UAB
Universitat Autònoma de Barcelona

Bioreactors

2026/2027

Code: 100961
Credits: 6

Degree programme	Type	Course
Biotechnology	OB	2

Contact lecturer

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Teaching staff

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Group languages

You can consult this information at the end of the document.

Prerequisites

To follow up this subject it is relevant to have completed previously the following topics: Mathematics, Biochemistry, Numerical Methods and Computation and Fundamentals of Bioprocess Engineering

Objectives

Bioreactors are an essential element in any biotechnological process in wiche the potentialities of a biocatalist (enzymes, cells, viruses) is exploited to obtain a product or a service. In such a context it is basic to design, buid and operate the required bioreactors for each specific application, that is dictated by the characteristics of the biocatalist (for example the reaction and cell growth kinetics) and its needs (operational conditions, culture media, oxigen supply, mixing, etc.).

The objectives of the topic are:

- To know about the main bioreactor types, their basic cjaracteristics and main applications, both for processes using enzymes and microorganisms

- To study the necessary elements to perform a bioreactor design, such as the most common kinetic equations and design equations

- To perform the analysis of ideal bioreactors and, on that basis, determine the requierements of real bioreactors.

- To analyse the most relevant factors in the oprration of a real bioreactor (mixing, esterilization, aeration), the tools for residence time distribution analysis and scale-up.

Learning outcomes

- CM20 (Propose the appropriate design of a bioreactor according to its application.) Propose the appropriate design of a bioreactor according to its application.
- CM21 (Design an industrial process taking into account ethical and sustainable development aspects.) Design an industrial process taking into account ethical and sustainable development aspects.
- KM21 (Illustrate an industrial process for obtaining products by biotechnological means from basic discovery to market introduction.) Illustrate an industrial process for obtaining products by biotechnological means from basic discovery to market introduction.
- SM18 (Apply the kinetic and enzymatic methods necessary for the operation of a bioreactor.) Apply the kinetic and enzymatic methods necessary for the operation of a bioreactor.
- SM19 (Use a bioreactor appropriately.) Use a bioreactor appropriately.

Contents

The topic consists of the following blocks:

2. Introduction: Bioprocess engineering. Aspects influencing the design of a bioreactor. Ideal and real reactors. Main tyoes of bioreactors. Basic design equations for idel reactors.

4. Enzymatic kinetics: Kinetics of reactions with a single substrate. Determination of kinetic parameters. Reactions with inhibition and multiple substrates. Variation of enzymatic activity with temperature and pH.

6. Microbial kinetics: Estequiometry and yields. Kinetics of cell growth, substrates consumption and product formation. Type of models.

8. Design of ideal bioreactors: Batch stirred tank bioreactor. Continuous stirred tank bioreactor. Continuous plug-flow bioreactor. Systems with feeding (fed-batch). Systems with recirculation. Series of reactors.

10. Design of real bioreactors: Aeration, mixing and esterilization of bioreactors. Mixing and residence time. Non-ideal flux: analysis and models. Scale-up: concepts and most used criteria.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Theory Lectures	32	1.28	
Student own work	75	3	
Practical exrecises	16	0.64	
Seminars	4	0.16	

The topic is based on:

- Theory lectures (material available in Campus Virtual)

- Practical exercises lectures (very relevant to work the exercises in anticipàtion to the lecture)

- Own work by student (important to prepare all lectures in anticipation)

- Seminars

The lecture sessions will cover the most fundamental and conceptual aspects of the course. Students will have access to the course materials in advance through the Virtual Campus.

The classroom practice sessions will focus on the more quantitative aspects of the course. Students will be provided with a collection of problems. Some of these problems will be solved during class, while the remainder will be available as additional material for independent study. This is a very important component of the course, and students are expected to prepare the problems to be covered in class in advance.

Students are expected to work consistently throughout the semester in order to achieve the intended learning outcomes. They should prepare both the lecture and problem-solving sessions beforehand to maximize their learning and performance.

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively as a study aid to help students better understand the course materials. The use of AI in the preparation of the submitted assignments (Long Problems) is not permitted. Failure to disclose the use of AI in this assessed activity will be considered a breach of academic integrity and may result in a partial or total reduction of the grade for the activity, or more severe disciplinary sanctions in serious cases.

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
Realization of two complete exercises to deliver	30%	20	0.8	CM21, SM18, SM19
Theory Examination	35%	1	0.04	CM21, KM21, SM18, SM19
Practical exrecises examination	35%	2	0.08	CM20, CM21, KM21, SM18, SM19

Evaluation will be based on four different components:

a) Two complet exercices, of higher complexity than those normally performed in the exercercice lectures, one after completion of Theme 3 and one after completion of theme 4. Weight of a 30% of the global mark of the topic.

b) One written examination of practical exercices. Weight of 35% of the global mark of the topic.

b) One written examination of theory. Weight of 35% of the global mark of the topic.

- To pass the topic a minimum mark of 5.0 should be achieved. It will be also mandatory to have a minimum mark of 4.0 in the exams of Theory and Practical exercises. The two complete practical exercises will be evaluated only one time. For students having to repeat the Course the marks of these two completed exercises will be saved and used for the evaluation of the next course. This will be valid for only one Course
- In case of failure inTheory or Practical exercises examans, the student will have the option to perform a second examination.
- To participate in the second examination, the studnt must have been evaluated of a minimu number of activities corresponding to two thirds oa the total qualification of the topic. Therefore, the student will receive the qualification of \"No avaluable\" when the activities evaluated performed have a ponderation over 67% of the total qualification.
- Appart from other potential disciplinary penalties, the student will be marked with zero in the case of irregularities such as copy, plagism, allow copying, missleading, etc.

- The students will be able to perform a SINGLE EVALUATION, corresponding to the realization of only the final examinations
- 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 change in the grade will result in that assessment being graded as 0.If the course syllabus stipulates that obtaining a minimum grade on that assessment is an essential requirement for passing the course, or if multiple irregularities occur in the assessment activities of the same course, the student's final grade for the course will be 0.In addition, disciplinary proceedings may be initiated against any student who commits any of these irregularities.

Bibliography

- Doran, P.M. "Principios de ingeniería de los bioprocesos", 1998, Editorial Acribia, Zaragoza.

- Doran, P.M. "Bioprocess engineering principles", 1995, Academic Press, London.

- Gòdia, F., López, J. "Ingeniería Bioquímica", 1998, Editorial Síntesis, Madrid.

- Van't Riet, Tramper, J. "Basic Bioreactor Design", 1991, Marcel Dekker, New York.

- Blanch, H.W., Clark, D.S. "Biochemical Engineering", 1996, Marcel Dekker, New York.

Software

A software will be used to perfoem simulations, that will be presented to the students

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	42	Catalan	second semester	afternoon
(PAUL) Classroom practices	421	Catalan	second semester	afternoon
(PAUL) Classroom practices	422	Catalan	second semester	afternoon