

**COURSE DATA****DATA SUBJECT****Code:** 33197**Name:** Biotechnological acquisition of industrial and health-related products**Cycle:** Undergraduate Studies**ECTS Credits:** 6**Academic year:** 2025-26**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**

PARDO CUBILLOS M ISABEL

**SUMMARY**

The contents of this subject is placed into a scenario in which molecular advances occur rapidly allowing to glimpse a vast horizon for organism uses. The chemical industries have been revolutionized by the almost infinite possibilities of organisms, particularly those of microbial nature, to synthesize almost any organic compound and, in many cases, with lower energy and cost than those produced by chemical synthesis. From the biomedical point of view, many of the existing infectious diseases can be prevented with the use of modern vaccines or treated with antibiotics produced by microorganisms. Cancer is a disease of significant concern to society. Currently, various strategies using enzymes, monoclonal antibodies, and nanoparticles are known to help combat it.

Similarly, plants traditionally used to solve health problems, are still used today to solve problems of our own current lifestyle, as well as cell factories for synthesizing metabolites and proteins.

A major achievement in the treatment of numerous human physiological problems was the possibility of using microorganisms for the production of human proteins in sufficient quantity to be applied to the population in inexpensive, safe and widespread way.



The aim, therefore, is the student knows what organisms are capable of synthesizing products of industrial or sanitary importance, evaluating the benefits of organic synthesis compared to chemical synthesis and understanding that the latter benefits from the discoveries of the former, obtaining the same products at a lower cost and with a lesser environmental impact. It is also intended that the student knows how the biotechnological production of human proteins and pharmacologically active substances has become accessible to most of the developed societies allowing clinical treatments unthinkable just 50 years.

## 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

-

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

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

Capacidad de interpretar datos relevantes.

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

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

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

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.

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

Ser capaz de evaluar las aplicaciones biotecnológicas de los microorganismos.

The ability to apply this knowledge in the professional world.

## 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 lab 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. Lab 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
<b>Total hours</b>	<b>60,00</b>

### 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
<b>Total hours</b>	<b>90,00</b>

## TEACHING METHODOLOGY

**Lectures**

Lectures of the course will be taught by the teacher using the lecture. Attendance at these sessions is optional for the student although regular attendance is recommended. During development of the class, the teacher will invite students to express their opinions or strategies about some of the aspects dealt with in the subject. To answer, the students do not require more than the knowledge gained in previous years or what they heard in the media or in everyday life. Responses will not have specific marks and the aims of the questions posed for the teacher is to involve students through personal contributions on the topic being addressed.

**Laboratory works**

Lab works will be runned over 5 weeks: one 4 hours session a week in the laboratory. Attendance is considered mandatory, at least 80% of practical hours.

Students will participate in groups of 2 to 4 people depending of the lab practice. Each student will have to collect its results each week in some worksheets that the teacher will provide through Virtual Classroom. Results compiled will be monitored weekly by the teacher. The teacher will monitor and correct the acquisition of skills in each practical session and compile the students and organize a discussion in a final session. The teacher will invite students to draw conclusions from the their own results, taking into account every problems occurred along their activities (handling errors, inconsistency of results, etc...).

It is recommended that students spend 1 to 2 hours a week to process the results obtained in the laboratory and fill out the worksheets.

**Visits**

Prior the visits acquisition of information about the visit is required in order to prepare questions to address to enterprise staff responsible for conducting the visit. This activity is not compulsory.

If this activity cannot be carried out for various reasons, it will be replaced by a prospective research work carried out by students on "Prospecting for Biotechnology at the Comunitat Valenciana" based on the Bioval website. Students in groups of 2-3 people will choose a company belonging to this association and will explain: its objectives, field of application, its social importance (identification of target customers), product / service they offer, number of workers, public / private nature of it. They will present their results in 10-minute expositions using 2 slides. Another option for this substitute activity is the exploration of recent patents in biotechnology. This activity is compulsory.



### **Individual tutorships**

It is recommended the student's attendance of, at least, 3 hours of tutorials for resolving doubts or other issues related to the subject.

### **Group tutorships**

For each group (P1 and P2) a 2-hour session will be held in the classroom, on the dates and times marked in the subject calendar. The aim of these sessions is to engage in a debate on topics related to the subject and which are controversial in some social sectors, such as the application or not of vaccines, the use of homeopathic medicines, etc. The discussion will be based on the use of scientific evidence that students should prepare in advance.

This activity is mandatory.

### **Individual learning**

We recommend a commitment of at least 2 hours per week of study, to establish knowledge and prepare for the exam.

## **EVALUATION**

### **EVALUATION**

60 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 or a combination of both types of questions. 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 surpassed Theoretical and Practical work above the minimum threshold, marks obtained will be kept until the second round (July) if any of the other parties were not surpassed in June. There will be, therefore, exams for evaluating separately theoretical and practical knowledges in July.

The second enrollment students (repeaters) having made the minimum number of laboratory sessions in the preceding year have not obligation to attend lab, but they must do an exam for evaluating their acquired practical skills.

## REFERENCES

- Manual of industrial Microbiology and Biotechnology. 2010. 3th ed. Baltz R.H., Davies J.E. Demain A.L. (Eds. In chief). ASM Press (accessible online Recursos Bibliotecas UV)
- Microbial Biotechnology: fundamentals of applied Microbiology. Nikaido H. & Glazer A. N. 2007. 2nd Edition. Cambridge University Press.
- Molecular Biotechnology. Principles and applications of recombinant DNA. Glick B. R., Patten C. L.. 2017. 5th edition. ASM Press (accessible online Recursos Bibliotecas UV)
- Biotechnology for beginners. 2016. Rennenberg R.; Berkling V. and Loroch V. Academic Press. (accessible on line Biblioteca Ciencias)
- Proteins. Biochemistry and Biotechnology. 2015. Walsh, G.. Wiley (accessible online Recursos Bibliotecas UV)
- Biopharmaceuticals. Biochemistry and Biotechnology. 2004. Walsh, G. Wiley. (accessible online en Recursos Bibliotecas UV)
  
- Basic Biotechnology. 2006. Ratledge C. & Kristiansen B., (Eds.) 3th ed. Cambridge University Press.
- Biotechnology. 2009. Smith E.S. (5th ed.). Cambridge University Press.
- Biopharmaceuticals: Biochemistry and Biotechnology. 2013. Walsh, G. 2nd. Wiley edition.
- Enzymes in human and animal Nutrition: Principles and Perspectives. 2018. Nunes C. and Kumar



- V. Academic Press (accessible online Recursos Bibliotecas UV)
- Pharmaceutical Biotechnology. Concepts and applications. 2007. Walsh, G. Wiley - Pharmaceutical Biotechnology.
  - Fundamentals and Applications 2019. 5th edition. Crommelin D. J. A.; Bernd Meibohm S. R. D. Springer (accessible online Recursos Bibliotecas UV)