

## CBEMS 110 REACTION KINETICS AND REACTOR DESIGN

(Required for ChE; Elective for MSE and ME)

- Catalog Data:** **CBEMS 110 Reaction Kinetics and Reactor Design (Credit Units: 4)**  
Introduction to quantitative analysis of chemical reactions and chemical reactor design. Reactor operations including batch, continuous stirred tank, and tubular reactor. Homogeneous and heterogeneous reactions. Prerequisites: Mathematics 3D, Chemistry 1C, CBEMS40B. (Design units: 2)
- Textbook:** Fogler, H. Scott, *Elements of Chemical Reaction Engineering*, 3<sup>rd</sup> edition, Prentice Hall, 1999.
- References:**
- Coordinator:** Nancy A. Da Silva
- Course Objectives:** To design chemical processes, a chemical engineer must understand the principles of chemical reaction kinetics and chemical reactor design. This course is an introduction to the basic concepts in these areas. The course builds on concepts from chemistry, thermodynamics, mass and energy balances, and differential equations.
- Course Outcomes:** Students will:  
Relate species' concentrations and describe rates of reaction in terms of conversion.  
Design and analyze isothermal batch reactors and flow (CSTR, PFR, PBR) reactors.  
Analyze systems of multiple reactions.  
Derive rate laws from reaction mechanisms.  
Use mass and energy balances in the design of non-isothermal flow reactors.  
Analyze surface reaction processes and design catalytic (heterogeneous) reactors.
- Prerequisites By Topic:** Chemical engineering thermodynamics, Mass and energy balances, Differential equations, Computer literacy and basic skills.
- Lecture Topics:** Rate laws and reactor mole balances  
Design of ideal isothermal reactors. (CSTR and PFR)  
Analysis of kinetic data  
Analysis of complex reaction networks  
Selectivity and optimization  
Non-elementary reaction kinetics  
Design of ideal non-isothermal flow reactors  
Surface reactions and heterogeneous reactor design  
Non-ideal reactors/residence time considerations  
Safety and Risk Aspect
- Class Schedule:** Meets for 4 hours of lecture each week for 10 weeks.

**Computer Usage:** Computer literacy and basic skills are required. MATLAB or Polymath is used to solve systems of algebraic and ordinary differential equations.

**Laboratory Projects:**

**Professional Component:** This course is designed to contribute to the students' knowledge of engineering topics and design experience. The following considerations are included in this course: economic, environmental, health and safety, manufacturability.

**Relationship to Program Outcomes:** This course relates to Program Outcomes a, c, e, j, k, l, and m as stated at: <http://undergraduate.eng.uci.edu/degreeprograms/chemical/mission>

**Design Content Description**

**Approach:** Multiple lectures on reactor design. Homework and computer problems on reactor design.

**Lectures:** Lecture and homework - 100%

**Laboratory Portion:** 0%

**Grading Criteria:**

Homework:	20%
Quizzes:	10%
Midterm exam:	35%
Final exam:	<u>35%</u>
	100%

Exams and quizzes are closed book and notes. In general, exams and quizzes cannot be made up and no late homework sets will be accepted.

**Estimated ABET Category Content:**

Mathematics and Basic Science: 0 credit units or 0%

Engineering Science: 2 credit units or 50%

Engineering Design: 2 credit units or 50%

**Prepared by:** Nancy A. Da Silva **Date:** July 2007

**CEP Approved:** Fall 2001