

## CHEN 4830 - Biokinetics

**Textbook:** *Elements of Chemical Reaction Engineering* by Fogler (Prentice-Hall)

**3 credits engineering topics:** three one-hour lectures per week

### Learning Goals

#### 1. Chemical Reaction Kinetics

- Knowledge of reaction order, rate constants, and activation energy
- Ability to determine kinetic parameters and mechanisms from an analysis of kinetic data
- Familiarity with techniques used to determine kinetic data
- Knowledge of the effects of catalysts on the reaction mechanism and reaction kinetics
- Basic understanding of the relationship between elementary rate laws and molecular transformations in terms of collision and transition state theories

#### 2. Reactor Design and Analysis

- Knowledge of mass and energy balances in batch, semibatch, plug flow, and continuous stirred tank reactors under both steady state and unsteady state conditions with emphasis on simultaneous solution of material balances
- Ability to apply stoichiometry to mass balances and to design reactors with volume and/or density changes
- Knowledge of multiple reactions, multiple reactors, and reversible reactions in reactors of all types including selectivity and yield determination and optimization
- Understanding of the objective of a chemical reactor, its safety aspects and nonlinear behavior, and how the reactor affects the rest of the chemical plant

#### 3. Biological System Kinetics

- Understanding of the features of biological systems that distinguish their kinetics from the kinetics of chemical systems
- Knowledge of the basic models and mechanisms for enzyme kinetics
- Familiarity with the methods for experimentally determining kinetic parameters relevant to enzyme kinetics ( $V_{\max}$ ,  $K_m$ )
- Understanding of stoichiometric methods for evaluating metabolic networks
- Ability to write overall and dynamic mass balances around whole cells
- Understanding methods for performing elemental balances involving metabolic networks
- Understanding methods for quantitatively describing cell growth and kinetics in multiple bioreactor configurations (batch, continuous)
- Understanding of basic bioenergetics as related to overall cell kinetics