UAB
Universitat Autònoma de Barcelona

Instrumental Techniques

Code: 101966
ECTS Credits: 6

2025/2026

Degree	Type	Year
Genetics	FB	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

There are no official prerequisites, but it is assumed that the student has previously acquired enough solid knowledge on the following subjects to follow this subject correctly:

- Basic concepts of Biochemistry, specially the physico-chemical characteristics of macromolecules
- Use basic computer tools and applications (Internet, office automation package) at user level.
- Good comprehension of English written publications and textbooks.

Objectives and Contextualisation

In this subject, instrumental foundations that are required to carry out genetic research will be taught. There are two distinct topics that will be treated as two independent modules: the computer tools to manage genetic data (Module of programming principles) and the methods and experimental techniques for the manipulation of biomolecules (Module Techniques in biochemistry).

MODULE I: PROGRAMMING PRINCIPLES

Nowadays, research in genetics and genomics is carried out with huge amounts of data from DNA sequences. In order to process this information, researchers must know and use computer tools. How is this information stored? How can we extract information in a flexible way? How can we obtain new information from it? Knowing the programming principles is fundamental to allow researchers to create programs to manage and analyze the genetic data.

The goal of this module is to explain the theoretical and practical principles of computer science, placing special emphasis on programming. Python will be learnt, the most popular programming language among

bioinformaticians. It is versatile, ease to learn and it was designed to manage sequences. R will be introduced, too. Theoretical classes will be complemented with the corresponding module from "Laboratori Integrat IV".

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
-Apply these techniques in the field of genetics
-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 interestinthe technical aspect of science.

Competences

- Be able to analyse and synthesise.
- Describe and identify the structural and functional characteristics of nucleic acids and proteins including their different organisational levels.
- Design experiments and interpret the results.
- Develop self-directed learning.
- Know and understand the underlying chemical basics of the molecular properties of genetic and biological processes in general.
- Know, apply and interpret the basic procedures of mathematical calculation, statistical analysis and IT, the use of which is indispensable in genetics and genomics.
- Reason critically.
- Recognise and structurally and functionally describe the different levels of biological organisation, from macromolecules to ecosystems.
- Understand and describe the structure, morphology and dynamics of the eukaryotic chromosome during the cell cycle and meiosis.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in one's own languages and in English.

Learning Outcomes

1. Be able to analyse and synthesise.
2. Describe electronic microscopy techniques applied to nucleic acids.
3. Describe the basic techniques for the analysis, purification and characterisation of biomolecules.
4. Design experiments and interpret the results.
5. Develop self-directed learning.
6. Explain the basics of databases and computer programming and develop applications.
7. Reason critically.
8. Recognise the basic theory and apply the suitable techniques for the structural and functional characterisation of proteins and nucleic acids.
9. Resolve problems with techniques and methods.
10. Resolve problems with the physical and chemical functions and properties of biomolecules.
11. Use and manage bibliographic information or computer or Internet resources in the field of study, in one's own languages and in English.

Content

Module I: PROGRAMMING PRINCIPLES

Unit 1. Introduction to the use of computer tools to the study of genetics.

Unit 2. Programming. Basic concepts of programmation. The importance of knowing how to program. Programming languages.

Unit 3. Programming with Python I. Why Python?: characteristics, installation and programming tools. Programming strategis. How a program works.

Unit 4. Programming with Python II. Variables and data structures. Basic operations. Input and Output. Reading and writing files.

Unit 5. Programming with Python III. Flow control: conditional instructions, operators and loops.

Unit 6. Programming with Python IV. Regular expressions: pattern matching.

Unit 7. Programming with Python V. Creating functions. Scripts and arguments. Introduction to BioPython.

Unit 8. Programming with R.

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. Centrifugación techniques.

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

Unit 4: Purification Strategiesof 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 Electrophoresis: SDS-PAGE, Two-dimensional gel electrophoresis, native electrophoresis. Nucleicacidelectrophoresis: native, denaturing, pulsating field, thermal gradient, electroelution.

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. RT PCR and Real time PCR.

Unit 8: Recombinant DNA Technology.

Unit 9: Immunological techniques. Preparation of monoclonal and polyclonal antibodies. Antigen-antibody reaction.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Seminars and problem classes	11	0.44	5, 4, 6, 7, 9, 1, 11

Theory classes	34	1.36	2, 3, 5, 4, 6, 7, 8, 9, 10, 1, 11
Type: Supervised			
Group and individual tutoring	6	0.24	2, 3, 5, 4, 6, 7, 8, 9, 10, 1, 11
Prepartion of materials	1	0.04	5, 4, 7, 1, 11
Type: Autonomous			
Bibliographic research	5	0.2	5, 7, 11
Problem resolution	34	1.36	5, 4, 6, 7, 1, 11
Study	40	1.6	7, 1, 11
Text readings	7	0.28	5, 7, 11
Work redaction	6	0.24	5, 4, 7, 1, 11

The teaching methodology includes theory classes, problems, seminars and tutorial sessions.

Module I: PROGRAMMING FUNDAMENTALS

Theoretical classes (14 hours): Classes to convey the basic concepts and information necessary to develop autonomous learning. Encouragement of active student participation by asking reciprocal questions. Support for presentations with multimedia material (PowerPoint presentations, program execution) that will be available to students on the Virtual Campus.

Self-learning problems and applications (7 seminars): Resolution and discussion of problems previously worked on independently by students (the problems are presented by the teacher or are found on the Virtual Campus). The teacher proposes to work on a problem or situation that the students must solve with the conceptual resources they have. Small groups of 30 people.

Tutorials: Discussion and resolution of doubts/problems by the teacher. They will be done individually or in small groups to be agreed between the students and the teacher. It is recommended to do at least one group tutorial before each exam, to resolve any doubts.

Module II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

Theory Classes: There will be master classes (20 hours). Through this system, the basic concepts of the syllabus will be introduced. An attempt will be made, whenever possible, to use audiovisual and interactive material that helps in understanding the concepts.

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

The students will work in groups and independently on the articles selected by the teacher based on specific questions formulated by the teacher himself about the figures and tables of these articles. There will be face-to-face seminar sessions to discuss and orally debate the articles worked on. These sessions aim to facilitate dialogue between teachers and students, helping to understand the concepts acquired in the master classes

Tutorials: Discussion and resolution of doubts/problems by the teachers. They will be done individually or in small groups to be agreed between the students and the teachers. It is recommended to do at least one group tutorial before each of the exams, to resolve doubts.

Use of Artificial Intelligence

For this subject, the use of Artificial Intelligence (AI) technologies is permitted exclusively in support tasks, such as bibliographic or information searches, explanation of concepts, codes and methodologies and as a tool for improving the understanding of the topics covered in the subject. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity. The use of artificial intelligence to carry out any of the assessable activities is completely prohibited. The use of artificial intelligence will be penalized and may lead to greater sanctions in serious cases.

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
Midterm exam module 1	35	2	0.08	5, 4, 6, 7, 9, 1, 11
Midterm exam module 2	42.5%	2	0.08	2, 3, 5, 4, 7, 8, 9, 10, 1, 11
Seminars and work deliveries at the CV module 1	15%	0	0	5, 4, 6, 7, 1, 11
Seminars and work deliveries at the CV module 2	7.5%	2	0.08	3, 5, 4, 7, 1, 11

CONTINUOUS ASSESSMENT

The competences of this subject will be evaluated through continuous assessment, which includes two mid-term exams, a final exam to recover or improve the mark, resolution of problems and the participation within the class.

Module I: PROGRAMMING PRINCIPLES

1. Theory (70% of module)

A written test at the end of this module. It will consist of theoretical questions, relation of concepts, applied questions and resolution of problems.

2. Seminars (30% of module)

Active participation in the resolution of exercises and the delivery of problems account for 30% of the final grade of this module. In the case of repeaters, the seminar note for previous courses is not saved.

Theory and seminars notes cannot be to be promised if the mark of the written theory test is not equal or superior to 5, therefore the students who do not pass it (note <5) will have to appear to the examination of recovery .

Theory requires a minimum grade of 5 points (out of 10) in order to add the seminar grade for the final module grade. Final module grade requires a minimum grade of 5 points (out of 10) in order to pass the module. If any grade is below 5, the student should do the reassessment test.

Module II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

1. Theory (85% of module)

A written test at the end of the module. It will consist of three parts: short questions relating and defining concepts, questions based on the interpretation and explanation of a methodology and a block of multiple-choice questions.

2. Seminars (15% of module)

There will be an individual written test with the content of the seminar sessions where the articles for examination will have been discussed and debated. The final grade for this block of seminars will be obtained from the grade obtainedin the individual test and from the participation in each of the groups in the seminar sessionsor by carrying out the tasks oriented by the teacher.

Theory requires a minimum grade of 5 points (out of 10) in order to add the seminar grade for the final module grade. Final module grade requires a minimum grade of 5 points (out of 10) in order to pass the module. If any grade is below 5, the student should do the reassessment test.

For both modules

In order to participate in the retake process, students must have been previously evaluated in a set of activities the weight of which is equivalent to a minimum of two thirds of the final score of the course or module. Therefore, students will obtain the grade of "Not evaluable" when the assessment activities carried out is less than 67% in the final score.

Reassessment test: It will be held on the same day for both modules for those who have not passed each of the partial tests with a mark equal to or higher than 5. The recovery of each of the modules is independent, only the module that has not been passed must be recovered.

The reassessment test only allows to recover the percentage of the midterm exam that has not been passed. The grades corresponding to the seminar activities and work deliveries, due to their characteristics, cannot be recovered.

The theory mark obtained in the recovery test and the seminar mark may be averaged as long as the written test mark is equal to or greater than 4.

Likewise, those who wish to improve their marks may opt for a final exam. Students who apply to improve their marks renounces the previous marks obtained in the mid-term exams. It is not possible to improveamark by means of work or other types of activities. The difficulty level of this thest will correspond to its objective and, therefore, may be higher than the midterm exams. In any case, the new grade obtained cannot be used to obtain "honors".

SINGLE ASSESSMENT

The competences of this subject may be assessed by means of a single assessment. The single assessment consists of a synthesis test consisting of theoretical questions, concept-related questions, applied questions, problem solving and a block of multiple-choice questions.

The mark obtained will be 80% of the mark for the subject. The test will differentiate the contents of the two modules into two independent marks (40% for each module in the final mark).

The single assessment test shall be held on the same date as the date fixed in the timetable for the last partial assessment test.

The evaluation of seminars will be done by handing in problems and/or a written test. These evidences can be handed in on the same day that the synthesis test is scheduled. The mark obtained will be 20% of the course mark. This evaluation will differentiate the contents of the two modules into independent marks (10% for each module in the final mark).

Final recovery test. It will be held on the same day for both modules together with those who follow the continuous assessment. The test will be taken by those who have not passed any of the modules (synthesis

test mark + seminar mark <5). The recovery of each of the modules is independent, only the module that has not been passed must be recovered. Only the grade of the synthesis test can be recovered.

GENERAL CONSIDERATIONS ON THE EVALUATION:

In order to pass the course, it is necessary to obtain a final mark equal to or higher than 5 for each of the modules. The final mark is the arithmetical average between both modules as long as the mark for each module is equal to or higher than 5.

The revision of the written tests will take place on an agreed date and at an agreed place.

Repeaters (second enrolment students) who have passed one of the modules (passed with a mark equal to or higher than 5) only need to be assessed for the module they have NOT passed.

Bibliography

Module I: PROGRAMMING PRINCIPLES

• Mitchell L Model. Bioinformatics Programming Using Python. O'Reilly. 2009.

• Allan Reese, R. Modern Statistics for Modern Biology. Cambridge university press. 2018

Module II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

• Creighton, T.E., The biophysical chemistry of nucleic acids & proteins, Helvetian Press, 2010

• Metzemberg, S., Working with DNA, Ed, Taylord & Francis Group. California, 2007

• Sheehan, D.,Physical biochemistry : principles and applications 2nd ed. Chichester: John Wilwy & Sons, 2009

• García-Segura, JL Técnicas Instrumentales de Análisis en Bioquímica. Editorial Síntesis. Madrid. 1999

• White BA PCR Protocols. Current Methods and Applications. Humana Press. 1993

Software

Module I: PROGRAMMING PRINCIPLES

- Anaconda and Python
  https://www.anaconda.com/products/distribution
  It will be used during the classes and for homework deliveries
- R studio https://www.rstudio.com/products/rstudio/
- R https://cran.r-project.org/

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

(PAUL) Classroom practices	621	Catalan/Spanish	second semester	morning-mixed
(PAUL) Classroom practices	622	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	62	Catalan/Spanish	second semester	afternoon