# SUBJECT TEACHING GUIDE

## G1632 - The advanced chemical reactor engineering

## Degree in Chemical Engineering

Academic year 2020-2021

| 1. IDENTIFYING DATA | | | | | |
|---|---|---|---|---|---|
| Degree | Degree in Chemical Engineering | | | Type and Year | Optional. Year 4 |
| Faculty | School of Industrial Engineering and Telecommunications | | | | |
| Discipline | SUBJECT OPTION C: GUIDANCE IN ADVANCED CHEMICAL ENGINEERING<br>Optional Module | | | | |
| Course unit title and code | G1632 - The advanced chemical reactor engineering | | | | |
| Number of ECTS credits allocated | 6 | Term | | Semester based (1) | |
| Web | | | | | |
| Language of instruction | Spanish | English Friendly | Yes | Mode of delivery | Face-to-face |

| | |
|---|---|
| Department | DPTO. INGENIERIAS QUIMICA Y BIOMOLECULAR |
| Name of lecturer | EUGENIO DANIEL GORRI CIRELLA |
| E-mail | daniel.gorri@unican.es |
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| Other lecturers | ALFREDO ORTIZ SAINZ DE AJA |

### 3.1 LEARNING OUTCOMES

- 1. Know how to select the most suitable type of chemical reactor for a particular process.
  2. Develop models of homogeneous and heterogeneous reactors based on mass, energy and momentum balances, as well as the type of flow and contact between the phases.
  3. Be able to design chemical reactors determining the most appropriate shape and size. Determine the sensitivity to a variation of the operating parameters and therefore its stability, optimum operating conditions and control.
  4. Know how to characterize the actual flow in the reactor and conveniently consideration in its design.

## 4. OBJECTIVES

The course is aimed at choosing the right type of chemical reactor for a given reaction process, the sizing of the reactor, the determination of optimal operating conditions and their behavior when changes in the values of the operation variables ocurr.
Develop and resolve property balances, material, thermal energy and momentum in homogeneous and heterogeneous reactors.

## 6. COURSE ORGANIZATION

| | CONTENTS |
|---|---|
| 1 | BLOCK1: Review of Chemical Kinetics concepts<br>a) Homogeneous reactions.<br>b) Heterogeneous catalytic reactions. The role of mass transfer in the overall rate of the process.<br>c) Non-catalytic heterogeneous reactions.<br>d) Tools for data analysis and estimation of kinetic parameters. |
| 2 | BLOCK 2: Study of the optimal operating conditions of multiple units systems. Case studies. Cascade reactors with recycle streams. |
| 3 | BLOCK 3: Analysis and design of heterogeneous reactors<br>a) Fixed bed reactors - pseudo-homogeneous and heterogeneous models.<br>b) Fluidized bed reactors - design models.<br>c) Reactors for G-L, L-L and G-L-S reactions.<br>d) Representative case studies in the chemical and petrochemical industry |
| 4 | BLOCK 4: Reactors for process intensification. Microreactors. Membrane reactors. Hybrid systems for separation and reaction: reactive distillation. |

## 7. ASSESSMENT METHODS AND CRITERIA

| Description | Type | Final Eval. | Reassessn | % |
|---|---|---|---|---|
| Conceptual examination of the contents corresponding to weeks 1-7. Minimum score of 3.5<br>It will take place in week 8<br>Second-chance examination will be at the final exam on the scheduled dates for the ETSIIyT. | Written exam | No | Yes | 20,00 |
| It will require a portfolio that integrates each of the activities scheduled throughout the course consistent in supervised works and problems (weeks 1-7) | Work | No | Yes | 30,00 |
| Conceptual examination of the contents corresponding to weeks 8-15. Minimum score of 3.5.<br>Second-chance examination will be at the final exam on the scheduled dates for the ETSIIyT. | Written exam | No | Yes | 20,00 |
| It will require a portfolio that integrates each of the activities scheduled throughout the course consistent in supervised works and problems (weeks 8-15) | Work | No | Yes | 30,00 |
| TOTAL | | | | 100,00 |

**Observations**

Continuous evaluation is based on the realization of written tests, oral presentations and delivery of a portfolio with all tasks proposed during the teaching period of the course. To access the continuous evaluation subject, the student must have attended 80% of classes.
Students who fail the course through continuous evaluation have the option to take the final exam of the course on the dates indicated in the ETSIIyT (minimum grade 5.0)
In the case of a health alert that makes it impossible to carry out the evaluation in person, the same type and distribution of tests will be maintained with the support of telematic tools.

**Observations for part-time students**

In the event that the part-time student cannot regularly participate in teaching activities, they could undergo a single evaluation process consisting of the delivery of portfolios in the ordinary exam period (60% of the final grade) and the completion of the final test on the date established by the School (remaining 40%).

## 8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

O. Levenspiel, Ingeniería de las reacciones químicas, 3º ed., Limusa Wiley, 2004.

G. Froment, K. Bischoff, J. De Wilde, Chemical reactor analysis and design, 3º ed., John Wiley, 2011.

S. Fogler, Elementos de ingeniería de las reacciones químicas, 4ª ed., Pearson Educación, México, 2008.

C. Hill, T. Root, An introduction to chemical engineering kinetics & reactor design, 2º ed., John Wiley, 2014.

H. Rase, Chemical reactor design for process plants, Wiley, 1977.