Universitat Autònoma de Barcelona

2021/2022

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

Name: Julián Carrera Muyo

Email: Julian.Carrera@uab.cat

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.
- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Apply scientific method to systems in which chemical, physical or biological transformations are produced both on a microscopic and macroscopic scale.
- Develop personal attitude.
- 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 and identify basic concepts related with chemical engineering.
5. Apply scientific method to perform macroscopic balances of matter, energy and momentum.
6. Apply the basic flow principles to chemical reactors.
7. Apply the basic principles on which chemical reactors are based.
8. Assume social, ethical, professional and legal responsibility, if applicable, derived from professional exercise.
9. Compare the alternative operation conditions for homogenous and heterogeneous chemical reactions.
10. Critically evaluate the work done.
11. Describe and apply the fundamental concepts of biological kinetics.
12. Develop a capacity for analysis, synthesis and prospection.
13. Develop critical thinking and reasoning
14. Develop curiosity and creativity.
15. Develop independent learning strategies.
16. Develop scientific thinking.
17. Identify, analyse and resolve balances of energy in simple chemical processes.
18. Identify, analyse and resolve balances of matter in a stationary or non- stationary state, with or without a chemical reaction, in simple chemical processes.
19. Identify, manage and resolve conflicts.
20. Obtain and apply the design equations for ideal isothermal reactors.
21. Work autonomously.
22. 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.

Master classes: This consists of the teacher's presentation. Students will be shown the basic concepts and techniques with indications on how to complement and deepen the learning of the subject.

Problems seminars: Students will solve problems related to the contents exposed in the master classes. The aim is to encourage the active participation of students in these activities.

Tutorials: 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.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes	30	1.2	
Problems seminars	15	0.6	

Type: Supervised		
Tutorials	9	0.36
Type: Autonomous		
Autonomous student learning	70	2.8
Collaborative learning	20	0.8

Assessment

Assessment

- Process and scheduled evaluation activities

The course consists of the following evaluation activities:

Activity A, Reactor design test, 25% on the final grade. This exam will be done in person in November.

Activity B, Reactor design task, 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, 60% of the final grade. This exam will be done in person in January.

Please note that activitiy B is not recoverable.

-

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 vir

- 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
Reactor design task	15%	0	0	1, 2, 3, 6, 7, 4, 8, 10, 9, 11, 16, 15, 12, 14, 17, 18, 19, 20, 21, 22
Reactor design test	25%	2	0.08	3, 6, 7, 15, 13, 22
Synthesis exam	60%	4	0.16	2, 3, 5, 6, 7, 4, 9, 11, 16, 15, 12, 13, 17, 18, 20, 21, 22

Bibliography

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

2) O. Levenspiel. Chemical Reactor Engineering.

Software

MS Office

Polymath 6.0