جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Reaction Engineering - CBE 203

Division	Physical Science and Engineering Division
Course Number	CBE 203
Course Title	Reaction Engineering
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Mon Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Subram Maniam Sarathy	Mani.Sarathy@kaust.edu.sa	+966128084626	4222, 5, Al-Kindi (bldg. 5)	NA
Jorge Gascon Sabate	JORGE.GASCON@KAUST.EDU.SA	+966128080723	4235, 3, Ibn Sina (bldg. 3)	NA

Teaching Assistant(s)

Name	Email
NA	NA

Course Information

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, catalyst characterization, and case studies in industrial process reactor design and operation.
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.
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 -Heterogeneous catalysis

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	**40.00**% - Exam 2 **10.00**% - Homework /Assignments **40.00**% - Exam 1 **10.00**% - Attendance and Participation
Nature of the assignments	HOMEWORKS: Evaluated based on assignments requiring the student to prepare a critical written review of a journal article and complete problem sets. EXAM 1: Evaluated based on a two hour written exam assessing the analytical and technical capabilities of the student to solve reaction engineering problems. EXAM 2: Evaluated based on a two hour written exam assessing the analytical and technical capabilities of the student to solve reaction engineering problems.
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.

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 01/28/2019	Introduction to the course and the importance of reaction engineering
1	Thu 01/31/2019	Stoichiometry, thermodynamics of reacting systems
2	Mon 02/04/2019	Reaction mechanisms and kinetics modeling I
2	Thu 02/07/2019	Reaction mechanisms and kinetics modeling II
3	Mon 02/11/2019	Complex reaction networks and complex systems I
3	Thu 02/14/2019	Complex reaction networks and complex systems II
4	Mon 02/18/2019	Computational chemical kinetics I
4	Thu 02/21/2019	Computational chemical kinetics II
5	Mon 02/25/2019	Exercises
5	Thu 02/28/2019	Assignment Solutions
6	Mon 03/04/2019	Gas-liquid reactions I
6	Thu 03/07/2019	Gas-liquid reactions II
7	Mon 03/11/2019	Mixing in Reactors I
7	Thu 03/14/2019	Mixing in Reactors II
8	Mon 03/18/2019	Exam Review
8	Thu 03/21/2019	Exam 1
9	Mon 03/25/2019	Reaction vs Diffusion in Heterogeneous Catalysis - Thiele modulus
9	Thu 03/28/2019	Good practices in catalyst performance testing
10	Mon 04/01/2019	Exercises
10	Thu 04/04/2019	Heterogeneous catalyst manufacture I
11	Mon 04/08/2019	Heterogeneous catalyst manufacture II
11	Thu 04/11/2019	Textural characterization
12	Mon 04/15/2019	Chemisorption and temperature programmed techniques
12	Thu 04/18/2019	Infrared and Raman spectroscopies
13	Mon 04/22/2019	Solid state NMR in heterogeneous catalysis
13	Thu 04/25/2019	XPS and Xray diffraction
14	Mon 04/29/2019	Advanced microscopy
14	Thu 05/02/2019	Synchrotron techniques in heterogeneous catalysis
15	Mon 05/06/2019	Examples
15	Thu 05/09/2019	Assignment Solutions
16	Mon 05/13/2019	Exam Review
16	Thu 05/16/2019	Exam 2
17	Mon 05/20/2019	Final Exam Week
17	Thu 05/23/2019	Final Exam Week

Note

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