CHEM 3130 - CHEMICAL SYSTEMS III

SPRING QUARTER 2005
10:00-10:50, MWF, Olin103

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Course Description

This is an advanced level Physical Biochemistry course intended primarily for graduate students and advanced level undergraduates. The course will focus on kinetics, thermodynamics and dynamic aspects of biopolymers, and will delineate the relationship of these properties to the mechanism and function of biological macromolecules. Some of the methods used by biophysical chemists to study these properties of biomolecules will also be discussed.

Topics Covered

A. Optical Spectroscopy - Interaction of light with molecules
   1. Absorption Spectroscopy
      a. Transition dipoles
      b. Electronic states
      c. Extinction coefficients
      d. Analysis of biopolymers
      e. Effect of conformation on absorption
   2. Optical Activity
      a. Molecular basis
      b. Optical rotary dispersion
      c. Circular dichroism
      d. Nucleic acid optical activity
      e. Protein Optical activity
      f. Determination of secondary structure
   3. Emission Spectroscopy
      a. Basic Principles
      b. Intensity/Time-resolved
      c. Properties of fluorescent groups
      d. Sensitivity to the environment
      e. Singlet-singlet energy transfer
      f. Fluorescence polarization
   4. Vibrational Spectroscopy
      a. Fundamentals
      b. Infrared spectroscopy
      c. Infrared microscopy
      d. Reflectance
      e. Vibrational optical activity
      f. Time-resolved
      g. Modulation spectroscopy
      h. Raman
      i. Surface enhanced Raman/ Infrared absorption

B. Protein Structure
   1. Polypeptide chain geometries
   2. Thermodynamic aspects
   3. Inter/intramolecular Forces
      a. Strong Forces
      b. Polar/electrostatic interactions
      c. Weak Forces
   4. Structure
      a. Secondary Structure
      b. Tertiary Structure
   5. Conformational Dynamics
   6. Protein Folding
      a. The helix coil transition
      b. Thermodynamics of folding
      c. Kinetics of folding
   7. Predicting and Modeling protein structure

C. Enzyme Kinetics
   1. Enzyme Activity

a. Reaction velocity
b. Catalysis models
c. Determination of catalytic parameters

2. Inhibition
   a. Reversible
   b. Irreversible
   c. Mechanism-based
3. Two-substrate reactions
   a. Sequential
   b. Ping Pong
4. Multi-site and cooperative enzymes
   a. Sequential interaction model
   b. Concerted interaction model
5. Transient phases
   a. Rapid reaction techniques
   b. Reaction mechanisms
   c. Relaxation techniques
6. Enzyme stability

D. Electron Transfer
1. Theory
   a. Classical
   b. Quantum
2. Rate vs Distance
   a. Dutton's Ruler
3. Photo-induced
   a. Forward
   b. Backward
4. In proteins
   a. Photosynthetic RC's
   b. Cytochrome bc1

Text etc.
There is no required text.

However, the best textbook for Biophysical Chemistry is:

Biophysical Chemistry Part I, II, and III by C.R. Cantor and P.R. Schimmel, Freeman, 1980.

Periodically, I will recommend journal articles and book chapters with strong relevance to the course material.

It is the student's responsibility to attend class and take notes.

Grading
Problem Sets - You will be assigned 4 problem sets each dealing with the topics above. Much of the work on these problem sets will require computer data analysis.

1. Problem Set I	100 points
2. Problem Set II	100 points
3. Problem Set III	100 points
4. Problem Set IV	100 points
5. Final Exam	200 points
Total	600 points

Completing each problem set is the responsibility of the individual student. Although seeking assistance from classmates is not forbidden, the work handed in must be each student's own.