Biophysical Chemistry 728 – Spring 2012

Classroom: LGRT 1234
Class Time: Tue/Thu 9:30-10:45
Course Website: http://www.chem.umass.edu/~rmweis/Chem728/

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Required Textbook: Alan Cooper. *Biophysical Chemistry*. 2nd Edition. 2011 (www.rsc.org/shop/books/). Also available from amazon.com.
This is an elementary textbook that provides (easy) problems to work and will serve as the point of departure for more in-depth treatment in lecture and with supplemental materials.

Computer/Software: A laptop with Windows OS capable of running Origin 8.60. (https://store.originlab.com/store/)
This software package can make high quality graphs and plots suitable for publications, and can be used to generate statistics, conduct nonlinear data fitting with prepackaged and user-defined functions, carry out simulations, analyze images and automate data analysis.

Biophysical Chemistry.

Biophysical chemistry applies the concepts and practices of physical chemistry to understand biology at the molecular level. (duh)

The chemical sciences emerged as a quantitative discipline (including that part now known as physical chemistry) before the molecular biological sciences, primarily due to the complexity of biological systems (understanding what organisms are made of), and the difficulty in preparing defined samples of biological molecules. The major classes of biological marcomolecules were identified first. Then, the new discipline of molecular biology (not genetic engineering, but the study of biological molecules) focused on readily available samples (myoglobin, hemoglobin, fibrous protein (hair), cellular extracts of RNA and DNA), which were studied using the methods of physics and chemistry (primitive instruments by today's standards). These investigations established foundations of structural biology (DNA and protein structure, organization of membranes), biothermodynamics (protein & nucleic acid stability, cooperativity) and biochemical kinetics (mechanism of enzyme catalysis).

The landscape for, and practice of, biophysical chemistry has been changed transformed through developments in the engineering, biotechnology, and applied chemistry: (i) Genome sequencing is ubiquitous. (ii) Chemical synthesis and isolation methods, and genetic and protein engineering facilitate the preparation of biological molecules in substantial quantities and with good purity – not unlike reagent-grade chemicals. (iii) Improvements in instrument automation

and sensitivity allow high throughput sample analysis and/or with ultimate (single-molecule) sensitivity. (iv) Computational methods for theory and simulations, and the analysis of enormous amounts of data (bioinformatics). (v) New imaging techniques facilitate the investigation of biological macromolecules and macromolecular assemblies in the cell, where their functions under physiological relevant conditions can be studied.

Course Goals. Therefore, we seek to use understand and apply the fundamentals of physical chemistry and physics most relevant to biological molecules, in the historical context and in the context of modern methodologies.

Course Mechanics. Meetings: twice a week that is a combination of lectures, student-directed presentations & discussions, and work sessions for analyzing data with Origin.

Assignments and Assessment Methods. Yet to be determined in detail, but to include graded in-class and homework problems – composed of derivations, word answers, arithmetic, and computer-based simulations and data analysis. In addition, assignments may require in-class presentations and/or a final take-home problem set (larger than the semi-weekly sets). Final grades will be determined according to a percent performance of the total points, but scaled fairly to balance class performance and instructor expectations.

Schedule Topics with Notable Dates (Preliminary, not complete nor in the final order)

Class #	Date(s)	Day	Topic	Cooper
1	1/26	Thu	First Day of Class, Thursday	
2-11	1/31 – 3/1	Nonbonded intermolecular interactions, DNA/RNA strcuture, protein structure, membrane structure, properties of water. Solution thermodynamics, phase diagrams, ideal and nonideal solutions, hydrodynamics, sedimentation, enzyme and reaction kinetics. AFM, STM, single molecule force methods. Macromolecule stability, thermodynamics of ligand-receptor and protein-protein interaction, etc.		Ch 1, Ch 4, Ch 5, Ch 6,
--	3/5	Mon	*Last day to drop with 'dr' (graduate)*	
12-15	3/6-3/15	Spectroscopy for structure and dynamics		Ch 2,
--	3/20	Tue	*Spring Break*	
--	3/22	Thu		
16-21	3/27-4/12	x-ray scattering and crystallography, nmr, epr, uv-vis absorbance spectroscopy, circular dichroism, fluorescence spectroscopy, single molecule fluorescence methods		Ch 8, Ch 9.
--	4/17	Tue	*Monday Schedule (Patriots Day)*	
22-25	4/19 – 5/1	Reserved for overflow and special topics		