

Degree programme	Type	Course
Advanced Biotechnology	OP	1

Contact lecturer

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Prerequisites

The requirements for the Master's degree. The classes will be mostly in Catalan, but they will also be taught in Spanish depending on the faculty. Classes could be conducted in English if requested by the students with sufficient advance notice, and if there is consensus within the student group and with the professor.

Group languages

You can consult this information at the [end](#) of the document.

Objectives

Upon completion of the module, the student will be able to:

1. Plan experiments for the identification, expression, purification, and functional characterization of biomolecules.
2. Analyze the structure and function of proteins using bioinformatics techniques.
3. Relate structural and functional changes in biomolecules to pathologies.
4. Select and apply methodologies for the design of enzyme inhibitors.
5. Identify and characterize enzyme inhibitors as drugs.
6. Utilize enzymatic technology for biomedical and biotechnological applications.
7. Recognize biomolecules associated with human pathologies and use them as therapeutic targets.
8. Associate specific diseases with the accumulation of misfolded proteins.
9. Understand the molecular basis of diseases caused by dynamic mutations and epigenetic changes.
10. Assess the functional role of membrane lipids and their involvement in specific pathologies.
11. Familiarize themselves with the main techniques and facilities in a reference clinical biochemistry laboratory.

Competencies

Advanced Biotechnology

Apply techniques for modifying living organisms or parts thereof to improve pharmaceutical and

biotechnological processes and products, or to develop new products. (Specialization in Molecular and Therapeutic Biotechnology)

Ability to synthesize, analyze alternatives, and engage in critical debate.

Integrate the content of metabolic pathways in living organisms under normal, pathological, or exogenously modified conditions (Specialization in Molecular and Therapeutic Biotechnology).

Apply acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.

Effectively communicate their conclusions, as well as the knowledge and ultimate reasons underlying them, to specialized and non-specialized audiences in a clear and unambiguous manner.

Possess learning skills that enable them to continue studying, largely through self-directed and autonomous work.

Possess knowledge that provides the foundation or opportunity for originality in the development or application of ideas, often in a research context. Utilize and responsibly manage bibliographic information and computer resources related to biotechnology.

Biochemistry, Molecular Biology, and Biomedicine

Analyze research results to obtain new biotechnological or biomedical products and transfer them to society.

Analyze and accurately interpret the molecular mechanisms operating in living organisms and identify their applications.

Apply techniques for modifying living organisms or parts thereof to improve pharmaceutical and biotechnological processes and products, or to develop new products.

Develop critical reasoning within the field of study and in relation to the scientific or business environment. Identify and utilize bioinformatic tools to solve problems related to biochemistry, molecular biology, and biomedicine.

Integrate content in biochemistry, molecular biology, biotechnology, and biomedicine from a molecular perspective.

Apply acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.

Effectively communicate their conclusions, as well as the knowledge and ultimate reasons underlying them, to specialized and non-specialized audiences in a clear and unambiguous manner.

Possess learning skills that enable them to continue studying, largely through self-directed and autonomous work.

Possess knowledge that provides the foundation or opportunity for originality in the development or application of ideas, often in a research context.

Utilize and manage bibliographic information and computer resources related to biochemistry, molecular biology, or biomedicine. Utilize scientific terminology to argue research results and effectively communicate them orally and in writing.

Learning outcomes

- CA08 (Transfer knowledge of advanced processes and methodologies to the study of biomolecules relevant to biomedicine in order to obtain new biotechnological or biomedical products for transfer to society, taking into account potential sources of sex/gender-based inequalities.) Transfer knowledge of

advanced processes and methodologies to the study of biomolecules relevant to biomedicine in order to obtain new biotechnological or biomedical products for transfer to society, taking into account potential sources of sex/gender-based inequalities.

- CA09 (Work both individually and as a team to address current problems and challenges of society in the fields of biochemistry, molecular biology and biomedicine while demonstrating ethical responsibility and respect for fundamental rights and duties, diversity and democratic values, in accordance with the Sustainable Development Goals.) Work both individually and as a team to address current problems and challenges of society in the fields of biochemistry, molecular biology and biomedicine while demonstrating ethical responsibility and respect for fundamental rights and duties, diversity and democratic values, in accordance with the Sustainable Development Goals.
- KA09 (Identify the molecular mechanisms of key biological functions and those related to the onset of diseases.) Identify the molecular mechanisms of key biological functions and those related to the onset of diseases.
- KA10 (Identify biomolecules whose function/dysfunction intervenes in human pathologies.) Identify biomolecules whose function/dysfunction intervenes in human pathologies.
- KA11 (Provide advanced methodologies for the functional study of biomolecules, both in normal and pathological conditions.) Provide advanced methodologies for the functional study of biomolecules, both in normal and pathological conditions.
- SA07 (Relate the molecular mechanisms of relevant functions responsible for diseases.) Relate the molecular mechanisms of relevant functions responsible for diseases.
- SA08 (Use methodologies, including bioinformatics, to analyse enzyme active sites and drug design.) Use methodologies, including bioinformatics, to analyse enzyme active sites and drug design.
- SA09 (Propose the molecular mechanisms of relevant functions in biomedicine.) Propose the molecular mechanisms of relevant functions in biomedicine.

Contents

Block 1: Identification, acquisition, and purification of biomolecules. Functional characterization.

Practical concepts for protein purification.

Methods for identifying substrates or potential inhibitors, and detecting enzymatic activity.

Practical considerations for enzymatic assays. Applied aspects of enzyme kinetics.

Identification of functional regions of enzymes using bioinformatics tools. Practical session in the computer lab.

Structural and functional analysis of enzyme inhibitors that act as drugs. Practical session in the computer lab.

Drug repositioning: Identification and development of new uses for existing drugs.

Block 2: Enzymes associated with human pathologies. Diagnostic and therapeutic applications.

Enzymes of retinoid metabolism. Associated pathologies.

Urea cycle disorders. Biochemical and computational approaches to evaluate the cause of the pathology.

Enzymes that modify chromatin and their role in human pathologies.

Enzyme replacement therapy. Enzyme activators. Pharmacoperones or pharmacological chaperones. Therapeutic applications.

Enzymes and nanomedicine. Enzyme encapsulation. Controlled drug release. Role of infectious proteins in degenerative diseases.

Strategies for treating lysosomal diseases: enzyme, cell, and gene therapy. Proteases and protease inhibitors. Biomedical applications and strong binding kinetics.

Yeast as a model organism. Three applications in biomolecule characterization: protein-lipid interactions, protein-protein interactions, and genetic interactions.

Block 3: Conformational diseases.

Proteostasis and conformational diseases.

Prions and related diseases.

Therapies in development for conformational diseases: Introduction to conformational diseases. Light chain amyloidosis. Alzheimer's disease.

Block 4: Membrane lipids in Biomedicine.

Role of lipids in various functions and dysfunctions of biomembranes: dynamics of lipid microdomains (lipid

rafts, etc.); endocytosis and exocytosis; oxidative stress; apoptosis. Study techniques.

Block 5: Visits to the Clinical Laboratories Service at the Consorci Corporatiu Sanitari Parc Taulí (Sabadell).

Visit to the genetics, biochemistry, immunology, microbiology, and hematology laboratories.

Block 6: In silico strategies for pharmacological identification.

Identification of pharmacophores against a specific protein involved in antibiotic resistance.

In silico screening through molecular docking.

Molecular dynamics and affinity energy calculations between molecules.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Theory classes	38	1.52	CA08, KA09, KA10, SA07, SA09
Visit to clinical laboratories	4	0.16	KA10, SA08, SA09
Independent work of the student	77	3.08	CA09, KA09, SA07, SA08
Practical activities in the computer classroom	8	0.32	CA08, CA09, KA10, SA08
Oral presentation	5	0.2	CA08, KA11, SA08
Preparation and presentation of an individual work	10	0.4	CA09, KA10, SA09

The module consists of theoretical classes, computer lab practical classes, a visit to a reference Clinical Biochemistry laboratory, and a seminar presentation by the student. The organization and teaching methodology for these educational activities are described below.

Theory classes:

The content of the theory program will be primarily delivered by professors in the form of lectures with audiovisual support. The presentations used by the professor in class will be made available beforehand on the Virtual Campus of the subject. It is recommended that students have access to this material as a support

for their classes. It is advised that students regularly consult the recommended books listed in the Bibliography section of this teaching guide to consolidate and clarify, if necessary, the content explained in class. It is also advisable for students to use the links provided in the presentations of different topics, which contain videos and animations related to the processes explained in class.

Computer lab practical classes:

Students will be directly called to the classroom for the development of the session. The work will be individual, and it will be important for the student to have prior knowledge of the software to be used.

Visit to a reference Clinical Biochemistry laboratory:

The session will take place at the Clinical Analysis Laboratory of the Parc Taulí Hospital in Sabadell, where the student will receive explanations about the functioning of all the facilities and the methodologies used by healthcare professionals. After the visit, a multiple-choice knowledge test will be conducted.

Seminar presentation:

Each student will be required to give a seminar presentation.

The student will prepare a seminar on a topic agreed upon with a tutor professor and will present it publicly in class using audiovisual means.

Preparation tutorials for the seminar:

There will be a group tutorial session led by the module coordinator to distribute the seminar topics and propose the general organization of the material to be presented. Students may also have individual tutorials with professors directly involved in the chosen topic to guide them in the preparation of the material.

Note: 15 minutes of a class, within the schedule established by the institution/program, will be reserved for students to complete evaluation surveys of the faculty's performance and evaluation of the subject/module.

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Continuous assessment	30%	30	1.2	CA09, KA09, KA10, SA07, SA08, SA09
Presentation of a seminar	20%	5	0.2	CA08, KA09, KA10, SA07, SA09
Theory exams	40%	10	0.4	CA08, KA09, KA10, SA07, SA09
Attendance and active class participation	10%	38	1.52	CA09, KA11, SA08, SA09

- Attendance and active participation in class:

Bibliography

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Software

Pymol vs 2.5

Autodock Vina

Gromacs

VMD (Visual Molecular Dynamics)

<https://www.uniprot.org/> (online database)

<https://www.rcsb.org/> (online database)

<https://www.ebi.ac.uk/Tools/msa/clustalo/> (online tool)

<https://swissmodel.expasy.org/> (online tool)

<https://www.ebi.ac.uk/pdbe/emdb/empiar/> (online database)

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE