Universitat Autònoma de Barcelona

2020/2021

Reactors

Code: 102402
ECTS Credits: 6

Degree	Type	Year	Semester
2500897 Chemical Engineering	OB	3	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)

Some groups entirely in English: No

Some groups entirely in Catalan: No

Some groups entirely in Spanish: Yes

Prerequisites

In order to take this subject, it is recommended that you should previously have passed the subjects of Mass and Energy balances on Chemical Engineering and Chemical Kinetics.

Objectives and Contextualisation

The objective of the subject of Reactors is that the student would be able to analyze, evaluate, design and operate ideal and homogeneous chemical reactors according to certain requirements, norms or specifications.

Competences

- Analyse, evaluate, design and operate the systems or processes, equipment and installations used in chemical engineering in accordance with certain requirements, standards and specifications following the principles of sustainable development.
- Communication
- Demonstrate knowledge of the different reaction, separation and processing operations for materials, and transport and circulation of fluids involved in the industrial processes of chemical engineering.
- Develop personal work habits.
- Develop thinking habits.
- Objectively compare and select different technical options for chemical processes.
- Understand and apply the basic principles on which chemical engineering is founded, and more precisely: balances of matter, energy and thermodynamic momentum, phase equilibrium and kinetic chemical equilibrium of the physical processes of matter, energy and momentum transfer, and kinetics of chemical reactions
- Work in a team.

Learning Outcomes

1. Adapt to multidisciplinary and international surroundings.
2. Adapt to unforeseen situations.
3. Analyse and evaluate the speed of a chemical reaction.

4. Apply knowledge of kinetics and thermodynamics to chemical reactors.
5. Apply the basic flow principles to chemical reactors.
6. Apply the basic principles on which chemical reactors are based.
7. Assume social, ethical, professional and legal responsibility, if applicable, derived from professional exercise.
8. Compare the alternative operation conditions for homogenous and heterogeneous chemical reactions.
9. Critically evaluate the work done.
10. Develop a capacity for analysis, synthesis and prospection.
11. Develop critical thinking and reasoning
12. Develop independent learning strategies.
13. Develop scientific thinking.
14. Identify, manage and resolve conflicts.
15. Use English as a language of communication and as the reference in professional relations.
16. Work in complex or uncertain surroundings and with limited resources.

Content

1. MOLAR BALANCES

1.1 Reaction rate

1.2 General equation of molar balance

1.3 Batch reactors

1.4 Continuous reactors

2. ISOTHERMAL REACTORS DESIGN

2.1 Definition of conversion

2.2 Design equations for batch reactors

2.3 Design equations for continuous reactors

2.4 Application of design equations for continuous reactors

2.5 Reactors in series

2.6 Reactions in gas phase

3. DESIGN OF NON-ISOTHERMAL REACTORS AT STEADY-STATE CONDITIONS

3.1 Energy balance

3.2 Adiabatic operation

3.3 Plug-flow tubular reactor at steady-state conditions with a heat exchanger

3.4 Equilibrium conversion in adiabatic operation

3.5 Continuous stirred tank reactor with a heat exchanger

4. DESIGN OF NON-ISOTHERMAL REACTORS AT NON STEADY-STATE CONDITIONS

4.1 Energy balance at non steady-state conditions

4.2 Energy balance in a batch reactor

5. RESIDENCE TIME DISTRIBUCION (RTD) IN CHEMICAL REACTORS

5.1 General characteristics

5.2 Measurement of the RTD

5.3 Characteristics of the RTD

5.4 RTD for Ideal reactors

5.5. Diagnosis and resolution of problems

6. CATALYTIC REACTORS

6.1 Design equation of a packed bed catalytic reactor

6.2 Pressure drop in catalytic reactors

6.3 Catalyst deactivation

Methodology

Autonomous student learning: Consists of the individual work of each student and encompasses: the resolution of problems, the search for information, the reading of books, articles and cases and individual study.

Collaborative learning: It consists of carrying out group work on a part of the subject, at the teacher's suggestion.

Virtual master classes: This consists of the teacher's presentation using virtual material available on the Virtual Campus. Students will be shown the basic concepts and techniques with indications on how to complement and deepen the learning of the subject.

Virtual problems seminars: Students will solve problems related to the contents exposed in the virtual master classes. The aim is to encourage the active participation of students in these activities. Preferably, the software Teams will be used to carry out these seminars.

Virtual tutorials: Virtual meetings of small groups of students with the teacher to clarify doubts, give advice on the writing of reports, follow up group work or deal with any specific issue. Preferably, the software Teams will be used to carry out these tutorials.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Virtual master classes	15	0.6	
Virtual problems seminars	15	0.6	
Type: Supervised			
Virtual tutorials	24	0.96	
Type: Autonomous			
Autonomous student learning	70	2.8	
Collaborative learning	20	0.8	

Assessment

<u>Assessment</u>

- Process and scheduled evaluation activities

The course consists of the following evaluation activities:

Activity A, several short tests (from 2 to 4) that will be carried out and delivered virtually, 10% on the final grade.

Activity B, work on real cases of industrial reactors, 15% on the final qualification. This work will be carried out in groups and will have to be presented in written form and in English.

Activity C, synthesis test, 75% of the final grade. This exam will be done in person.

Please note that activities A and B are not recoverable.

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Programming assessment activities

The calendar of evaluation activities will be given during the first week of classes and will be made public through the Campus Vitual and the website of the Escola d'Enginyeria.

- Recovery process

75% of the final grade can be recovered in a classroom exam with theory

- Grade reviewprocedure

For each assessment activity, a review date and time will be indicated where the student will be able to review vi

- Special qualifications

Honor's registration. Granting a grade of honor's registration is the decision of the teacher responsible of the subj

- Plagiarism

Total or partial plagiarism of any of the assessment activities will automatically be awarded a "fail" (that is, zero) for the plagiarised item.

Plagiarism is copying from unidentified sources and presenting this as original work (this includes copying phrases or fragments from the internet and adding them without modification to a text which is presented as original).

Plagiarism is a serious academic offence. It is essential to respect the intellectual property of others, to identify any source uses, and to take responsibility for the originality and authenticity of all work produced.

- Assessment of repeating students

The repeating student will be evaluated with the same procedure as any other student.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Short tests	10%	2	0.08	2, 3, 4, 5, 6, 12, 11, 16
Synthesis exam	75%	4	0.16	2, 3, 4, 5, 6, 9, 8, 13, 12, 10, 11, 16
Work on real cases of industrial reactors	15%	0	0	1, 3, 6, 7, 13, 10, 14, 15

Bibliography

1) H. Scott Fogler. Elements of chemical reaction engineering 4th edition solutions

2) O. Levenspiel. Chemical Reactor Engineering.