Universitat Autònoma de Barcelona

2023/2024

Instrumental Techniques

Code: 100998
ECTS Credits: 6

Degree	Type	Year	Semester
2500502 Microbiology	FB	2	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

Jordi Vilardell Vila

Prerequisites

It is recommended to review the basic concepts of Biochemistry of first year, especially the physical-chemical characteristics of macromolecules.

It is recommended to take this course at the same time as "Laboratori Integrat III" (100978) of this degree.

Objectives and Contextualisation

MODULE II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

The general objective is the students learn the instrumental techniques that are developed in a laboratory and that they may need throughout their studies and professional activity.

This objective can be specified in:

-Acquire and understand the theoretical basis of the main instrumental techniques
-Application of these techniques in the field of microbiology
-Strengthen the self-learning ability of the student. The student must learn to obtain information and acquire the habit of using this information critically.
-Increase student interest in the technical aspect of science.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply suitable methodologies to isolate, analyse, observe, cultivate, identify and conserve microorganisms.
- Identify and solve problems.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- 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.
- Use molecular and immunological techniques in the characterisation of microorganisms and materials of biological origin.

Learning Outcomes

1. Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
2. Assimilate the basic principles of mass spectrometry and its applications.
3. Identify and solve problems.
4. Identify culture media, culture types and the separation and cloning of eukaryotic cells and the generation of monoclonal antibodies
5. Identify suitable techniques for detecting, quantifying and purifying biological molecules and for determining protein structure.
6. Identify the principles and the sample preparation methods in electron microscopy.
7. Know the functioning of the equipment used in microscopy, chromatography, filtering, dialysis, cytometry, spectroscopy, electrophoresis, amplification and DNA sequencing, among others.
8. Know the principles behind techniques that are used to analyse components of cells, viruses and microbial products.
9. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
10. Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
11. Take sex- or gender-based inequalities into consideration when operating within one's own area of knowledge.

Content

Module II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

Unit 1: Basic Principles of absorption spectroscopy. Lambert-Beer Law. Spectrophotometers. Spectroscopic analysis of biopolymers. Fundamentals of spectrofluorimetry. Spectrofluorimeter. Applications.

Unit 2: Centrifugation. Fundamentals.Sedimentation Coefficient. Factors on which the sedimentation coefficient depends. Instrumentation: preparative and analytical ultracentrifuge.

Unit 3. Chromatographic techniques. Introduction. Fundamentals and characteristics. Chromatography type: gel filtration, ion exchange, hydrophobic, affinity. High Performance Liquid Chromatography (HPLC). Gas chromatography.

Unit 4: Purification Strategies of macromolecules. Stages of purification. Optimization of each stage. Preparative techniques of nucleic acids: plasmid DNA, bacteriophage DNA, genomic DNA, total RNA and messenger RNA.

Unit 5: Electrophoretic techniques. Protein and Nucleic acid electrophoresis.

Unit 6. Hybridization techniques: Western-blot, Southern-blot, Northern-blot, Southwesthern, Microarrays, FISH, in situ hybridization. Labeling techniques.

Unit 7: Polymerase Chain Reaction: PCR. Fundamentals of the technique. Primers design . Set up of the reaction. Applications.

Unit 8: Recombinant DNA technology.

Unit 9. Mass spectrometry. MALDI-TOF bacterial identification. Other techniques for biopolymers.

Unit 10: Radioactive isotopes. Kinetics of disintegration. Isotopes used in Biochemistry. Labeling. Methods for LabelingNucleic Acids and Protein. Detection & Measurement of Radioactivity. Protection in the use of radioactive isotopes. Chemiluminescence systems as an alternative to radioactive methods.

Unit 11: Immunological techniques. Preparation of monoclonal and polyclonal antibodies. Antigen-antibody reaction. Examples of Immunotechniques

Unit 12: Electron microscope (TEM / SEM). Sample preparation methods.

Methodology

Theory classes:

There will be master classes (30 hours). Through this system the basic concepts of the syllabus will be introduced. Whenever possible, audiovisual and interactive material will be used to help the understanding of the concepts.

Problem classes:

Throughout the course, 12 hours will be dedicated to problem class sessions. The group will be divided into two subgroups, the lists of which will be made public at the beginning of the course. Students will attend the sessions scheduled by their group. At the same time, each subgroup will be divided into working teams consisting of 3-4 people that will be maintained throughout the course.

At the beginning of the semester, the dossier of problem statements will be delivered through the Virtual Campus. The teams will solve the problems outside class time. In each of the problem sessions, 2-3 teams will be chosen at random. A representative of the chosen team will present the solution of a problem on the blackboard. At the end of the presentation, the problem will be discussed and, if necessary, corrected with the participation of all students. The teacher will ensure that all teams have, throughout the course, the opportunity to publicly expose the resolution of problems. As indicated in the evaluation section, the resolution, public exhibition of problems, discussion and correction will be taken into account in the final grade, in addition to the grade obtained in the individual evaluation.

Seminars:

This activity is an activity supervised by the teacher that is carried out in groups (3-4 people) and consists in the reading by the students of articles previously selected by the teacher. Students must understand and analyze the techniques used in each article. The objective of this methodology is that students see real examples of the use of the techniques explained in class and know how to recognize and interpret them.

During the 3 scheduled seminar sessions there will be a presentation, discussion and debate of the figures of the articles worked on.

The objective of these sessions is to facilitate the dialogue between the teacher and the students, helping them to understand the concepts acquired in the master classes.

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			
Magisterial class	30	1.2	2, 7, 8, 4, 6, 5
Problem Class	12	0.48	2, 7, 8, 4, 6, 3, 5
Seminars Class	3	0.12	2, 7, 8, 4, 6, 3, 5
Type: Supervised			
Group and individual tutoring about seminars and problems	10	0.4	2, 7, 8, 4, 6, 3, 5
Type: Autonomous			
Autonomous Study	62	2.48	2, 7, 8, 4, 6, 3, 5
Problem resolution	14	0.56	2, 7, 8, 4, 6, 3, 5
Work redaction (seminar)	9	0.36	4, 6

Assessment

Continuous evaluation

1. Theory Module (60%).

Two written tests (60%). The two partial tests will contain short questions that allow to relate concepts and a block of multiple-choice questions. The two types of questions will have the same weight in each midterm. The final grade is obtained by the average of the grade obtained in the two midterm exams. The weight of each midterm in the final grade will be directly proportional to the number of classes during which the subject matter included in the exam has been taught.

2. Problems Module (25%).

This module consists of two parts:

2.1. Team evaluation (10% of the total): it is based on the resolution of the problems worked in teams and exposed in class. Each time a team presents a problem it will receive a grade. If a team is not present in the classroom or refuses to present a problem they will receive a grade of 0.

2.2. Individual evaluation (15% of the total) by means of two written tests. Each of the partial tests will consist of the resolution of 1-2 problems. The final grade is obtained by the weighted average of the grade obtained in each of the two tests. The weight of each of the midterm exams in the final grade will be directly proportional to the number of classes during which the subject matter included in the exam has been taught.

3. Seminar Module (15%)

This section evaluates the student's capacity for analysis and synthesis, as well as group work skills. The evaluation will consist of two parts:

> 3.1 Participation in the presentation, discussion, and debate of the articles to the seminar class (5%).
> 3.2 Individual written tests on the figures and tables of the articles worked and discussed during the seminar class (10%). The written tests of the seminars will take place at the end of each of the seminar sessions.

The two parts (3.1 and 3.2) are inseparable, so that the student has to participate, and be evaluated, in both to obtain a grade for the seminars. The grade obtained in this module is NOT subject to recovery.

Single Evaluation

1. Theory Module (60%).

On the day marked by the second partial in the calendar of the course, the students who have taken the single evaluation system will take a single written test on the whole of the syllabus of the subject, and will be of two types: short questions that allow relating concepts and a block of multiple-choice questions. The block of short questions and the multiple-choice questions will have the same weight within this single test.
The weight of this single evaluation test of theory will be 60% of the course.
The single evaluation test of theory is recoverable and will take place on the same day as the recovery of the continuous evaluation tests, in this case the recovery will also be a single written test with questions of the whole syllabus of the subject, with the same format described in the previous paragraph.

2. Problems Module (25%).
This module consists of two parts:

> 2.1. Team evaluation (10% of the total): In this teaching typology the same system described to the continuous evaluation will be applied, it will have the same weight as in the continuous evaluation and in the same way that the continuous evaluation can NOT be recovered.
> 2.2. Individual evaluation (15% of the total). On the day marked by the second partial in the calendar of the course, the students who have taken the single evaluation system will take a single written test consisting of the resolution of 2-4 problems of the set of problems of the whole syllabus of the course. The weight of this single evaluation test of problems will be15% of the subject. The single evaluation test of problems is recoverable and will take place on the same day as the recovery of the continuous evaluation tests, in this case the recovery will also be a single written test with problems on the whole set of the syllabus of the subject, with the same format described in the previous paragraph.

3. Seminar Module (15%).
In this teaching typology the same system described in the continuous evaluation will be applied. It will have the same weight as in the continuous evaluation and in the same way that the continuous evaluation can NOT be recovered.

General considerations for the two types of evaluation (continuous and single)

- The evaluation of the modules of Theory and Problems are inseparable and in order to pass the course the student must participate and be evaluated in both modules. The written tests of theory and problems will be taken together on the scheduled dates already fixed in the calendar.
- On the other hand, in order to pass the course it is NOT necessary to be evaluated in the seminar module.
- The grade is obtained by the weighted average of each of the modules: 0.60 (theory) + 0.25 (problems) + 0.15 (seminars) = final grade. To pass the course it is necessary to achieve a final grade equal to or higher than 5.
- This weighted average can only be done in the case that in the evaluations of the theory and problems modules a grade equal or higher than 4 has been achieved.

- The students who do not pass the written tests of theory and problems with a grade equal or higher than 4 will be able to recover them on the date scheduled for the recovery exam at the end of the semester.
- To participate in the recovery, the student must have been previously evaluated in a set of activities the weight of which is equivalent to a minimum of two thirds of the total grade of the subject or module.
- If after the recovery a grade of 4 or higher in the written tests of theory and problems is not achieved, the subject will be evaluated with a final grade of 4 at the most.
- Students who wish to improve their grade may take the grade improvement exam at the end of the semester, which will take place on the date scheduled for the make-up exam. Students who take the make-up exam waive the grade previously obtained in the same test.
- The make-up exam will have the same format as the previous exams.
- The review of the written tests will take place on an agreed day and place, according to the evaluation regulations of the Faculty of Biosciences.
- Students will get the grade of "Not Evaluable" when the evaluation activities carried out have a weight of less than 67% in the final grade.
- Students who cannot attend an individual evaluation test for justified reasons and provide the corresponding official documentation to the coordination of the degree, will have the right to take the test on another day. The coordination of the degree will ensure the concretion of this with the faculty of the affected subject.
- Any aspect that is not covered in this guide must be followed.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Resolution of exercises in class	10%	1	0.04	1, 11, 10, 2, 7, 8, 4, 6, 3, 5, 9
Seminar summary and Participation during seminar class	5%	0.5	0.02	1, 11, 10, 2, 7, 8, 4, 6, 3, 5, 9
Theory, problems and seminars written exam	85%	8.5	0.34	2, 7, 8, 4, 6, 3, 5

Bibliography

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-Reiner Westermeier; Electrophoresis in Practice : A Guide to Methods and Applications of DNA and Protein Separations eBook | 2016

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Direccions de interès relacionades amb diferents tècniques instrumentals:

Aula Virtual de la Autònoma Interactiva: https://cv2008.uab.cat

Biorom 2008: http://www.um.es/bbmbi/AyudasDocentes/bIOromDISCO/indices/index.html

Roolpi. Tutorial explicativo de la PCR: http://palou.uib.es/roolpi/docencia/docencia.html

University of Akron: http://ull.chemistry.uakron.edu/analytical/index.html

Software

Microsoft Word, PowerPoint, Excel.