COURSE DATA

DATA SUBJECT

Code: 33197
Name: Biotechnological acquisition of industrial and health-related products
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Optability	ELECTIVES

COORDINATION

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SUMMARY

The subject covers the fundamentals and applications of industrial and healthcare biotechnology, focusing on the identification, development and production of biomolecules and bioproducts of interest using living organisms and their derivatives. It examines biodiversity as a source of new compounds and biotechnological processes, as well as the use of animals, plants, microorganisms and viruses in the production of products with industrial, energy, pharmaceutical and medical applications.

The programme covers the sustainable production of biofuels, amino acids, biopolymers and enzymes, analysing both the biological processes involved and strategies for improving strains and proteins. It also explores in depth the development of innovative therapies based on enzymes, nucleic acids and aptamers, as well as the production of antimicrobials, vaccines and monoclonal antibodies for the prevention and treatment of diseases.

Finally, the programme examines the emerging applications of nanobiotechnology and nanosystems in medicine, highlighting their potential in diagnostics, targeted drug delivery and new therapeutic strategies. All of this is approached from a perspective of innovation, sustainability and the transfer of biotechnology to the manufacturing and healthcare sectors.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Among the most important previous courses required for understanding OBPIIS are Genetics, Microbiology, Biochemistry, Metabolism and Regulation, Molecular Biology, Molecular Genetics and Cell Biology, and the course contained in the module Instrumental Methods in Biotechnology and in the module Biochemical Engineering, taught in 1st and 2nd and 3rd year).

COMPETENCES / LEARNING OUTCOMES

1102 -

Be able to convey ideas, problems and solutions in the field of biotechnology.

Capacidad de interpretar datos relevantes.

Conocer los diferentes tipos de procesos biotecnológicos asociados a la producción industrial.

Develop skills to undertake further study.

Have abilities for teamwork and cooperation in multidisciplinary teams.

Have abilities to disseminate and participate in the social debate on aspects related to biotechnology and its use.

Have an integrated view of the R&D&I process from the discovery of new basic knowledge to the development of particular applications of that knowledge and the introduction of new biotechnological products into the market.

Poseer y comprender los conocimientos en Biotecnología.

Ser capaz de evaluar las aplicaciones biotecnológicas de los microorganismos.

The ability to apply this knowledge in the professional world.

1111 - Grado en Biotecnología

Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

DESCRIPTION OF CONTENTS

1. Biodiversity and bio prospecting

Biological diversity as a reservoir of new products. Screening of organisms and activities of interest. Tools for searching for compounds of interest. Current status and prospects for industrial and healthcare biotechnology.

2. Living organisms of interest and applications.

Animals. Plants and cell cultures. Microorganisms: filamentous fungi, algae, yeast, prokaryotes, viruses. Concepts of biorefinery and the circular economy. Types of mutants useful in industry.

3. Biofuel from plants and microorganisms

Climate change and fossil fuels. Types of fuels by origin. Bioethanol, substrates, metabolic pathways involved, and organisms used. Plant and microbial biodiesel. Other biofuels: biogas, methane, and hydrogen.

4. Production of amino acids and derivatives

Commercial uses of amino acids. Global market. Processes for obtaining amino acids. Types of strains used for amino acid overproduction. Production of L-glutamic acid with altered permeability mutants. Production of L-lysine: chemical, microbiological, and mixed processes for its production. Industrial applications of D-amino acids and their derivatives.

5. Biopolymers from plants, algae and microbes

Uses of the polymers. Polymers from plants, algae and microorganisms. Rheological properties of the polysaccharides. Advantages of microbial compared to plants polysaccharides. Microbial synthesis of homo and hetero polysaccharides. Poly-hydroxyalkanoates: raw material for biodegradable plastics. Poly-hydroxyalkanoate production in bacteria and plants.

6. Production of enzymes for industrial, pharmaceutical/cosmetic and analytical use

Origins of the enzyme industry. Global enzyme market. Selection and development of enzyme-producing strains. Protein improvement: objectives and techniques. Recombinant versus non-recombinant proteins. Major industrial enzymes and applications. Enzymes of pharmaceutical and cosmetic interest. Major analytical enzymes for diagnostics and molecular biology.

7. Therapeutic enzymes and new therapies based on nucleic acids and aptamers

Therapeutic applications of enzymes. Enzymes used for the treatment of blood clotting problems. Enzymes used for the treatment of cancer. Enzymes used for the treatment of diseases/symptoms related to enzyme/protein deficiencies or malfunctions. Enzymes used for wound cleansing and healing. Enzymes used for the treatment of digestive problems. New therapies based on nucleic acids and aptamers.

8. Antimicrobials against infectious diseases

Antibiotics, antimicrobial peptides, and enzybiotics. Objectives of antibiotic research. Methods for

improving antibiotic production. Antibiotic resistance. Antimicrobial peptides and enzybiotics (peptide-glucan hydrolases).

9. Vaccines and monoclonal antibodies

Polyclonal (PCA) and monoclonal antibodies (MCA) Preparation of MCA and phage display tracking. Therapeutic applications of MCA. Traditional and recombinant vaccines. Vaccine production technologies (traditional, recombinant, nucleic acid and toxoid). Cancer vaccines: limitations

10. Applications of nanosystems in medicine

Definition of nanosystems. Nanomaterials and nanobiotechnologies. Applications.

11. Laboratory work 1: Attainment of mutants of *Penicillium chrysogenum* overproducing penicillin

The objective of this experiment is to employ the mutation in order to improve a micro-organism from the original strain. In this case the improvement is focused on obtaining penicillin overproducing mutants from an industrial strain of the fungus Penicillium chrysogenum. This lab work seeks to demonstrate that the mutation is a random technique producing also less efficient producers of penicillin, or other kind of mutants. Other objectives of this la work are to inform students about bioassays and methods for quantifying penicillin obtained in broth cultures.

12. Laboratory work 2: Production of dextran by *Leuconostoc mesenteroides*

The objective of this experiment is to demonstrate the production of the polysaccharide dextran by the bacterium *Leuconostoc mesenteroides* CECT 394. The dextran is used for the manufacture of artificial blood plasma, and in food processing. Labl work objectives are: a) demonstrate that dextran production requires the presence of sucrose in the culture medium as a carbon source, b) establish the dextran recovering procedure from liquid medium, c) to quantify the dextran produced by measuring the viscosity and d) calculate the yields.

13. Practical 3: Obtaining citric acid by the fungus *Aspergillus carbonarius*

The objectives of this practical are: to demonstrate the production of this acid by *A. carbonarius*, to show that the cultivation conditions influence the yield, to show the methodology to recover this acid and to quantify the production, to show the calculation of yields.

14. Laboratory work 4: Searching for microorganisms with hydrolytic enzymes

The purpose of this lab is to show a procedure to reveal extracellular enzyme activities in microorganisms isolated from natural habitat, such as a soil.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	38,00
Laboratory	20,00
Classroom practices	2,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	90,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

Theoretical content

The basic theoretical content of the module will be delivered by the lecturer through a series of lectures. Attendance at these sessions is optional for students, although regular attendance is recommended. During the lectures, the lecturer will invite students to express their opinions or strategies regarding some of the aspects covered in the topic. To respond, students will need only the knowledge they have acquired

in previous years or what they have heard in the media or in their daily lives. There will be no specific mark for this, and the aim is to encourage student participation through personal contributions to the topic being discussed.

Practical content

The practical sessions will take place over 5 weeks, with one 4-hour session per week in the laboratory. Attendance is compulsory for at least 80 per cent of the practical hours.

Students will take part in these sessions in groups of 2 to 4 people, depending on the practical activity. Each group will produce its own results, which they will record each week on worksheets provided by the lecturer via the Virtual Classroom; these must be completed by each student on a weekly basis. The lecturer will review the results obtained by the students each week. The lecturer will monitor and assess the development of skills during each practical session, as well as collate the results from all students and organise a discussion of these in a final session; during this discussion, students will be invited to draw conclusions based on the results they have obtained themselves, taking into account all the issues that may have arisen during the practical sessions (handling errors, inconsistent results, etc.)

It is recommended that students spend between 1 and 1.5 hours per week processing the results obtained in the laboratory and completing the worksheets.

Visits

Prior to the visits, students are required to familiarise themselves with the proposed visit so that they can prepare questions for the staff who will be hosting them during the visit. Participation in this activity is voluntary.

Should this activity not be possible for various reasons, it will be replaced by a descriptive assignment on biotechnology companies in the Valencian Community, using the Bioval website (https://www.bioval.org/socios/). Working in groups of 2–3, students will choose a company belonging to this association and explain: its objectives, field of application, social significance (identifying target customers), the product or service it offers, the number of employees, and whether it is a public or private organisation. They will present their findings in 5–10-minute presentations supported by 5–7 slides. Another option for this alternative activity is to explore recent patents in biotechnology. These activities are compulsory.

Individual tutorials

Students are recommended to attend at least 3 hours of tutorials per year to clarify any doubts and discuss other issues relating to the module.

Group tutorials

For each group (P1 and P2), a 2-hour session will be held in the classroom on the dates and at the times specified in the course calendar. The aim of these sessions is to facilitate a debate on topics related to the course that are controversial in certain sectors of society, such as whether or not to use vaccines, the use of homeopathic medicines, etc. The discussion will be based on scientific evidence, which students must prepare in advance. Students will be assessed on the submission of their views to the lecturer prior to the session and on their participation in the discussion.

Group tutorials are compulsory.

Independent study

It is recommended that students dedicate at least 2 hours per week to study, in order to consolidate their knowledge and prepare for the exam.

EVALUATION

EVALUATION60 points out of 100, with a minimum of 30 points, obtained through the corresponding final examination. The exam may consist of short questions, multiple-choice questions, a combination of both types of questions, or oral. In order to pass the course, the theory exam must be graded with a score equal to or higher than 5. Class attendance: optional.PRACTICAL SKILLS: 30 points out of 100, with a minimum of 20 points to pass this block.Attendance (10%), recording of skills and attitudes by direct observation (25%) and exam (65%) will be assessed. The exam will include multiple-choice or short-answer questions, and a problem requiring numerical calculations. In order to pass the course, the practical exam must be graded with a score equal to or higher than 5.Compulsory attendance: failure to attend more than 1 session of the total of 5 laboratory sessions will disqualify the student from taking the exam.VISITS: 5 points out of 100. Attendance (80%) and questions to company staff (20%) will be assessed. Attendance is optional.If the visit cannot be carried out, it will be replaced by the activity "Prospecting on Biotechnology in the Valencian Community", which will be compulsory. In this case, the score for this activity will be 7 points out of 100. GROUP TUTORSHIPS: 5 points out of 100 if the visit to the company takes place. If the visit is replaced by the activity "Prospecting on Biotechnology in the Valencian Community", the score will be 3 points out of 100. Once the Theory or Practical components indicated above have been passed, the mark obtained in the

first examination session (January) will be retained until the second examination session (June/July) of that academic year, but not in subsequent academic years. Therefore, students may sit the theory exam, the practical exam or both in June/July, depending on the results obtained in January. The assessment criteria are the same for both the first and second examination sessions; field trips and group tutorials cannot be retaken.

Students repeating the course who have completed the minimum required number of practical sessions in the immediately preceding academic year may, if they so choose, opt not to attend face-to-face classes in the laboratory, but they must sit the practical examination.

REFERENCES

Core texts: those marked with * cover most of the syllabus

*Biotechnology: The Technological Applications of Genetics and Genomics. Clark D.P., Pazdernik N.J., McGehee M.R., Rader B.A. 2025. Academic Press. This is the best textbook for linking molecular biology to real-world biotechnological applications. It covers biological diversity and bioprospecting, organisms of industrial interest, genetic engineering, recombinant proteins, monoclonal antibodies, recombinant vaccines and nucleic acid-based therapies.

*Industrial Biotechnology: Products and Processes. W. Soetaert, E. Vandamme (Eds.) 2010. Wiley. Covers biorefineries, the circular economy, bioethanol, biodiesel, biogas, amino acid production, microbial polysaccharides, polyhydroxyalkanoates, industrial enzymes and high value-added products.

Janeway's Immunobiology. K. Murphy, C. Weaver (Eds.) 2022. Covers antibodies, monoclonal antibodies, vaccines, the immune response, immunotherapy, anti-tumour agents and the molecular basis of RNA vaccines.

*Principles of Fermentation Technology. Authors: Stanbury P. F., Whitaker A., Hall S.J. 4th ed. 2026. Elsevier. This is the standard reference work in industrial biotechnology. It covers the selection of industrial microorganisms, the production of amino acids, the production of enzymes, the production of antibiotics, industrial scale-up, bioreactors, and the optimisation of strains and fermentation processes.

The Nanobiotechnology Handbook. Y. Xie (Ed.) 2012. The book highlights the importance of nanobiotechnology for a wide range of medical applications, such as stem cell technology and tissue engineering, drug development and delivery, diagnostic imaging, diagnosis and therapeutic treatments.

Supplementary

Review articles provided by the lecturer on each topic.