UAB
Universitat Autònoma de Barcelona

Bioreactors

Code: 100961
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500253 Biotechnology	OB	2

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this 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 and Contextualisation

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

1. CM20 (Competence) Propose the appropriate design of a bioreactor according to its application.
2. CM20 (Competence) Propose the appropriate design of a bioreactor according to its application.
3. CM21 (Competence) Design an industrial process taking into account ethical and sustainable development aspects.
4. KM21 (Knowledge) Illustrate an industrial process for obtaining products by biotechnological means from basic discovery to market introduction.
5. KM21 (Knowledge) Illustrate an industrial process for obtaining products through biotechnological means, from basic discovery to market introduction.
6. SM18 (Skill) Apply the kinetic and enzymatic methods necessary for the operation of a bioreactor.
7. SM19 (Skill) Use a bioreactor appropriately.
8. SM19 (Skill) Use a bioreactor appropriately.

Content

The topic consists of the following blocks:

1. Introduction: Bioprocess engineering. Aspects influencing the design of a bioreactor. Ideal and real reactors. Main tyoes of bioreactors. Basic design equations for idel reactors.
2. 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.
3. Microbial kinetics: Estequiometry and yields. Kinetics of cell growth, substrates consumption and product formation. Type of models.
4. 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.
5. 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.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical exrecises	16	0.64	
Seminars	4	0.16	
Theory Lectures	32	1.28	
Type: Autonomous			
Student own work	75	3	

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

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Practical exrecises examination	35%	2	0.08	CM20, SM18, SM19
Realization of two complete exercises to deliver	30%	20	0.8	CM20, SM18, SM19
Theory Examination	35%	1	0.04	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

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

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	421	Catalan	second semester	afternoon
(PAUL) Classroom practices	422	Catalan	second semester	afternoon
(TE) Theory	42	Catalan	second semester	afternoon