Universitat Autònoma de Barcelona

**2019/2020**

# Analysis and Design of Chemical and Biological Reactors

Code: 43326
ECTS Credits: 6

| Degree | Type | Year | Semester |
|---|---|---|---|
| 4314579 Biological and Environmental Engineering | OB | 1 | A |

## Contact

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## Use of Languages

Principal working language: spanish (spa)

## Prerequisites

Any requirement

## Objectives and Contextualisation

The main objective of the module is to perform advanced analysis and design of different types of reactors. The fundamental concepts of Chemical Engineering will be applied to the different biological and catalytic reactors with particular emphasis on reactors with immobilized biological catalysts. The module proposes to integrate kinetics, thermodynamics, transport phenomena and numerical methods to solve the models corresponding to the reactors. Likewise, simulation studies will be conducted to understand the sensitivity of the design parameters and to understand the operation of chemical and biochemical reactors.

## Competences

- Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.
- Integrate and use chemical, environmental and biological engineering tools to design biological systems for the sustainable processing of waste and for industrial biotechnological processes.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Integrate knowledge of kinetics, thermodynamics, transport phenomena and numerical methods to analyse, design, model and optimise different types of biological reactors and their operating strategy.
- Seek out information in the scientific literature using the appropriate channels and integrate this information, showing a capacity for synthesis, analysis of alternatives and critical debate.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use IT tools to acquire further knowledge in the field of biological and environmental engineering.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Work in a multidisciplinary team

## Learning Outcomes

1. Apply engineering concepts to the design and operation of non-ideal, catalytic heterogeneous reactors.
2. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.

3. Apply the methodology to the case of bioreactors with immobilised enzymes and cells.
4. Evaluate the capacities of the different biological reactors for application in industry.
5. Evaluate, calculate and choose operating methods for reactors and bioreactors.
6. Formulate, solve and use in simulation mathematical models to predict the behaviour of reactors.
7. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
8. Seek out information in the scientific literature using the appropriate channels and integrate this information, showing a capacity for synthesis, analysis of alternatives and critical debate.
9. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
10. Use IT tools to acquire further knowledge in the field of biological and environmental engineering.
11. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
12. Work in a multidisciplinary team

## Content

1. ANALYSIS AND DESIGN of bioreactors:

Semicontinuous reactors. Fed-bacth operation. Sequential batch reactors.
Bioreactors with immobilized cells and enzymes
Reactors with membranes
Fotobioreactors

2. ADVANCED DESIGN OF CHEMICAL REACTORS

Biphasic reactors, liquid gas: bubbled columns
Biphasic reactors, solid liquid: catalytic reactors

## Methodology

The classes are structured in two modules: in a first module, the design of biological reactors will be analyzed by means of scientific publications and the fundamentals of chemical engineering. In a second module, the mathematical models will be used to design of two-phase reactors

## Activities

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Class Teaching | 38 | 1.52 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 10 |
| Self study | 45 | 1.8 | 1, 3, 2, 5, 8, 6, 7, 9, 11, 12, 10 |
| Type: Supervised | | | |
| Case studies | 15 | 0.6 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 12, 10 |
| Type: Autonomous | | | |
| Advanced reactor design | 20 | 0.8 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 10 |
| Analysis of scientific papers | 20 | 0.8 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 12, 10 |

## Assessment

The subject is divided into two well differentiated parts. You need to obtain a minimum of 4.0 in each of the parts 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.

## Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Advanced reactor design | 17.5% | 0 | 0 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 12, 10 |
| Advanced reactor design (II) | 17.5% | 0 | 0 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 10 |
| Report on a scientific paper | 35 % | 9 | 0.36 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 10 |
| Written exam | 30% | 3 | 0.12 | 1, 3, 2, 4, 5, 8, 6, 7, 9, 11, 12, 10 |

## Bibliography

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).