29926 - Reactor Design

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	435 - Bachelor's Degree in Chemical Engineering
ECTS	6.0
Course	3
Period	Half-yearly
Subject Type	Compulsory
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

5.1.General methodological presentation

The learning process has been proposed to encourage continued student work and focuses on the basic theoretical aspects to be able to understand, analyze and apply that knowledge to solve real problems.

For the development of the subject, on the one hand theoretical sessions will be held with the whole group, in which the theoretical foundations of the subject will be presented in the form of lecture. These classes are complemented with problem solving-type classes of problem-based learning. In these classes the students, in smaller groups, will be tutored

by the teacher.

In parallel, during the 15 weeks of the semester, students will have to solve assignments tutored by professor and reflected in some deliverables that will be corrected and assessed work.

Finally a written exam testing will be held at the end of the class period.

5.2.Learning activities

The program offered to the student will help to achieve the expected results and includes the following activities:

Classroom activities (60 hours) , distributed as follows:

- *Face to face classes* (M1). 40 hours. In these sessions exposition and explanation of theoretical contents related to the design of chemical reactors will be conducted according to the program of the course set out in paragraph 5.3 Program.

The student will have teaching materials prepared by the teacher as well as an agenda of evolution of the subject accessible via Web (ADD Zaragoza University) to help the monitoring of the lectures.

- *Problem-based learning Classes* (M4). 20 hours. In coordination with the theoretical contents, problems and case studies related to these theoretical presentations will be developed. Students will address problems under the supervision of a tutor.

Tutored assignments (28 hours Non-contact). During the development of the course, in relation to the contents of some of the topics, students will be proposed performing work for application and extension of the concepts studied. These will be related to literature searches, development of case studies, preparation of presentations, etc... These assignments will be distributed during the course (with a total number around four to five) and will be performed individually or in small groups (2-3 students) and will be reflected in a deliverable that will be corrected and qualified.

Individual study (59 hours Non-contact) spread over the 15-week course. The ongoing work of the student will be promoted by the evenly distribution of the various learning activities throughout the semester

Assessment test (3 contact hours). Besides having a qualifying function, evaluation is also a learning tool with which the student checks the degree of understanding and assimilation of knowledge and skills achieved.

5.3.Program

The program is divided in five sections that develop basic concepts about reactor design and are the following:

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- Section 1. Fundamentals and concepts about reactor design
- Section 2. Homogeneous reactions in ideal flow reactors
- Section 3. Non ideal flow homogeneous reactors
- Section 4. Two phase heterogeneous reactors
- Section 5. Additional aspects

The sequence of the contents intends to guide the students starting with the fundamentals of design and types of reactors, after that addressing the design and the particularities of the simplest case, as will be homogeneous reactors. Once the student has become familiar with the ideal design a deviation from the ideality will be introduced; the non-ideal flow, and how to take it into account in the design will be discussed. The next block will address the design for heterogeneous systems, focusing on solid-gas processes which are the most common and trying to combine the intrinsic kinetic design of each system with the physical transfer processes. The end of the course is done with a block in which attention to a specific type of reactors will be provided such as bioreactors. Finally the aspect of thermal stability in the design and operation of reactors will be considered.

The corresponding 16 chapters of this subject are distributed as follows:

Section 1. Fundamentals and concepts about reactor design

1.-Concept, steps in the design and type of reactors. Design equations

Section 2. Homogeneous reactions in ideal flow reactors

2.1 Types of ideal reactors

2.-Batch Stirred Tank Reactor BSTR

3.-Continous Stirred Tank Reactor CSTR

4.-Plug Flow Reactor PFR

5.-Semicontinuos stirred tank reactor

2.2 Reactor selection and operating conditions

6.-Design for irreversible single reactions

7.-Design for multiple reactions

8.-Temperature regimes

Section 3. Non-ideal flow homogeneous reactors

9.-Basics of non-ideal flow

10.-Non ideal flow models

Section 4. Two-phase Heterogeneous reactors

11.-General considerations for heterogeneous reactor design

4.1 Fluid-solid catalytic reactions

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

13.-Fluidized bed reactors. Design models.

4.2 Fluid-solid non-catalytic reactions

14.-Fixed bed, circulating bed and fluidized bed reactors

Section 5. Additional aspects

15.-Specific reactors. Bioreactors

16.-Autothermal regime

5.4.Planning and scheduling

Schedule of sessions and presentation of assignments

Lectures and solving problems classes are held according to schedule established by the EINA. Furthermore each teacher will also inform about tutoring hours.

5.5.Bibliography and recomended resources

BB	1. Levenspiel, Octave. Chemical Reaction Engineering, 3ªed. John Wiley, cop. 1999
BB	2. Jesús Santamaría . [et al.], Ingeniería de reactores /. - [1ª ed.], 1ª reimp. Madrid: Síntesis, D. L. 2002
BB	3. Smith, J.M. . Chemical Engineering Kin etics / J.M. Smith . - 1st ed, Mc Graw Hill 1970,
BB	4. Fogler, H. Scott. Elements of chemical

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	reaction engineering / H. Scott Fogler . - 3 rd ed., reprinted with corrections Upper Saddle River, New Jersey : Prentice-Hall, 2000
BB	5. Charles G. Hill, Thatcher W. Root "Introduction to Chemical Engineering Kinetics and Reactor Design" John Wiley & Sons 2 nd Ed. 2014