Course guide
295552 - 295EQ013 - Chemical and Catalytic Reaction Engineering

Last modified: 16/06/2023

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). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Soler Turu, Lluis

Others: Primer quadrimestre:
JORGE BOU SERRA - Grup: T10
AURELIO CALVET TARRAGONA - Grup: T10
FRANCISCO ESTRANY CODA - Grup: T10
LLUIS SOLER TURU - Grup: T10

PRIOR SKILLS

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REQUIREMENTS

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DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEQ-01. To apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience and practice, with critical reasoning, to establish economically viable solutions to technical problems
CEMUEQ-02. To design products, processes, systems and services of the chemical industry, as well as the optimization of others already developed, taking as a technological base the various areas of chemical engineering, including processes and transport phenomena, separation operations and engineering of chemical, nuclear, electrochemical and biochemical reactions
CEMUEQ-05. To manage and supervise all types of facilities, processes, systems and services of the different industrial areas related to chemical engineering

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

Transversal:
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
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

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

LEARNING OBJECTIVES OF THE SUBJECT

To develop the technical criteria to define a system of reactors of an industrial process based on chemical, biological, catalysis, mass and heat transfer data, material and energy flows
To obtain the training to analyze scientifically and technologically any kind of chemical or biological reactor and express the bases for its optimization and/or modification
Identify the problems and shortcomings of reactor-based chemical facilities and be able to provide engineering solutions
To reach scientific spirit to investigate new developments in the field of reactors

STUDY LOAD

Type	Hours	Percentage
Hours large group	42,0	28.00
Hours small group	12,0	8.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

Catalysis

Description:
The catalytic phenomenon. Types of catalysis: homogeneous and heterogeneous. Active centers. Langmuir theory. Industrial catalysts. Catalyst evaluation: activity, selectivity, stability and cost. Preparation of catalysts. Design strategies. Common methods of catalyst synthesis. Additives and promoters. Characterization techniques: physical properties of the support, determination and optimization of active centers. Aspects related to mass and heat transfer. Effectiveness and Thiele module. Design strategies

Specific objectives:
To obtain the scientific basis of catalysis and the catalytic systems used at industrial level. Acquire the ability to evaluate the efficiency of catalysts and be able to design and use them successfully in industrial processes

Related activities:
Design of heterogeneous catalysts

Full-or-part-time: 38h
Theory classes: 16h
Self study : 22h

Multiphase reactors

Description:
Fixed bed catalytic reactors. Fluidized and transported catalyst reactors. Reactors G / L. Multiphase reactors G/L/S (slurry, trickle bed). Multifunction reactors and process integration (catalytic distillation, membranes). Reactors with phase change. Agitation and aeration. Reactors with supercritical fluids. Reactor safety

Specific objectives:
To acquire the theoretical and practical concepts of reactors that work in different phases, extrapolating the bases of mass transfer to these units. To acquire the theoretical and practical concepts of the reactors that work with solid catalysts and be able to perform a design and dimensioning of these equipment

Related activities:
Reactor analysis

Full-or-part-time: 38h
Theory classes: 16h
Self study : 22h

Enzymatic reactors and bioreactors

Description:
Enzymatic kinetics. Inhibition. Effect of the medium and temperature. Enzymatic bioreactors: discontinuous stirred tank reactors. Continuous reactors. Enzyme immobilization: strategies and types of supports. Microbial growth: kinetics and others. Biological yields. Aerobic and anaerobic processes. Inhibition. Fermentation bioreactors: discontinuous stirred tank reactors. Continuous reactors, washing process and dilution rates. Immobilized cell systems. Transfer of O2 (OUR) and agitation. Air-lift reactors and bubble size. Scale up

Specific objectives:
Acquire the theoretical and numerical concepts of enzymatic bioreactions and their applications. Acquire the theoretical and numerical concepts of fermentations and their applications

Related activities:
Analysis of enzymatic production systems and fermentation

Full-or-part-time: 38h
Theory classes: 16h
Self study : 22h

GRADING SYSTEM

Continuous assessment (3 exams, 25% each exam) and completion and presentation of a project (25%). Without reassessment.

EXAMINATION RULES.

Written exams are individual. The project is carried out in groups of two people

BIBLIOGRAPHY

Basic:
- Darvas, Ferenc; Dormán, György; Hessel Volker; Ley, Steven V.. Flow Chemistry. 2nd edition. Berlin, [Germany]: Walter de Gruyter GmbH, 2021. ISBN 9783110693591 / 9783110693614.
- Darvas, Ferenc; Dormán, György; Hessel Volker; Ley, Steven V.. Flow Chemistry. 2nd edition. Berlin, [Germany]: Walter de Gruyter GmbH, 2021. ISBN 9783110693591 / 9783110693614.
- Froment, Gilbert F.; De Wilde, Juray; Bischoff, Kenneth B.. Chemical reactor analysis and design. 3rd ed. Hoboken, N.J: John Wiley & Sons, cop. 2011. ISBN 9780470565414.
- Campbell, Ian M. Catalysis at surfaces. London [etc.]: Chapman and Hall, 1988. ISBN 0412289709.
- Hagen, Jens. Industrial catalysis : a practical approach [on line]. 2nd ed. Weinheim: Wiley-VCH, cop. 2006 [Consultation: 13/05/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/3527607684. ISBN 9783527607686.
- Ramachandran, P. A.; Chaudhari L. Catalytic multiphase reactors. Gordon and Breach Sci. Pub., 1984.

Complementary:
- Santamaría, Jesús [etc.]. Ingeniería de reactores. Madrid: Síntesis, DL 1999. ISBN 847738665X.
- Levenspiel, Octave. Ingeniería de las reacciones químicas [on line]. 3a ed. México: Limusa Wiley, 2004 [Consultation: 23/11/2021]. Available on: http://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5758266. ISBN 9681858603.

RESOURCES

Other resources:
Notes from class and other documents from the Digital Campus