ChBE 6300: Kinetics and Reactor Design *(core course)*
Credit: 3-0-3

Suggested Prerequisites:
undergraduate kinetics and reaction engineering, undergraduate mass transfer

Catalog Description:
Study of chemical kinetics and mechanisms in complex homogeneous and heterogeneous reaction systems. Design and analysis of chemical reactors for such systems.

Textbook:
TBD

Course Objectives:
This course covers the science and engineering of reactive chemical systems. Ideal reactors are modeled. The theory of chemical reactions in the gas phase from fundamental physical chemical principles is introduced. Reacting systems are identified and analyzed at the level of elementary steps, including single, chain and catalytic reactions. Mathematical models for heterogeneous reactions, including associated mass transfer limitations, are also developed.

Learning Outcomes:
By the end of this course, a student should be able to:

1. Formulate and solve problems involving homogeneous reactions in ideal reactors.
2. Hypothesize, mathematically describe, and test the validity of homogeneous multi-step reaction mechanisms.
3. Describe the motion of, and collisions between, molecules in an ideal gas.
4. Predict reaction rates based on collision and transition state theory.
5. Distinguish between single, chain and catalytic reactions.
6. Describe and mathematically model heterogeneous chemical reactions, particularly those occurring on solid catalyst surfaces.
7. Assess the impact of transport processes on observed chemical reaction rates.

Representative Topical Outline:

1. Undergraduate review (2 weeks)
    a. Homogeneous kinetics
    b. Ideal reactor design
2. Kinetic theory of gases (≥1 week)
    a. Maxwell-Boltzmann distribution
    b. Collision theory
    c. Transition state theory
3. Chain and catalytic kinetics (≥1 week)
4. Heterogeneous catalysis (≥1.5 weeks)
5. Transport effects in heterogeneous catalysis (≥2 weeks)
    a. Reaction-diffusion equations

Instructor's discretion (7.5 weeks)