weighs 4.5 out of 10 of the overall score. Minimum mark of each test: 4 out of 10.

- Participation in the Moodle classroom. It has a weight of 1 out of 10 in the overall score. It has no minimum grade and it is not a referral assessment.

- Grades higher than 4 can be improved (only for partial tests) by retaking the exam the same day in which the referral exams are called. However, retaking the test implies the waiver of the previously obtained qualification.

- To participate in the referral test, the student must have been previously evaluated in a set of activities the weight of which equals a minimum of two-thirds of the total grade of the subject or module. Therefore, the student will obtain the grade of "Not Evaluable" when the evaluation activities carried out have a weight lower than 67% in the final grade.

- To pass the subject it is necessary to obtain a global grade equal to or greater than 5 points out of 10 and the minimum grade of 4 in the two partial tests. If in any of these tests the grade is lower than 4, the maximum final grade will be 4 points out of 10.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Participation in the Moodle virtual class	10	1	0.04	1, 3, 7, 6, 2, 10
Test	90	3	0.12	1, 3, 5, 4, 7, 9, 8, 2

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.