2022

Physics 422 (Biophysics)

Ronald Koder
CUNY City College

Physics 422/V3800 – Biological Physics

Prof. Ronald Koder
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Tue, Thu 5:00 pm – 6:15 pm
Office hours Tue., Thurs. 4:00 pm – 5:00 pm or by appt.

Course email list: physics422@gmail.com

Introduction to the structure, properties, and function of proteins, nucleic acids, lipids and membranes. In depth study of the physical basis for biopolymer structure and function. Introduction to spectroscopic methods for monitoring reactions and determining structure including light absorption or scattering, fluorescence, NMR and X-ray diffraction. The course emphasizes reading and interpretation of the original literature. Prereq.: 1 yr. of Math, 1 yr. of Physics 3 hr./wk.; 3 cr.

Text

The bulk of the course material will be from lectures and primary literature.

Suggested reference texts:

- Linus Pauling. The Nature of the Chemical Bond
  https://archive.org/details/natureofthechemicalbondpauling
- Any first year physics textbook with thermodynamics and E&M sections.
  A good free one is at:
  https://cnx.org/contents/dP0ocxV9@14.71:bG-_rWXy@11/Introduction

The following are on reserve for this course in the Marshak Science Library:

- Ken Dill. Molecular Driving Forces: Statistical Thermodynamics in Chemistry & Biology.
- Voet and Voet. Biochemistry

Course Objectives:

1) Be able to describe the chemical makeup and three dimensional structures and properties of biopolymers such as proteins and nucleic acids
2) Understand the thermodynamic basis for these structures and be able to formally describe the coupling mechanisms which drive function
3) Become familiar with the techniques with which these biomolecules are interrogated
4) Be able to read and interpret primary literature in this field.

Grading:

- 50% Weekly homework, class participation, quizzes
- 25% Midterm
- 25% Final

Date	**Topic**
2/1	Course intro.
	Section I: Macromolecular Structure
2/3	Intro to Molecular structure. Boltzman distribution. Conformational distributions of small molecules
2/8	No class, Friday schedule
2/10	Basic Definitions, Nucleic Acids, DNA/RNA structure and conformational equilibrium
2/15	DNA nanotechnology, Amino Acids
2/17	Amino Acid Properties, Peptide Bonds
2/22	protein structure, protein visualization
2/24	sequence homologies, structural homologies, protein families
	Section II: Intermolecular Forces and Computational Biophysics
3/1	Review of statistical thermodynamics
3/3	electrostatics, hydrogen bonds, pKa's
3/8	the hydrophobic effect, Lenard-Jones potentials
3/10	statistical thermodynamics and protein folding, rotamer libraries
3/15	Computational structure calculation
3/17	Binding - Midterm handed out
3/22	Transition state theory, catalysis
	Section III: Biophysical Methods
3/24	spectroscopy– Midterm due
3/29	ultracentrifugation, circular dichroism
3/31	magnetic resonance 1
4/5	magnetic resonance 2
4/7	magnetic resonance 3
4/12	crystallography
4/14	microscopy
Spring Recess 4/15-4/22	
4/26	calorimetry
4/28	single molecule methods
5/3	plasmonics
S*ection IV: Biological design*	
5/5	Nucleic acid design

5/6	Molecular Dynamics
5/10	Protein design – Rosetta/ProCAD
5/12	Synthetic biology, CRISPR Final Handed out
5/22	Final Due

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