Analysis and Design of Chemical and Biological Reactors

Code: 43326
ECTS Credits: 6

2025/2026

Degree	Type	Year
Biological and Environmental Engineering	OB	1

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

Basic concepts of Chemical Engineering on: fundamentals of chemical reactors, kinetics, thermodynamics, transp

Basic concepts on bioreactor design

Objectives and Contextualisation

The main objective of the module is to perform advanced analysis and design of different types of reactors and their applications in biotechnological processes

The fundamental concepts of reactor desing and bioprocess engineering will be applied to different types of bioreactors, with special emphasis on reactors with immolibized biocatalysts, reactors in series, reactoris with membranes and photobioreactors

The module proposes to integrate kinetics, thermodynamics, transport phenomena and bioreactor design to the analysis of different type of bioreactors and their optinal operational strategies and conditions

Learning Outcomes

1. CA08 (Competence) Integrate and abridge the information obtained from the scientific literature using the appropriate channels, contrasting and critically debating different alternatives.
2. CA09 (Competence) Integrate knowledge of kinetics, thermodynamics, transport phenomena and numerical methods to analyse, design, model and optimise different types of reactors and their operating strategies.
3. CA11 (Competence) Propose the corresponding mathematical simulation to conduct sensitivity studies and explain the operational results of chemical and bioreactors.
4. CA12 (Competence) Assess the capacities of different biological reactors for their industrial application.
5. KA08 (Knowledge) Distinguish between the fundamental concepts of Chemical Engineering in the different forms of reactor design and operation, including catalytic reactors and with special emphasis on reactors with immobilised biological catalysts.
6. SA10 (Skill) Build mathematical models for steady-state and non-steady-state processes.
7. SA11 (Skill) Apply engineering concepts to the design and operation of heterogeneous, non-ideal, and catalytic reactors.
8. SA12 (Skill) Calculate and categorise the different operational methods for chemical reactors and bioreactors, including work with immobilised enzymes and cells.

Content

ANALYSIS AND DESIGN OF BIOREACTORS:
Semicontinuous reactors. Fed-bacth operation.
Continous reactors
Bioreactors with immobilized cells and enzymes
Reactors with membranes
Reactors in series
Photobioreactors

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Class Teaching	28	1.12	CA08, CA09, CA11, CA12, KA08, SA10, SA11, SA12, CA08
Self study	45	1.8	CA08, CA09, CA11, CA12, KA08, SA12, CA08
Type: Supervised			
Case studies	14	0.56	CA08, CA09, CA11, CA12, KA08, SA10, SA11, SA12, CA08
Type: Autonomous			
Study cases of advanced reactor design	40	1.6	CA08, CA09, CA11, CA12, KA08, SA10, SA11, SA12, CA08

The course methodology is based on the analysis of a family of study cases covering the design of different types of biological reactors and what are the corresponing basis of design as a function of the charateristics of the biological catalyst used (cells, metabolism, enzymes, reaction type, etc.)

For each case, the different blocs required for the reactor design will be analyzed together with the operational strategy selection (batch, fed-batch, continuous, perfusion, series, etc.) and the operational conditions for bioprocess optimization

The students will work on the study cases and will present one case to the rest of the group

Also, a more detailed design of an indusrial bioreactor will be pergormed, in groups

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
Analysis in group of an Study Case	25 %	10	0.4	CA08, CA09, CA11, CA12, KA08, SA10, SA11, SA12
Analysis of an individual Study Case	25 %	10	0.4	CA08, CA09, CA12, KA08, SA10, SA12
Written exam	50%	3	0.12	CA09, CA11, CA12, KA08, SA10, SA11, SA12

The evaluation will be based on the study case presentation assignment to each student invidually (25%), on the study case prepared in groups (25%) and a final writen examination (50%). You need to obtain a minimum of 4.0 in each of the parts and an average mark higher than 5.0 to pass the course. There will be the possibility of retaking the written exam or the required homeworks with an extra synthesis exam.

For each evaluation activity, a place, date and time of revision will be indicated. If the student does not appear in this review, this activity will not be reviewed later.

Honors (MH): Granting a grade of honor registration is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. You can grant up to 5% of MH of the total number of students enrolled.

A student will be considered non-evaluable (NA) if he/she has not been submitted to 50% of the evaluation activities

Copying, plagiarism, cheating, etc. in any of the evaluation activities will result in a fail and grade of zero.

This subject does not offert single assessment.

Bibliography

Collection of articles provided in Campus Virtual

Books:

Scott Fogler, H., "Elements of Chemical Reaction Engineering". 4th ed. (2005).

Levenspiel, O., "Chemical reaction engineering". 3rd ed. (1999).

Euzen, J-P., Trambouze, P., "Chemical reactors: from design to operation". (2004).

Mann, U. "Principle of Chemical Reactors Analysis and Design". (2011).

Missen, R., Mims, C.A., Saville, B.A. "Introduction to chemical reaction engineering and kinetics". (1998).

Blanch, H.W. and Clarlk, D.S. "Biochemical Engineering", 2nd ed. (1996)

Mandenius, C.F. "bioreactors". (2016)

Software

MS Office and MATLAB requirements

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	Catalan	annual	morning-mixed