

Course Outline
CHEM 440B / BIOC440B
Physical Biochemistry I
Physical Chemistry Principles
Fall 2019

Tue / Thu 9:30-10:50am, 213 Gregory hall (Lectures)

Tue 5:30-6:50pm, 165 Noyes Lab (Discussion)

Principles of Thermodynamics and Kinetics and their Applications to Biological Macromolecules

PART I: The principles of thermodynamics applied to biochemical reactions

8 lectures

- Equilibrium, driving forces, free energy and the chemical potential
- The Boltzmann distribution
- Electrochemistry
- The thermodynamics of transport across membranes

Part II: Structure and stability of macromolecules

9 lectures

- The hydrophobic force, micelles and the lipid bilayer
- Protein structure and stability
- RNA and DNA structure and thermal stability

Part III: Molecular interactions and ligand binding

4 lectures

- Diffusion, on-rates and off-rates
- Binding isotherms: Model-independent and model-dependent binding equations
- Allostery: classical and modern treatments and examples

Part IV: The principles of kinetics applied to biochemistry

4 lectures

- Enzyme kinetics
- Kinetics of protein folding

EXAM 1: Oct, 2019 in class - Covering Lectures 1 - 8

EXAM 2: Nov, 2019 in class - Covering Lectures 9 - 17

EXAM 3: Dec, 2019, in class - Covering Lectures 18 - 25

Lectures:

Lecture 1 - Introduction

Lecture 2 - Enthalpy

Lecture 3 - Boltzmann Distribution

Lecture 4 - Free Energy & Chemical Potential

Lecture 5 - Equilibrium Constant
Lecture 6 - Redox Reactions
Lecture 7 - Membrane Transport
Lecture 8 - Oxidative Phosphorylation

EXAM I

Lecture 9 - Biomolecular Stability
Lecture 10 - Micelle and Protein Structure
Lecture 11 - Protein Folding Thermodynamics
Lecture 12 - Mutations, Denaturants, and Protein Folding Stability
Lecture 13 - Electrostatics
Lecture 14 - Physical Chemistry of Water
Lecture 15 - DNA Structure and Topology
Lecture 16 - RNA Structure
Lecture 17 - Kinetics Principles I
Lecture 18 - Kinetics Principles II

Special Lecture - An Introduction to VMD URL

We will be giving a demo on the molecular visualization program VMD to display, animate, and analyze large biomolecular systems. Students are encouraged to bring a laptop but are not required. Students are also encouraged to download and install VMD before class.

EXAM II

Lecture 19 - Multiple Equilibrium
Lecture 20 - Cooperativity
Lecture 21 - Allostery
Lecture 22 - Enzyme Kinetics I
Lecture 23 - Enzyme Kinetics II
Lecture 24 - Protein Folding I
Lecture 25 - Protein Folding II - Experimental Measurements

EXAM III