

Advanced Reaction Engineering - Course Syllabus

Course Number: CBE 203

Course Title: Advanced Reaction Engineering

Academic Semester: Spring **Academic Year:** 2015/ 2016
Semester Start Date: Jan 24, 2016 **Semester End Date:** May 19, 2016

Class Schedule: Mon and Wed 2:30-4pm

Classroom Number:

Instructor(s) Name(s): S. Mani Sarathy
Email: mani.sarathy@kaust.edu.sa

Teaching Assistant name:
Email:

Office Location: Al Kindi Bldg 5 Room 4336

COURSE DESCRIPTION FROM PROGRAM GUIDE

The objective of this course is to impart and to continue the rigorous study of reaction engineering. In this course, particular emphasis will be given to chemical kinetics and transport phenomena, review of elements of reaction kinetics, rate processes in heterogeneous reacting systems, design of fluid-fluid and fluid-solid reactors, scale-up and stability of chemical reactors and residence time analysis of heterogeneous chemical reactors.

COMPREHENSIVE COURSE DESCRIPTION

Advanced reaction engineering applies the basic concepts of reaction rate, stoichiometry and equilibrium to the design and analysis of chemical and biological reacting systems. The course is designed for graduate students with interests in the design and optimization of process reaction vessels in the chemicals/petrochemicals, biological/food as well as materials/minerals processing industries. The following core concepts are covered: analysis of complex industrial reaction kinetics, effect of micromixing on reactive systems, computational chemistry, non-isothermal reactor design, nonlinear analysis in reaction systems, catalytic processes, multiphase (gas-liquid-solid) reactors for single and multiple reactions, strategies for reactor optimization and case studies in industrial process reactor design and operation.

GOALS AND OBJECTIVES

The objective of this course is to help the student master several advanced ideas in chemical reaction engineering, notably:

- Complex chemical reaction mechanisms and kinetics.
- Transport effects in multiphase reactive systems.
- Advanced reactor design and stability, including consideration of the energy balance.
- Computational tools for reaction engineering

REQUIRED KNOWLEDGE

Undergraduate level chemical reaction engineering, mass transfer, and thermodynamics.

REFERENCE TEXTS

[1] H.S.A. FOGLER, Elements of Chemical Reaction Engineering, Prentice-Hall PTR, 2006.

[2] O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons Inc, 1999.

[3] C.G. Hill, An Introduction to Chemical Engineering Kinetics & Reactor Design, 1983.

METHOD OF EVALUATION

Percentages %	Graded content
(20%) (20%) (60%)	HOMEWORK, MID TERM EXAM RESEARCH PROJECT This student's performance in this course is evaluated by a combination of formative (30%) and summative (70%) evaluations. The formative evaluations assess the student's progress during the course and guide the student through the learning process. These include class participation, homework, and a written project proposal. The summative evaluations determine the student's level of understanding at the completion of specific course milestones (i.e., mid-term exam and final project).

COURSE REQUIREMENTS

Assignments

HOMEWORK: Evaluated based on assignments requiring the student to prepare a critical written review of a journal article and complete problem sets.

MID TERM EXAM: Evaluated based on a two hour written exam assessing the analytical and technical capabilities of the student to solve sustainable engineering problems.

RESEARCH PROJECT – Evaluated based on the following three components of the course research project: a written project proposal (10%), a written final project report (40%), and a final oral presentation (10%).

Course Policies

10% of the final course evaluation is based on class participation, for which a physical and intellectual presence is required. Late work will be penalized 10% for each 24 hours after the due date.

Additional Information

In accordance with the University policy and professional standards, the highest levels of academic integrity are expected in this class. The code of student conduct is strictly enforced. Academic dishonesty will result in reductions in grades and/or expulsions from this class and/or the University.

Week 1: Introduction to the course and the importance of reaction engineering

Week 2: Stoichiometry, thermodynamics of reacting systems

Week 3: Kinetics of elementary reactions, ideal reactors

Week 4: Reaction mechanism and kinetics

Week 5: Complex reaction networks and complex systems

Week 6: Computational chemistry part 1

Week 7: Computational chemistry part 2

Week 8: Midterm and intro to catalytic systems

Week 9: Catalytic systems

Week 10: Biofuel reaction engineering

Week 11: Mixing in reactors, external and internal transport

Week 12: Advanced reactor design

Week 13: Advanced reactor design

Week 14: Non-ideal reactor design

Week 15: Final oral presentations

NOTE

The instructor reserves the right to make changes to this syllabus as necessary.