Teaching guide

IDENTIFICATION DETAILS

Degree:	Biotechnology
Scope	Biology and Genetics
Faculty/School:	Experimental Sciences
Course:	INDUSTRIAL MICROBIOLOGY I
Type:	Compulsory
ECTS credits:	3
Year:	3
Code:	2049
Teaching period:	Sixth semester
Subject:	Applied Biotechnology
Module:	Biotechnological Processes and Products
Teaching type:	Classroom-based
Language:	Inglés
Total number of student study hours:	75

Teaching staff	E-mail
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SUBJECT DESCRIPTION

Industrial Microbiology focuses on obtaining microbial products for societal benefits, aligning it with applied sciences. The Industrial Microbiology course starts with a historical perspective on the utilization and domestication of microorganisms, emphasizing those significant to the biotechnology industry. It examines the potential applications of specific microorganisms and the methods to enhance industrial productivity. The course covers all facets from small-scale to large-scale microbial fermentation and explores industrial processes that produce everyday consumer goods.

This field uses microorganisms grown on a large scale to produce commercially valuable products and perform significant chemical transformations. Louis Pasteur's discovery of fermentation was a major milestone, leading to the exploration of both fermentative and non-fermentative processes that generate industrially important products, laying the groundwork for Industrial Biotechnology. Initially, fermentation processes for beer and wine production were developed, followed by processes for pharmaceuticals (antibiotics), food additives (amino acids), enzymes, and chemicals like butanol and citric acid.
Previously, microbiologists used classical genetic methods to modify microorganisms for better process efficiency and higher product yields. The advent of recombinant DNA technologies introduced new genetic manipulation techniques, allowing to produce novel microbial products not naturally synthesized by microorganisms. In Industrial Microbiology course we will focus on microorganisms of industrial interest, their characteristics, and methods to enhance their productivity. The course includes both traditional and modern genetic improvement techniques for creating genetically modified microorganisms. It also covers how to manage and adjust the parameters of microbial fermentations to ensure optimal system performance. Detailed studies of contemporary industrial fermentation processes are included and emphasized with multiscale and integrative approaches used in strain optimization to enhance microbial metabolic pathways for increased production. The primary aim is to equip students with the skills to be able to analyze results and to propose an optimisation approach based on experimental data for the best possible outcomes.
Additionally, the course addresses the intellectual properties protection alternative for the protection new microbial variants. Indeed, the course delves into the protection of intellectual property related to the creation of new microbial variants and emphasizes the importance of strains and process patent protection. It also focuses on the methods for managing and fine-tuning microbial fermentation parameters to ensure optimal system performance. The curriculum includes in-depth studies of microorganism strains optimization and production processes.
The primary goal is to equip students with the ability to analyze experimental data and optimize industrial processes to achieve the best possible results.

GOAL

The main objective of this course is for students to gain the necessary knowledge regarding the design, optimization, and control of industrial processes that utilize microorganisms. Specifically, the course will cover which microorganisms are of industrial significance, their characteristics, and the methods to boost their productivity. It also includes learning how to manage and adjust the parameters of microbial fermentations to ensure the system optimally performance, and how to enhance microbial productivity through multiscale and integrative approaches. The course's specific goal is to equip students with the skills to analyze results and propose optimization strategies based on experimental data to achieve the best possible outcomes.

The specific aims of the subject are:

- Identify and learn about the main microorganisms of interest for the biotechnological industry and its application Understand the structure and functioning of the biotechnological industry

- The course's specific goal is to equip students with the skills to analyze results and propose optimization strategies based on experimental data to achieve the best possible outcomes.

PRIOR KNOWLEDGE

Prior knowledge on Microbiology I, Microbiology II, Biochemical Engineering, Molecular Genetics and Regulation of Gene Expression, Bioreactors, Biocatalysis is essential to be able to course this subject

COURSE SYLLABUS

SECTION I. From Microbiology to Industrial Microbiology Chapter 1. Introduction and course Syllabus Chapter 2. From Industrial Microbiology to Microbial Biotechnology: the Flowchart used in Industrial Microbiology
SECTION II. Microorganisms and Products Chapter 3. Micro-organisms of Industrial Interest Chapter 4. Substrates For Microbes and Microbial Products, Culture media & substrate, Media preparation Chapter 5. Microbial Products: Primary and secondary metabolites. Chapter 6. Recombinant Microorganism Strain Design and Selection Chapter 7. Microorganism Strains Optimization 7.1. In Procaryotic strain 7.2. In Eukaryotic Strain
SECTION III. Industrial Process Chapter 8. Industrial Fermentation and Type of Fermenters Classical and single use fermenters Chapter 9: Approaches in Microbial Biotechnology Development 9.1. Multi-scale Approach from small-scale to large-scale 9.2. Integrated Approach in Microbial Biotechnology Genetic Engineering, Synthetic Biology, Systems Biology, Omics Technologies, Metabolic Engineering and Directed Evolution
Section IV. Patent in Industrial Microbiology Chapter 10: Securing intellectual property rights in the microbial and biotech sectors involves patenting innovative advancements. This legal process ensures exclusive ownership of novel microbial strains, genetic modifications, bioprocesses, and bio-based products. By obtaining patents, companies establish a competitive edge, attract investment, and drive the commercialization of innovative biotechnological discoveries.
SECTION V. Applications Of Microbial Biotechnology: Examples related to each industrial sector will be addressed throughout the preceding sections. This part focuses on:
- Pharmaceutical Industries: Production Of Human Recombinant Drug; Applications Of Microbial Biotechnology To Chemical And Energy and Applications of Microbial Biotechnology to Food industry

EDUCATION ACTIVITIES

-Participative Lecture sessions. Will be held by the corresponding teacher employing IT support. Besides, some sessions might be held by other teachers or professionals from other institutions according to their expertise in certain topics included in the subject's syllabus. To maximize the utilization of the assets of the lecture sessions, prior study of the unit (or at least a first read) is highly recommended. Students will study autonomously employing the recommended bibliography and all related material which will be available at the Virtual Classroom of the course. During lecture sessions questions about what has been explained will be formulated and doubts will be solved too.
- Activities during the course sessions: The teaching method adopted in this course is grounded in a Reflective Learning Approach, which provides students with dedicated time to process and reflect on the material presented in class. Specifically, it follows a model of Resource-Based Reflective Learning, characterized by the following key features: Emphasis on resource availability and the cultivation of critical thinking through structured reflection periods. Focus on both the provided resources and scheduled reflection time, enabling students to deepen their understanding by absorbing and internalizing course content. Use of resources as a guide to facilitate meaningful reflection on the subject matter. Integration of Interactive Reflective Learning, where students engage with the material during class sessions, followed by group reflection activities to reinforce comprehension. Recognition of reflection as a fundamental part of the learning process. To support this approach, the instructor will provide a 'Pause and Reflect' file during the semester, designed for discussion and in-class collaborative work.
-Development of Team projects work: Students will carry out a Project Based Learning (PBL) projects in groups of 3 students. The Project Based Learning is a teaching method in which students gain knowledge and skills by

working for an extended period of time to investigate and respond to an authentic and complex question, problem, or challenge. Students work on a project over an extended period of time during the semester: This work will engage them in solving a problem and answering a complex question. They have to demonstrate their knowledge and skills by creating a public presentation for a real audience. As a Result, students will develop deep content knowledge as well as critical thinking, collaboration, creativity, and communication skills. Students will work with English-written bibliography illustrating any biotechnological process or product of industrial interest, which involves microbes. Therefore, students should acquire full understanding of the research described in a scientific Patent document and checked bibliography in order to be able to propose an innovative approach. Indeed, inclusion of innovative proposal based on prior art will increase the quality of the final project.
- Tutorial sessions will be organized in coordination with the instructor, who will provide personalized guidance and support to each student based on their specific needs and areas requiring further development. The main goal of these tutorials is to maximize student performance and ensure the acquisition of the competencies associated with the course. At least one mandatory tutorial will be scheduled for the teamwork project, to take place once the group has selected a topic and defined the project objectives. During this session, the instructor will review and approve the proposed plan and advise on an appropriate timeline for its execution. Additional tutorial will be offered if needed toward the end of the project development phase to provide final guidance and feedback. Student attendance during the tutorial is mandatory.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
30 Horas	45 Horas
• * Engaged Learning: Lectures and In-Class Activities 30h	• * Working on PBL Team Projects 30h • * Homework: Maximizing Learning Outcomes Through Autonomous Pre-Study 15h

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within their field of study.

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

To be familiar with the applications of biotechnology in the healthcare, food, agrobiotechnological, environmental and chemical fields.

Capacity for teamwork and group management.

To develop an ability to search for, take in, analyze, sum up and relate information.

General Skills

To be familiar with the applications of biotechnology in the healthcare, food, agrobiotechnological, environmental and chemical fields.

Capacity for teamwork and group management.

To develop an ability to search for, take in, analyze, sum up and relate information.

Specific skills

Point out the influence and contributions of new technologies in Molecular and Cellular Biology to the pharmaceutical sector.

Develop habits of rigorous thinking

Know how to work as a team in an effective and coordinated way.

Develop criteria for problem solving and decision-making in both the professional and personal spheres.

Cultivate an attitude of intellectual concern and the search for truth in all areas of life.

LEARNING RESULTS

Students should demonstrate comprehensive knowledge and understanding of advanced concepts in their field, integrating cutting-edge research, and applying critical thinking to practical applications based on advanced textbook information.

Students can apply their academic knowledge professionally, showcasing their ability to develop, defend arguments, and solve problems within their field of study.

Students will be able to collect and interpret relevant data within their field of study to make informed judgments,

including reflections on significant social, scientific, or ethical issues.

Students will develop the ability to effectively communicate information, ideas, problems, and solutions to both specialist and non-specialist audiences.

At the completion of this course/module, students will have acquired the learning skills essential for pursuing further studies independently, demonstrating a high level of autonomy in their academic endeavors.

LEARNING APPRAISAL SYSTEM

- Learning assessment of the contents of this subject will take into account the work done by the student during the semester in the different activities.
Standard Evaluation System:
- Theoretical Exam: Will take place during the exams period. The score on this test will account for 65% of the final grade. It is compulsory to achieve at least 50% in this test to pass the course.
- Project Based Learning Project: The students have to work within a team work on a project during the semester. This activity will engage them in solving a problem or answering a complex question. They have to demonstrate their knowledge and skills by creating a public presentation for a real audience. As a Result, students develop deep content knowledge as well as critical thinking, collaboration, creativity, and communication skills. The search for literature, development and defense of the project, together with the design of the audiovisual support and/or its written report, will be graded on the basis of dedication, innovation, study and accuracy among the components of the team group. Therefore, an oral presentation of the project, along with a printed copy of the PBL project report /or the Power point presentation file, must be submitted to the Professor prior to the presentation day. Submission deadlines will be set by the Professor.
The grade for this component will account for 35% of the final course grade
- A student will be considered to have failed this component if they are absent on the day of the oral presentation of the Project-Based Learning (PBL) project, or if the project receives a grade below 50%.
In such cases, the student will be required to answer additional questions related to the PBL project during the resit (extraordinary) session. The PBL component will continue to account for 35% of the final grade
- The final grade of the course is obtained by applying the percentages previously indicated to the final marks obtained in the different modules under evaluation.

- Alternative Evaluation System for Repeating Students or those granted academic exemptions:
Eligibility: This system is available to students who are retaking the course (second attempt or beyond), or those who have been granted academic exemptions.
Students have two options:
-1. Follow the standard evaluation system, which includes class attendance and all related activities.
-2. Opt for the alternative evaluation system, with the following assessment structure:
 - Theoretical Exam: 65%
 - Written submission of the Project-Based Learning (PBL) project: 35%. The project must be submitted by the deadline set by the professor and prior to the official theoretical exam period.
Important: Students wishing to follow the alternative evaluation system must notify the Professor via email or through the virtual classroom of the course, within the first two weeks of the semester. If no notification is received, the standard evaluation system will be applied by default.
Plagiarism: Any form of plagiarism or use of unauthorized materials during the exam or assessments will be penalized in accordance with UFV University regulations.

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

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