CME 425 Introduction to Catalysis

Course Instructor: Prof. Taejin Kim

Website: None

Course Goals:

The production of chemicals and fuels is heavily related on catalysis in the petroleum and pharmaceutical industry: over 90% of chemicals produced rely on the use of a catalyst. This course is intended to give the student a background of the fundamentals and applications of catalyst. This course will be divided into three parts. Part 1 introduces the history of catalysis and basic reaction kinetics. Part 2 introduces the heterogeneous and homogeneous catalysis concepts. Past 3 shows the catalysts application in the industry. Topics to be covered include: 1) Historical background of catalysis 2) Introduction to catalysis 3) Physical and Chemical adsorption 4) Homogeneous catalysis 4) Heterogeneous catalysis 5) Surface characterization 6) Surface reaction mechanism 7) Industrial applications of catalyst. [3 credits]

Pre- or Corequisite(s): B- or better in CME 304; CME 312; CME314

Text(s): Julian R.H. Ross, Heterogeneous Catalysis: Fundamentals and Applications,

2011, Elsevier Publications, ISBN 978-0444533630

Gadi Rothenberg, Catalysis; Concepts and Green Applications

2008, Wiley-VCH Publications, ISBN 978-3527318247

Class/ Laboratory Schedule: Fall Semester, Lecture, Monday (10:00am–1:00 pm),

Topics Covered:

Week 1: History and concepts of catalysis

Week 2: The basic of heterogeneous catalysis, homogeneous catalysis and biocatalysis

Week 3: Kinetics and rate equations in catalysis: Reaction order: Zero, first and second

Week 4: Kinetics and rate equations in catalysis Reaction order: Zero, first and second

Week 5: Heterogeneous catalysis: catalysts and surface characterization.

Week 6: Heterogeneous catalysis: metal, metal oxide and zeolite

Week 7: Review/Make-up/ Midterm

Week 8: Heterogeneous catalysis in practice: oil refining and petrochemistry

Week 9: Heterogeneous catalysis in practice: environmental catalysis

Week 10: Biomass conversion into biochemical and biofuel: heterogeneous and homogeneous catalysis

Week 11: Homogeneous and biocatalysis: industrial applications and catalyzed reactions

Week 12: Spectroscopy in Catalysis

Week 13: Theoretical calculation in catalysis research

Week 14: Case Study/Review/Make-up

Week 15: Final Exam/Presentation

Contribution of course to meet professional component:

Students understand of catalyst synthesis methods and know where catalysts are applied in different chemical reaction. Characterize unknown chemical using by spectroscopic techniques. Students learn to apply catalysis to understand the environmental, social and economic issues

Relationship of course to program outcomes:

Ability to apply knowledge of math, engineering, and science/ Ability to design and conduct experiments/ Ability to analyze and interpret data to meet necessary for chemical engineering practice and field, such as petrochemical.

CTPC "3a-k" Outcomes	% contribution
A. Ability to apply knowledge of math, engineering, and science	15%
B1. Ability to design and conduct experiments	15%
B2. Ability to analyze and interpret data	15%
C. Ability to design system, component or process to meet needs	6%
D. Ability to function on multi-disciplinary teams	5%
E. Ability to identify, formulate, and solve engineering problems	10%
F. Understanding of professional and ethical responsibility	5%
G. Ability to communicate effectively	5%
H. Broad education	4%
I. Recognition of need an ability to engage in life-long learning	2%
J. Knowledge of contemporary issues	9%
K. Ability to use techniques, skills, and tools in engineering practice	9%
Any other outcomes and assessments?	
	100%

Prepared by Taejin Kim

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