



# Course guide

## 295562 - 295EQ132 - Advanced Catalytic Reactors

Last modified: 09/08/2024

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Optional subject).  
ERASMUS MUNDUS MASTER IN HYDROGEN SYSTEMS AND ENABLING TECHNOLOGIES (HYSET) (Syllabus 2024). (Optional subject).

**Academic year:** 2024    **ECTS Credits:** 6.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:** LLUIS SOLER TURU

**Others:** Primer quadrimestre:  
MONTSERRAT PEREZ MOYA - Grup: T1  
LLUIS SOLER TURU - Grup: T1

### PRIOR SKILLS

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### REQUIREMENTS

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Have passed the subject "Chemical and Catalytic Reaction Engineering" (Q1)

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Generical:**

CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental

CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

CGMUEQ-04. To carry out the appropriate research, undertake the design and manage the development of engineering solutions, in new or little known environments, relating creativity, originality, innovation and technology transfer

**Transversal:**

03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

### TEACHING METHODOLOGY

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Classroom. Self-study. Learning from projects and study cases



## LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of the different types of catalytic wall reactors and their operation  
Knowledge of catalyst deposition techniques  
Knowledge of the operation of structured reactors and microreactors  
Ability to design a process with catalytic wall reactors  
Knowledge of the fundamentals and operation of catalytic membrane reactors and their applications  
Knowledge of the mechanism of photocatalytic reactions and operation of photocatalysts  
Knowledge of the different types of photocatalytic reactors and their applications  
Ability to design a photocatalytic process

## STUDY LOAD

Type	Hours	Percentage
Hours large group	42,0	28.00
Self study	108,0	72.00

**Total learning time:** 150 h

## CONTENTS

### Structured reactors

**Description:**

Honeycomb catalytic reactors with ceramic and metallic substrates. Techniques of deposition of catalysts in structured reactors. Environmental applications. Microreactors: manufacturing, mass and heat transfer, advantages of "scale out" vs. "cale up". Applications in the chemical and pharmaceutical industry. Peripheral elements

**Specific objectives:**

To learn the different types of catalytic wall reactors and how to coat them with a catalyst. To understand the operation of the catalytic converters of vehicles with combustion engines. To know the advantages of microreactor technology and its applications

**Related activities:**

Design of a structured reactor or microreactor

**Full-or-part-time:** 28h 30m

Theory classes: 7h 30m

Self study : 21h

### Membrane catalytic reactors

**Description:**

Types of membrane catalytic reactors. Transport mechanisms. Sieverts' law. Catalyst distribution in membrane catalytic reactors. Influence of the operating parameters: pressure, temperature, residence time and specific area. Dynamics and controllability of membrane catalytic reactors. Energy applications

**Specific objectives:**

To understand the operation of a membrane catalytic reactor and the importance of the operating conditions in its dynamics and behavior. To know the basic control tools of the catalytic membrane reactors and their main applications

**Related activities:**

Case study of a real application

**Full-or-part-time:** 24h

Theory classes: 6h

Self study : 18h

### Photocatalysis

**Description:**

Principles of photocatalysis. Types and preparation of photocatalysts. Characterization of photocatalysts. Reaction mechanisms. Artificial photosynthesis and hydrogen production

**Specific objectives:**

To know the principles of photocatalysis and the characteristics of a photocatalyst. To understand the operation principles of photocatalysis and its application in different types of chemical processes

**Related activities:**

Search of documentation in patents and scientific literature

**Full-or-part-time:** 24h

Theory classes: 6h

Self study : 18h

### Photoreactors

**Description:**

Advanced oxidation processes. Water treatment. Study of the operating parameters: photon transfer, temperature effect, mass transfer. Design of photoreactors

**Specific objectives:**

To know the principles of applied photocatalysis and photoreactors, with emphasis on water treatment. To understand the operating parameters of photoreactors and the optimization of photocatalytic processes

**Related activities:**

Study case of a real application

**Full-or-part-time:** 13h 30m

Theory classes: 10h 30m

Self study : 3h

## GRADING SYSTEM

50% written exam and 50% exercises

## EXAMINATION RULES.

Written exams and exercises are individual

## BIBLIOGRAPHY

**Complementary:**

- Sánchez Marcano, J. G.; Tsotsis, T. T. Catalytic membranes and membrane reactors. Weinheim: Wiley-VCH, cop. 2002. ISBN 9783527302772.
- Ehrfeld, Wolfgang; Hessel, Volker; Löwe, Holger. Microreactors : new technology for modern chemistry. Weinheim [etc.]: Wiley-VCH, 2001. ISBN 3527295909.
- Ameta, Rakshit; Ameta, Suresh C. Photocatalysis : principles and applications. Boca Raton: CRC Press, [2017]. ISBN 9781482254938.
- Patrocinio, Antonio Otavio T.; Bahnemann, Detlef. Springer handbook of inorganic photochemistry [on line]. Cham, Switzerland: Springer Nature Switzerland AG, 2022 [Consultation: 16/06/2023]. Available on: [https://discovery.upc.edu/permalink/34CSUC\\_UPC/rdqucl/alma991005068333906711](https://discovery.upc.edu/permalink/34CSUC_UPC/rdqucl/alma991005068333906711). ISBN 9783030637125.



## RESOURCES

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### Other resources:

Notes from class and other documents from the Digital Campus