CHBE 550: Advanced Reactor Design

The course provides a comprehensive review of reactor design, and progressively specializes on transport phenomena in catalytic reactors, synthesis and characterization of catalysts, numerical simulations and industrial applications.

LEARNING OBJECTIVES

After the course, students will be able to:

- Design and operate continuous stirred-tank, plug-flow, packed-bed and batch reactors
- Synthesize catalysts and estimate their properties
- Derive the reaction rate expressions for typical catalytic cascades
- Design experiments to validate assumptions about catalytic mechanisms
- Analyze the transport phenomena in catalysts and catalytic reactors
- Author a scientific manuscript that meets the standards of peer review

GRADE BREAKDOWN

Midterm problem set – 20%
End-of-term design project – 40%
Final exam (take home) – 40%

COURSE SCHEDULE

Lectures - 2 sessions of 80 minutes each week

Week	Description
1	Review of reactor types Gas-phase reactions in isothermal PFRs
2	Pressure drops in isothermal PBRs Numerical methods
3	Energy balances in reacting systems Design of heat exchangers for reactors
4	Simulating PBRs Start-up of CSTRs
5	Transport phenomena in reacting systems – The ‘master’ equation
6	Transport phenomena in heterogeneous catalysis Hougen-Watson kinetics
7	Design of experiments for validating catalytic mechanisms Synthesis of catalysts
8	Experimentation for measuring catalyst properties The single pore model
9	Influence of reaction stoichiometry on effectiveness factor of catalysts Non-isothermal catalysts
10	Biocatalysis and metabolic engineering Fermentation demonstration
11	Mathematical models of poisoning External transport resistances

12 Design & simulation of catalytic reactors

13 End-of-term project presentations