CHE611: Experimental Techniques/Instrumentation for Catalysis Research

Program and Course Code	Chemical Engineering CHE611
Course Title	Experimental Techniques/Instrumentation for Catalysis Research
Credit Hours	3
Instructor	Simo Pehkonen
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Office Hours	TBA
Bulletin Course Description	Fundamental theories of reaction rates. Determination of rate parameters using various analytical techniques such as UV-VIS, GC, GC-MS, FTIR, etc. Analysis of rate data and complex reaction networks. Analytical chemistry of catalytic reactions.
Pre-requisites	CHE503, CHE610, or equivalent
Co-requisites	
Course Objectives (Learning Outcomes of the Course)	After completing this course students will be able to: • Measure reaction kinetics using widely available analytical tools • Specify the mechanism, rate expressions, and models needed for heterogeneous reactors. • Synthesize detailed reaction networks for catalytic reactions on solid catalyst surfaces, such as zeolites and TiO2

Week	Course Topics and Contents	Readings
1	Review of homogeneous reactions	Class Notes and papers
2	Chemistry and mechanisms of homogeneous reactions	Class Notes and papers
3	Review of analytical equipment to be used	Class Notes
4	Data Analysis and Error Analysis, Lab 1 on homogeneous 2^{nd} order reaction via UV-VIS.	Class Notes
5		Class Notes
6	Homogeneous catalyst experiment, Lab 2	Class Notes
7		Class Notes
8	Reactions on solid surfaces	Class Notes
9	Catalytic chemistry I	Class Notes
10	Heterogeneous catalyst experiment, Lab 3	Class Notes
11	Heterogeneous catalysis and kinetics	Class Notes
12	Heterogeneous catalysis and kinetics II	Class Notes
13	Lab 4, energy related experiment on fuels	Class Notes
14	Theory of Phase Transfer Catalysis	Class Notes
15	Phase-Transfer Catalysis Experiment, Lab 5	Class Notes

Relationship of course objectives to program outcomes	
Program Outcome	Demonstrate appropriate depth and breadth of knowledge that is at the frontier of their disciplines
Program Outcome	Use skills of interdisciplinary scholarship and research to integrate multiple perspectives

Out-of-class assignments	
Homework	Three homework assignments based on the experiments performed in the lab.

Course Grading	
Homework	15%
Labs (and lab reports)	5x15% (five lab experiments every other week)
Class Participation	10%
Total	100 %

Class/Laboratory schedule and Methodology	
Class	The class meets 15 weeks, 1 lecture Every other week, 90 minutes each, laboratory component, 3 hours every other week.
Laboratory	
Teaching and learning methodologies	A combination of white board use, Power-point slide presentation, and interactive class discussions to encourage student participation and enhance the learning.

Course Materials	
Textbooks	None
Recommended Ref. Readings	1. B.C. Gates, J.R. Katzer and G.C.A Schuit; *Chemistry of Catalytic Processes* , McGraw-Hill (1979)
Instructional material and resources	A course website will be set at the beginning of the semester where all course necessary material will be posted including homework assignments and solutions.