

Degree programme	Type	Course
Microbiology	OB	3

Contact lecturer

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Prerequisites

No specific requirements are defined for this course

Group languages

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

Objectives

- Knowledge acquisition about relevant aspects related to microbial bioindustrial processes, such as mass balances, bioreactor design and its proper utilization, depending on its specific application.
- Learning about the main bioreactor types, their basic features and their main applications, for both enzymatic and microorganism based processes.
- To study the required elements to design and operate a bioreactor, such as conventional kinetic equations and design equations, the interaction between the kinetic law and the operation mode, the mixing and aeration hardware, as well as the instrumentation and basic control elements. To analyze the ideal reactor types, and from those to determine the requirements for the utilization of real reactors.
- Introduce the basic concepts of downstream processing and understand the main stages and technologies involved in the separation and purification of microbial products, with a focus on their industrial application.

Learning outcomes

- CM15 (Evaluate the role of microorganisms in processes of economic interest as producers of key compounds in the development of our societies and in the improvement of the quality of life.) Evaluate the role of microorganisms in processes of economic interest as producers of key compounds in the development of our societies and in the improvement of the quality of life.
- CM16 (Propose microbial processes to assess the environmental impact of human activity, as indicators of ecosystem alteration, as well as to recover contaminated environments.) Propose microbial processes to assess the environmental impact of human activity, as indicators of ecosystem alteration, as well as to recover contaminated environments.
- KM23 (Identify the operations and production processes involving microorganisms or their components.) Identify the operations and production processes involving microorganisms or their components.
- SM22 (Manage specific bibliography and internet tools to develop an academic work within the field of environmental or industrial microbiology both in English and in one's own language or others.) Manage specific bibliography and internet tools to develop an academic work within the field of environmental or industrial microbiology both in English and in one's own language or others.
- SM23 (Select the appropriate methodologies to characterise populations and communities of

microorganisms from environmental and industrial samples and their abiotic environment.) Select the appropriate methodologies to characterise populations and communities of microorganisms from environmental and industrial samples and their abiotic environment.

- SM24 (Analyse industrial operations and processes involving microorganisms or their components in order to contribute to their improvement and guarantee their success.) Analyse industrial operations and processes involving microorganisms or their components in order to contribute to their improvement and guarantee their success.

Contents

UNIT 1.- BIOPROCESS ENGINEERING AND MICROBIAL BIOTECHNOLOGY.

- The bioreactors in the biotechnological processes.

- *Biotechnology, basic definitions*
- *Microbial biotechnology applications*
- *Productive process and position of bioreactors*

- Enzymatic and microbial kinetic models

- *Definitions*
- *Microbial growth stoichiometry*
- *Cellular growth, substrate consumption and product obtention.*
- *Microbial growth kinetic models*
- *Effects of the physico-chemical parameters on the enzymatic activities and on the microbial growth*

- Mass and energy balances

- *Mass and energy conservation principle.*
- *Mass balances in bioreactors.*

UNIT 2.- IDEAL BIOREACTORS

- Basic bioreactor design

- *Classifying bioreactors*
- *Ideal bioreactors: continuous and batch operation.*
- *Fed-batch operation. Systems with recirculation. A series of reactors.*

UNIT 3.- REAL BIOREACTORS: OPERATION, INSTRUMENTATION AND CONTROL OF BIOREACTORS.

- Typical configurations and bioreactor elements.

- *Real bioreactors: examples*
- *Non ideal flow*
- *Advanced Bioreactors*

- Aeration

- *Oxygen transfer.*
- *Aeration and its efficiency.*
- *Determination of the $k_L a$ coefficient.*

- Mixing

- *Fermentation growth reology*
- *Shear stress effects.*
- *Mixers.*
- *Mixing and aeration.*

- Bioreactor scale-up

- Control and instrumentation:

- *Definitions*
- *Needs and incentives*
- *Elements of a control system*
- *Implementation of a control system: pH control, temperature control and dissolved oxygen*

UNIT 4.- SEPARATION AND PURIFICATION PROCESSES

- Introduction and key concepts in downstream processing

- *Objectives of downstream processing*
- *Requirements of the downstream depending on product type*
- *Purification train strategy: how to combine steps to optimize it*

- Main stages and equipment in microbial bioprocess downstream

- *Clarification*
- *Concentration*
- *Purification*
- *Drying*

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Team working	10	0.4	CM16, KM23, SM22
Workshops	1	0.04	CM16, KM23, SM22
Lectures	20	0.8	CM15, CM16, KM23, SM23, SM24
Study	38	1.52	CM15, KM23, SM23, SM24

LECTURES (20h): lectures will introduce the basic concepts of the course contents. If possible interactive audiovisual material to assist concept understanding.

WORKSHOPS (3h): From the beginning of the course, students will be organized into working groups that, throughout the semester, will carry out an in-depth study of an industrial microbial bioprocess of their choice. This project will allow students to apply the knowledge acquired in the course to a real and specific case.

- The last two sessions of the course -with mandatory attendance- will be dedicated to oral presentations of the projects to the rest of the class. Each group will present the bioprocess they have studied, giving all students the opportunity to learn about various industrial microbial bioprocesses explained by their peers.
- These seminars are part of an innovative project-based and flipped classroom learning methodology, aiming to foster teamwork, analytical and synthesis skills, as well as students' communication and critical thinking abilities.

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
Partial Test 2 (EP2, Units 3 i 4)	45%	2	0.08	CM15, CM16, KM23, SM23, SM24
Workshop about industrail microbial bioprocesses	10%	2	0.08	CM15, CM16, KM23, SM22, SM23, SM24
Partial test 1 (EP1, Units 1 and 2)	45%	2	0.08	CM15, CM16, KM23, SM23, SM24

A) Continuous assessment

- To pass the course, students must obtain a final grade equal to or higher than 5/10, based on the average of the three assessment components described below.

- The main assessment component consists of two individual written exams (referred to as Midterm Exam 1 - EP1 - and Midterm Exam 2 - EP2 - in the course calendar), which will combine open-ended questions with the application of concepts to practical cases.

- Each exam will account for 45% of the final grade.
- To pass the course, students must obtain a minimum grade of 3.5 in both exams.
- These exams are resit-eligible.

The seminar on industrial microbial bioprocesses accounts for 10% of the final grade, based on the oral

presentation and submission of the materials on the day of the presentation.

- Attendance on the day of the presentations is mandatory.
- This is a non-recoverable activity.

Students will receive a "Not assessable" (NA) grade if the total weight of the evaluation activities they completed is less than 67% of the final grade.

B) Reassessment

Students who do not pass the course (either for not reaching the minimum final grade of 5 or for obtaining less than 3.5 in one of the midterm exams) may take a resit exam for only one of the failed partial exams - never both.

- If both EP1 and EP2 grades are below 3.5, the course will be automatically failed, as both exams cannot be retaken.
- The resit exam will only cover the part of the syllabus not passed in the original assessment (EP1 or EP2).
- Students who have passed the course but wish to improve their grade in one of the two midterms may also take this resit exam. In such cases, the final grade will be the one obtained in the resit.

Students who, for justified reasons (as defined by faculty and university regulations), were unable to take EP1 or EP2 on the scheduled date will be allowed to take the corresponding resit exam on the official resit date in the calendar.

C) Review of grades

For each assessment activity, a time, date, and location will be announced for grade review, during which the student may go over the activity with the instructor.

During this session, grade-related complaints may be submitted and will be evaluated by the course instructor.

Students who do not attend the review session will not be entitled to request a later review.

D) Final grades

Honours Distinction (MH): Awarding an honours distinction is at the discretion of the course instructor. According to UAB regulations, honours may only be granted to students who have obtained a final grade equal to or greater than 9.00. Up to 5% of enrolled students may be awarded this distinction.

Students who take the resit exam (partially or fully) cannot be awarded Honours.

A student will be considered Not Assessable (NA) if they do not complete assessment activities representing at least two-thirds of the total course grade.

E) Student misconduct: copying and plagiarism

Any irregularity committed during an assessment activity (academic fraud, plagiarism, or improper use of AI, unless such use is expressly authorized in the course syllabus) that could lead to a significant variation in the grade will result in that activity being graded with a 0. If the course syllabus stipulates that passing the course requires obtaining a minimum grade on that specific assessment activity, or if several irregularities occur across assessment activities within the same course, the final grade for the course will be 0. Independently of this, a disciplinary process may be initiated against the student who commits any of these irregularities.

F) Use of AI: Restricted use

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as bibliographic or information searches, text correction or translations, assistance with coding or data analysis, and the generation of diagrams or illustrative figures for the report. Under no circumstances will the

use of AI be permitted for solving numerical problems, bioprocess engineering calculations, critical analysis of experimental results, or drafting the conclusions of reports and lab assignments. Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these tools influenced the process and final outcome of the activity. Lack of transparency regarding the use of AI in this assessable activity will be considered a breach of academic integrity and may result in a partial or total penalty on the activity's grade, or more severe sanctions in serious cases.

G) Single assessment

This course/module does not include the option for single (final-only) assessment.

Bibliography

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Gòdia, F., López, J. Ingeniería Bioquímica. Síntesis. Madrid. (1998)

Kosaric, N., Pieper, H.J., Senn, T., Vardar-Sukan, F., "The Biotechnology of Ethanol", Wiley (2001)

Levenspiel, O. "Ingeniería de las reacciones químicas", Wiley (2004)

Ollero de Castro, P.; Fernández Camacho, E. "Control e instrumentación de procesos químicos". Editorial Síntesis. (1997)

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Software

During lectures as well as for the proposed tasks the use of EXCEL is widespread.

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

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	73	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	731	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	732	Catalan	first semester	morning-mixed