Universitat Autònoma de Barcelona

2023/2024

Integrated Laboratory Class 4

Code: 100925
ECTS Credits: 3

Degree	Type	Year	Semester
2500253 Biotechnology	OB	2	2

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

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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

- Molecular Microbiology

- Bioreactors

- Numerical Methods and Computer Applications.

These modules are grouped into two blocks:

1- Animal Physiology and the molecular biology of microoorganisms.

2- Fundamentals for the design of bioreactors and development of bioprocesses: The aim is to acquire basic knowledge in the design, operation and characterization of the main types of bioreactors, and the approach and resolution of the mathematical equations derived from them.

Competences

- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Describe the principles behind the design and functioning of bioreactors and calculate, interpret and rationalise the main parameters in transport phenomena and the matter and energy balances in bioindustrial processes.
- Interpret experimental results and identify consistent and inconsistent elements.
- Lead and manage teams, and develop capacities for organisation and planning
- Make decisions.
- Search for, obtain and interpret information from the principal databases on biology, bibliography and patents and use basic bioinformatic tools.
- Think in an integrated manner and approach problems from different perspectives.
- Use ICT for communication, information searching, data processing and calculations.
- Use analytical methodologies for assaying the biological activity of cellular components, especially enzymes, both in vitro and in vivo.
- Use the fundamental principles of mathematics, physics and chemistry to understand, develop and evaluate a biotechnological process.
- Work individually and in teams

Learning Outcomes

1. Apply the different waste disposal processes correctly.
2. Apply the general safety rules in place in a a biotechnology laboratory.
3. Characterise the physiology of the different organs and the different metabolic states of an organism .
4. Extract complementary information from databases to support the analysis of results and the writing of reports on experiments.
5. Interpret experimental results and identify consistent and inconsistent elements.
6. Lead and manage teams, and develop capacities for organisation and planning
7. Make decisions.
8. Obtain significant experimental data to calculate transport phenomena and balances of matter and energy.
9. Think in an integrated manner and approach problems from different perspectives.
10. Use ICT for communication, information searching, data processing and calculations.
11. Use the basic techniques for studying biomolecules in a chemistry laboratory.
12. Work individually and in teams

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 mutagenesis used for the genetic modification of prokaryotes, and the mechanisms that allow the study of gene expression and its regulation in bacteria. All these contents will be grouped into the 4 practices that are listed below.

Practice 1 (4h) 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 (4h). 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 type ofjumps of these elements will be described, as well as their frequency of movement.

Practice 4 (2h). Control of gene expression in prokaryotes

The tools for the quantification of the bacterial gene expression will be applied, and these methodologies will be used to study regulated promoters as well as toidentify the mechanisms that control their gene expression.

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.

Methodology

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory session	54.5	2.18	1, 10, 2, 4, 5, 6, 8, 9, 7, 12, 11
Type: Autonomous			
Reading protocols	6.5	0.26	10, 4, 5, 6, 9, 7, 12

Assessment

Attendance at practical sessions is mandatory. The students will obtain the "Non-Avaluable" qualification when the absence exceeds 20% of the programmed sessions.

Students who do not obtain the minimum qualification of 4, required to be able to pass each one of the modules of the integrated laboratory, will not pass the subject. In this case, the final maximum grade of the subject will be 4.

Due to the fact that the Integrated Laboratory is differentiated in modules, from the second enrollment, repeat students will only have to evaluate the specific modules that have not been exceeded. This exemption will be

maintained for a period of three additional tuition fees, participating in a number of assessment activities that can not be granted, at best, the qualification of approved.

The evaluation of each module will be carried out independently, following the criteria detailed below.

The final evaluation of the subject will be obtained from the average assessment of the different modules (33.34%, 22.22%, 22.22%, 22.22%).

Animal Physiology

The assessment will consist of two parts:

1.- Evaluation of group work: The group must submit a report on one of the practices carried out, in a format that is comparable to that of a scientific paper, in accordance with the guide that will be provided by the responsible professor. Contribution to the mark of the module: 50%. Skills: E3, E16, T1, T2, T5, T11, T12

2.- Individual/in pairs assessment: Each student must submit the reduced version of a report on different aspects of the practices carried out, according to the teacher's instructions. Contribution to the mark of the module: 50%. Skills: E3, T1, T2, T5, T11, T12

Molecular Microbiology
Two different aspects will be taken into account, on the one hand, the mark obtained in a questionnaire that will be done at the end of the session 5 and which will refer to all the practices that make up this module, and on the other, the achievement of the Targets set in each of the programmed practices. The questionnaire will represent 70% of the final grade of the module while the remaining 30% will depend on the evaluation of the results obtained and the experimental work performed.

Bioreactors
Several different aspects will be taken into account, the quality of the work in the laboratory (20%), the experimental data obtained (10%), questions and problems proposed (20%) and the preparation of the report of the practices (50%). The reports must be submitted before a specific date, which will be announced at the beginning of the laboratory. The delay not justified in the presentation of the reports will imply a punishment in the punctuation of the same.

Numerical Methods and Computer Applications
This module will be evaluated by means of an individual examination at the end of the semester, which will mean 70% of the final mark, and the questionnaires that must be submitted at the end of each practice and which will represent the remaining 30%. In the final exam thestudent will have to solve someproblems similar to those that have been dealt with in the practices.

This subject/module does not include the single evaluation system.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Animal Physiology:Individual evaluation	1.0	0	0	10, 3, 5, 7
Animal physiology: Individual evaluation	1.5	0	0	1, 2, 3, 5, 6, 9, 7, 12
Bioreactors report	1.11	11	0.44	10, 4, 5, 8, 9, 7, 12

Continuous evaluation Bioreactors	1.11	0	0	1, 10, 2, 5, 6, 8, 9, 7, 12, 11
Continuous evaluation Molecular Microbiology	0,67	0	0	1, 2, 5, 7, 12
Exam Numeric Methods and Computer Applications	1.89	1	0.04	10, 5, 9, 7, 12
Questionnaire Molecular Microbiology	1.55	1	0.04	5
Questionnaire Numerical Methods and Computer Applications	0.33	1	0.04	10, 5, 9, 7, 12

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Software

Animal Phisyology

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

Molecular Microbiology

It does not apply

Bioreactors

It does not apply

Numerical Methods

Matlab/Octave