UAB
Universitat Autònoma de Barcelona

Integrated Laboratory 4

Code: 100925
ECTS Credits: 3

2025/2026

Degree	Type	Year
Biotechnology	OB	2

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

It is recommended to attend simultaneously, or have taken, the theory subjects corresponding to the contents of the laboratory practices.

You must have passed the safety test in laboratories. The test is answered in the corresponding space of the Virtual Campus and the information that must be consulted is in the space for communication of the Degree in Biotechnology.

Objectives and Contextualisation

The Integrated Laboratory 4 is the fourth subject of a set of 6 that are distributed over the 6 semesters corresponding to the first three years of the Degree in Biotechnology.

The training objectives of these subjects focus on the acquisition of competences within the framework of the practical training of the student.

The contents are organized in a growing order of complexity and associated to the needs and progress of the theoretical contents of the Degree.

The Integrated Laboratory 4 has as its training objectives the acquisition of practical skills in 4 modules:

- Animal Physiology: Understand the physiological responses of the cardiovascular, respiratory, and nervous systems to different stimuli through hands-on activities and data analysis.

- Molecular Microbiology: Learn and apply genetic manipulation techniques and gene expression analysis in bacteria through experiments involving mutagenesis and DNA transfer.
- Bioreactors: Learn the basic operation and design of CSTR and air-lift bioreactors and their applications in growth kinetics and gas transfer.
- Numerical Methods and Computer Applications: Develop basic programming skills and apply numerical methods to solve scientific and engineering problems.

Learning Outcomes

1. CM22 (Competence) Prioritise the instrumentation necessary for the different techniques for the separation and characterisation of biomolecules.
2. CM24 (Competence) Review the general safety standards of a biotechnology laboratory.
3. KM22 (Knowledge) Relate the physiology of different organs and the various metabolic states of an organism.
4. KM23 (Knowledge) Recognise the key microscopic characteristics that distinguish prokaryotic cells from eukaryotic cells, and animal cells from plant cells.
5. SM20 (Skill) Use the basic techniques of manipulation, separation, detection and analysis of proteins and nucleic acids.
6. SM21 (Skill) Use prokaryotic and eukaryotic cell culture techniques and techniques for the manipulation of biological systems.
7. SM22 (Skill) Use analytical methodologies for the assay of biological activity of cellular components.

Content

The subject is structured in 4 modules.

Animal Physiology

Contents: they are organized in 4 sessions of 3 hours that are done in the laboratory (1 and 2) or computer room (3 and 4).

1. Cardiovascular and respiratory adaptation to physical exercise. Influence of sex and hydrostatic pressure.

Determination of heart rate, systolic and diastolic blood pressure, and saturation of blood oxygen in various conditions before and after exercise. Empirical verification of the effect of hydrostatic pressure on blood pressure.

2. Study of the human electrocardiogram (ECG). Cardiac respiratory physiological arrhythmia (ACRF).

Acquisition of the ECG and identification of the different waves that comprise it. ECG and ACRF.

3. Identification of structures and gene expression in the central nervous system: virtual brain stereotactic brain atlas.

Physiological neuroanatomy study of the brain of the mouse to identify some of the main structures that it contains, as well as the degree of gene expression of genes of interest. An interactive 3D steroidal brain mouse atlas will be used, with online access to gene expression databases.

4. Statistical analysis of the data obtained for the whole group of practices.

Preliminary inspection of the data obtained in sessions 1 and 2, and subsequent statistical analysis of the results obtained for the entire group of practices. Assessment of the possible statistically significant differences in the results.

Molecular Microbiology

The Molecular Microbiology module is organized into 5 sessions. The practices in these sessions will allow the student to learn the basic techniques of DNA transfer in bacteria, the mechanisms of directed and random mutagenesisused for the genetic modification of prokaryotes, the mechanisms that allow the study of gene expression and its regulation in bacteria and the use of cell lines to study bacterial pathogenicity. All these contents will be grouped into the 5 practices that are listed below.
Practice 1 (3h) Transfer of genetic material into prokaryotes
Different methodologies will be used for the incorporation of exogenous DNA into bacteria, such as transformation mechanisms, biparental conjugation, triparental conjugation, and transduction of markers between bacteria.
Practice 2 (2h). Processes of mutagenesis and recombination to obtain new strains
Basic processes for the interchange of bacterial genetic material will be applied, such as experiments to obtain spontaneous mutants, directed mutagenesis, or the integration and / or replacement of genetic material by recombination.
Practice 3 (3h). Use of mobile genetic elements to obtain mutants
Methodologies based on the use of mobile genetic elements for bacterial genetic manipulation will be used. The types of transposition events and their frequency of movement will also be described.
Practice 4 (2h). Control of gene expression in prokaryotes
Tools for quantifying bacterial gene expression will be applied, and these methodologies will be used to study regulated promoters by identifying the mechanisms controlling their gene expression.
Practical 5 (2h): Use of cell lines to study bacterial pathogenicity
An assay using mouse cell lines will be performed to evaluate the effect of a bacterial infection on cell survival. This session will also introduce work in a biosafety level 2 cabinet (BSL-2).

Bioreactors

The practices are organized in 4 sessions of 3 h.

Practice 1 (3h) + Practice 2 (3h). Continuous Stirred Tank Reactor (RCTA)

The operation and the main characteristics of an RCTA type bioreactor are learned. The kinetics of growth of a yeast strain are determined. The stimulus-response techniques are used to determine the distribution of the residence time of the bioreactor, and analyze its hydrodynamic behavior, in particular the mixing characteristics. All this knowledge is included in the equations for the design of RCTA-type bioreactors.

Practice 3 (3h) + Practice 4 (3h). Air-lift reactor.

The operating bases of an Air-lift bioreactor are learned, as well as the different elements involved in its design. The experimental techniques to determine the coefficient of oxygen transfer between a gasphase and a liquid, $k_L a$ are used. The influence of the operating conditions of the bioreactor on the properties of gas-liquid transfrence is studied.

The methodology is analyzed to determine the oxygen consumption of a yeast culture.

Numerical Methods and Computer Applications

They are organized in 5 sessions of two and a half hours that are done in the computer room.

Practice 1 (2.5h) Introduction.

The objective is that the student becomes familiar with the programming environment that will be used in these practices. You will see the basic instructions and instructions for the programming of algorithms.

Practice 2 (2.5h) Errors.

The purpose of this practice is to know the limitations of numerical errors. We will see how to detect and control different sources of error in the scientific calculation.

Practice 3 (2.5h) Function Zeros.

In this practice, different numerical methods will be implemented for the calculation of zeros of functions. Its applicability will be studied in different cases.

Practice 4 (2.5h) Integration.

In this practice, polynomial interpolation algorithms will be developed and different numerical methods will be implemented to evaluate defined integrals.

Practice 5 (2.5h) Differential equations.

The objective of this practice is to implement some basic numerical resolution methods for simple cases. You will also see how to use software routines based on more advanced methods.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory session	54.5	2.18	
Type: Autonomous			
Reading protocols	6.5	0.26	

The attendance to the classes of this subject is obligatory since they imply an acquisition of competences based on the practical work.

Animal Physiology, Molecular Microbiology and Bioreactors:

The students carry out the experimental work in groups of 2 and under the supervision of the responsible professor.
The practical protocols and, if applicable, the questionnaires for response, will be available on the Virtual Campus of the subject
Before beginning a practical session the student must have read the protocol and know therefore the objectives of the practice, the foundations and the procedures that must be carried out.
If so, you must know the specific safety and waste treatment measures.
When completing the practice of the module of Bioreactors, the students will have to work with the obtained data and present the corresponding reports.

In the practical sessions you must have:
- Protocol and, if applicable, the questionnaire.
- A notebook to collect the information of the experimental work.
- Laboratory baton.
- Safety glasses.
- Permanent marker

Numerical Methods and Computer Applications:

Practical classes in the computer rooms of the faculty.
The students will carry out the proposed work in the practice script under the supervision and direction of the responsible professor. In each session the student will complete a questionnaire on the different problems resolved in practice.
The practical scripts will be available on the Virtual Campus of the subject.
Before beginning a practical session the student must have read the script and know therefore the objectives of the practice and the foundations of the numerical methods that he will have to use.

In the practical sessions you must have:
- The script of the practice.

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
Animal physiology: Continuous evaluation	2.5	0	0	CM24, KM22, SM22
Bioreactors report	1.11	11	0.44	CM22, CM24
Continuous evaluation Bioreactors	1.11	0	0	CM22, CM24
Continuous evaluation Molecular Microbiology	0,67	0	0	CM24, SM20, SM21
Exam Numeric Methods and Computer Applications	1.89	1	0.04	KM23
Questionnaire Molecular Microbiology	1.55	1	0.04	CM24, SM20
Questionnaire Numerical Methods and Computer Applications	0.33	1	0.04	

A) Continuous assessment by modules

Attendance at practical sessions is mandatory. Students will receive a "Not assessable" grade if their absence exceeds 20% of the scheduled sessions.

Each module will be assessed independently, following the criteria described below.

The final grade of the course will be calculated as the weighted average of the assessments of each module.

Students who do not obtain the minimum required grade of 4 in any of the modules of the integrated laboratory will not pass the course. In this case, the maximum final grade will be a 4.

Since the Integrated Laboratory is structured by modules, from the second enrollment onwards, repeat students will only need to be assessed on the modules not previously passed. This exemption will be valid for three additional enrollments, and students must participate in a number of assessment activities that allow them, at most, to obtain a passing grade.

Students requesting the validation of a module and whose request is approved by the subject and module coordinators will receive a grade of 5 for the validated module.

Animal Physiology

Assessment will be conducted individually and will be based on questionnaires and/or reports for each of the four practical sessions, following the professor's instructions.

Each practical will contribute 25% to the final grade of the module, for a total of 100%.

All questionnaires and reports must be submitted within the deadlines set by the teaching staff. Unjustified delays will result in grade penalties.

Molecular Microbiology

Two components will be considered in the assessment of this module:

- On the one hand, the grade obtained in a final questionnaire to be completed at the end of session 5, which will assess the content of all practical sessions.
- On the other hand, the achievement of the objectives of each practical session, as well as participation and laboratory performance, will also be evaluated.

The questionnaire will account for 70% of the final grade of the module, while the remaining 30% will correspond to continuous assessment based on participation and results.

Passing the final questionnaire (minimum grade of 5 out of 10) is a prerequisite for calculating the average module grade.

Bioreactors

Several components will be assessed:

- Laboratory work quality and technique (20%)
- Quality of experimental data obtained (10%)
- Practical report writing (50%)
- Assigned questions and problem-solving (10%)

Reports must be submitted by the specified deadline, which will be communicated at the beginning of the laboratory. Unjustified late submissions will result in a grade penalty.

Numerical Methods and Computer Applications

This module will be assessed through a final individual exam (70% of the final grade) and questionnaires to be submitted at the end of each session (30%).

In the final exam, students will solve problems similar to those covered during the practical sessions.

B) Reassessment

As this is a highly practical course, assessment activities are not recoverable, except in exceptional cases duly justified according to Faculty regulations, in which the student was unable to participate in the evaluation.

C) Review of grades

For each assessment activity, a date, time, and place for grade review will be announced. During this session, students may review the activity with the instructor.
Complaints regarding grades may be submitted and will be evaluated by the course coordinator.
If the student does not attend the review session, no later review will be accepted.

D) Final grades

Honours Distinction (MH): The award of an Honours Distinction is at the discretion of the course coordinator. According to UAB regulations, it may only be granted to students with a final grade of 9.00 or higher. Up to 5% of enrolled students may receive this distinction.

Students who take the resit exam (fully or partially) are not eligible for Honours.

A student will be considered Not assessable (NA) if they do not complete assessment activities that account for at least two-thirds of the total course grade.

E) Student misconduct: plagiarism and cheating

Without prejudice to other disciplinary measures, any irregularity committed by the student that may affect the grade of an assessment activity will be graded with a zero.

Therefore, plagiarism, cheating, copying, or allowing others to copy in any assessment activity will result in a failing grade of zero.

These activities cannot be resat.
If they are required to pass the course, the student will fail the course with no opportunity to recover it during the same academic year.

F) Single assessment

This course/module does not offer a single-assessment option.

Bibliography

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Software

Animal Phisyology

MS Office, BSL-Biopac Student Lab, BrainExplorer, vassarstats.net.

Molecular Microbiology

It does not apply

Bioreactors

Microsoft excel

Numerical Methods

Matlab/Octave

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	421	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	422	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	423	Catalan/Spanish	second semester	morning-mixed

(PLAB) Practical laboratories	424	Catalan/Spanish	second semester	morning-mixed