Universidad Zaragoza

Academic Year/course: 2023/24

29926 - Reactor Design

Syllabus Information

Academic year: 2023/24
Subject: 29926 - Reactor Design
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 330 - Complementos de formación Máster/Doctorado
435 - Bachelor's Degree in Chemical Engineering
ECTS: 6.0
Year: 435 - Bachelor's Degree in Chemical Engineering: 3
330 - Complementos de formación Máster/Doctorado: XX

Semester: Second semester
Subject type: 435 - Compulsory
330 - ENG/Complementos de Formación
Module:

1. General information

The subject is oriented towards the correct choice of the type of chemical reactor for a given reaction process, its sizing, the determination of its optimal operating conditions, the prediction of its behaviour in the face of alterations in the values of the operating variables and the safety measures to be adopted towards its environment.}

These approaches and goals are aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda of United Nations (https://www.un.org/sustainabledevelopment/es/), specifically, the learning activities planned in this subject will contribute to the achievement of objective 7.3 of Goal 7, objectives 9.4 and 9.5 of Goal 9 and objectives 12.4 and 12.5 of Goal 12.

2. Learning results

- R1_Know how to select the most suitable type of chemical reactor for a specific process.
- R2_Develop models of homogeneous and heterogeneous reactors based on the balances of matter, energy and quantity of motion, as well as the type of flow and contact between phases.
- R3_Design chemical reactors by determining the most appropriate configuration and size and the sensitivity of their to a variation of operating parameters and consequently its stability, optimum operating conditions and control .
- R4_Characterize the actual flow in the reactor and consider it conveniently in the reactor design.
- R5_Select, model and design biochemical reactors.

3. Syllabus

BLOCK 1.- CONCEPTS AND FUNDAMENTALS OF DESIGN

1.- Concept, design stages and types of reactors. Design equations.

BLOCK 2.- IDEAL HOMOGENEOUS REACTORS

2.1.- Reactor type

2.- Ideal batch reactor

3.- Ideal continuous perfect mix reactor

4.- Ideal continuous tubular reactor

5.- Semi-continuous perfect mix reactor

2.2.- Choice of reactor and operating conditions

6.- Design for simple irreversible reactions

7.- Design for complex reactions

8.- Temperature regimes

BLOCK 3.- HOMOGENEOUS NON-IDEAL FLOW REACTORS

9.- Non-ideal circulation in reactors.

10.- Models for non-ideal flow

BLOCK 4.- TWO-PHASE HETEROGENEOUS REACTORS

11.- General design considerations in heterogeneous reactors

4.1.- Catalytic solid-fluid reactions

12.- Fixed-bed reactors - Pseudo-homogeneous and heterogeneous models

13.- Fluidized bed reactors. Design models

4.2.- Non-catalytic solid-fluid reactions

14.- Fixed, moving and fluidized bed reactors

BLOCK 5.- ADDITIONAL ASPECTS

15.- Specific reactors. Bioreactors.

16.- Autothermal regime

4. Academic activities

- Theoretical fundamentals class (40 hours). Exposure of theoretical contents and concepts necessary for the resolution of practical cases.
- Problem-based learning classes (20 hours). Problems and practical cases will be developed and coordinated in content with the temporal evolution of the theoretical expositions.
- Tutored work (8 hours), carrying out (individually or in groups of 2-3 students) of tasks of development, extension, documentation, resolution... of cases proposed by the teacher. They will be distributed throughout the term and will be posted on a deliverable to be assessed.
- 79 hours of personal study, spread over the term.
- 3 hours of global control test during the test period.

5. Assessment system

The global assessment composed of:

- **1. Supervised work** (**15%** of the total): Your deliverables (2-3 assignments per term) will be graded according to content, understanding of concepts and presentation (written/oral). Results R1, R2 and R5.
- **2. Problems (15%** of the total): The active and voluntary participation in the problem-based learning classes , the exposition and/or delivery of the resolution of the problems posed will be assessed. Results R3 and R4.
- **3. Final test (70%** of the total, with a minimum grade of 4.0 out of 10 to pass the subject): Written test with two parts, which assessed what has been seen in *lectures* and in *problem-based learning classes*.

Results R1 to R5.

3a) theoretical part (50%, minimum 3.5 out of 10 to be able to average): three applied questions to be solved, without the aid of reference material, in 1 hour of reference material, in 1 hour.

3b) practical part (50%, minimum 3.5 out of 10 to be able to average): two numerical resolution problems to be solved, with the help of reference material, in 2 hours.

Those who lack a grade in one or both of the blocks 1 and 2 of the assignments, their corresponding assessment percentage will be increased by the relative value of the final test.