ChemE 3900 - Chemical Kinetics & Reactor Design

Chemical Engineers design and analyze processes and products based on chemical change.

The chemical reaction is the essence of any chemical product.
The chemical reactor is the essence of any chemical process.

Reactor Design is the core of Process Design. Other units serve the reactor and/or treat the reactor output. The reactor dictates the type and size of other process units.

Part 1 - Chemical Kinetics

Reaction Coordinate Energy Level Diagrams
  Thermodynamics vs. Kinetics
Rate Equations from Experimental Data
  Method of Initial Rates
  Saturation Methods
  Method of Half Lives
Rate Constants and Activation Energies from Experimental Data
  Arrhenius Plots
Rate Equations from Mechanisms of Elementary Reactions
  Reactive Intermediates - the usual suspects
  Steady-State Approximation
  Pre-equilibrium Approximation
  Rate-Limiting Step
Special Classes of Reactions
  Chain Reactions
  Photo-initiated Reactions
  Polymerization
  Homogeneous Catalysis - Enzymes
  Heterogeneous Catalysis - Solid Acids and Transition Metals
  Autocatalysis (if time permits)
  Reactions in Solutions (if time permits)
Part 2 - Reactor Design

Thermodynamics of Chemical Reactions
- heat of reaction
- chemical equilibrium

Isothermal Reactors
- one chemical reaction
- multiple chemical reactions

Non-isothermal Reactors

Non-ideal Reactors

Multiphase Reactors

Ancillary Skills

Mathematical Modeling & Graphical Modeling
- How to translate a chemical description into equations and graphs

Approximation
- How to identify dominant effects and estimate the consequences of neglecting secondary effects.

Evaluation
- How to test assumptions and assess predictions.

Numerical Methods
- Numerical Integration
- Statistical methods - linear regression and least-squares fits
- Finite elements

Analytical Concepts
- Rate constants and time constants
- Residence times and residence time distributions