PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
SCHOOL OF ENGINEERING
DEPARTAMENT OF CHEMICAL ENGINEERING AND BIOPROCESSES
ABET COURSE SYLLABI

IIQ2113 REACTOR DESIGN

Credits and contact hours: 10 UC credits / 10 hours (3 h. Lectures; 1,5 h. Labs; 5,5 h. Independent learning experiences)

Instructor's name: César Sáez

Course coordinator's name None

Textbook:
- Sáez-Navarrete, C. Apuntes del curso Diseño de Reactores. Pontificia Universidad Católica de Chile.2006.
- Levenspiel, O. Chemical Reaction Engineering. 3ª ed., John Wiley & Sons. 1999.

Course Catalog Description:

We usually associate the concept of "reactor" with a unit of industrial scale where atomic changes or rearrangements occur between molecular "reactant" to generate molecular "products" and "subproducts" at various stages and various conditions, with energy release requirements. However, the reactors -and their biological equivalent, called bioreactors- are more common than it seems. Hidden in everyday life are presented in the form of various artifacts such as a catalytic converter, a battery, a pot or oven for cooking food; and others more sophisticated as nuclear reactors, fuel cells, or hydrogen (bio)production systems. While the course addresses the issue of reactor design from a quantitative and process-oriented focus, students must understand it as a wide concept with high impact on modern life.

The course will review the basic concepts needed to understand the functioning and operation of reactors and bioreactors, central elements of chemical and biochemical processes of various kinds. The course takes an integration of various topics that students have been revised and supplement them by specific topics, enabling them to solve problems and perform conceptual design of reaction systems with industrial and environmental applications.

Prerequisite Courses: IIQ 1112 “Chemical Process” y approved credits ≥300

Co-requisite Courses: IIQ2133 Chemical Process

Status in the Curriculum: Minimum course

Course Learning Outcomes:

1. Sizing ideal reactors, CSTR1, PFR2 in isothermal operation conditions.
2. Sizing ideal reactor systems, conversions quantification, yields and selectivities.
3. Sizing ideal reactors, CSTR1, PFR2 in non-isothermal operation

conditions.
4. Sizing non isothermal ideal reactor systems, conversions quantification, yields and selectivities.
5. Sizing isothermal and non-isothermal ideal reactors and reactors systems with recycle.
6. Sizing real reactors and quantify conversions.
7. Sizing bioreactors of various types and in various applications.
8. Dynamically modeling reactors and bioreactors systems.

Relation of Course to ABET Criteria:

a. Knowledge of mathematics, science and engineering
b. Design and conduct experiments: analyze and interpret data
c. Design a system, component, or process
d. Multidisciplinary teams
e. Identify, formulate, and solve engineering problems
f. Professional and ethical responsibility
g. Effective communication
h. Broad education necessary for global, economic, environmental and societal context
j. Knowledge of contemporary issues
k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

Unit 1: Introduction
Chemical and biochemical reactions
Reaction rate
Reaction mechanisms
Temperature effects
Unit 2: Isothermal design of ideal reactors
Batch reactors
Perfectly stirred reactors (CSTR)
Tubular reactors or piston type (PFR)
Multiple reactor configurations
Unit 3: Multiple Reactions
Series and parallel reactions
Ideal reactor design for multiple reactions
Unit 4: Non-isothermal ideals reactors design
Energy balances, isothermal flow and steady conditions
Equilibrium conversion
Non stationary operation; no adiabatic operation
Unit 5: Real Reactors
Non ideal flow patterns
Contact types
Residence time distribution (RTD) and conversions.
Unit 6: Bioreactors design
Classification and applications
Bioreactors selection
Conceptual design for batch operation, continuous and fed-batch
Bioreactors modeling and dynamic analysis.

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