Physical Biochemistry
Course Syllabus
BCHM 485: TuTh, 9:30-10:45am, CHEM 2201
Spring 2007

Prof.: David Fushman
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Office hours: Wednesday, 2:00-3:30pm (tentative)

Teaching Assistant: Ming-Yih Lai
Office hours: Thursday, 2-4pm, Room 1122, Biomolecular Sciences Bldg (#296), voice: x58710, e-mail: **mylai@umd.edu**

Course Description

This is section II of the Physical Chemistry course designed to cover topics of particular relevance to problems and applications of physical methods to modern biochemistry. There is significant emphasis on various experimental techniques: sedimentation, chromatography, electrophoresis, relaxation kinetics, a broad range of spectroscopies and their applications to biomacromolecules, and on methods for biomolecular structure determination.

Mathematical level required: physical chemistry is a rigorous quantitative discipline. Many of the problems and methods discussed throughout the course require familiarity with the following mathematical techniques: logarithms and exponentials, trigonometric functions, complex numbers and complex functions, basic vector analysis, matrix algebra (including determinants and eigenvalue equations), derivation and integration techniques, power series and Taylor expansions, differential equations.

Textbooks:
Required: (Copies of the required textbooks are available in the Chemistry Library)
(1) Peter Atkins, Julio de Paula, *Physical Chemistry*, 8th edition, **Volume 2: Quantum Chemistry, Spectroscopy, and Statistical Thermodynamics**, W.H.Freeman & Co, New York
(2) David Eisenberg, Donald Crothers, *Physical Chemistry with Applications to the Life Sciences*. Benjamin/Cummings Publishing Co.

Additional recommended sources: *Principles of Physical Biochemistry* by van Holde, Johnson & Ho; *Molecular Driving Forces* by Dill & Bromberg; *Biophysical Chemistry* by Cantor & Schimmel.

There is a course homepage at: **http://wam.umd.edu/~fushman/**

where you will find a copy of the syllabus, regular homework and reading assignments, exam solutions and statistics, and extra material. Some of these materials will be posted as we proceed

with the course. You are welcome to email your questions and comments. I do not guarantee individual responses, but errors or common points of confusion will be addressed in class. Links to courser pages from previous years can be found at **http://gandalf.umd.edu/FushmanLab/**.

Course Outline

The exact order of topics and the number of lectures on each may change.

1. Quantum Mechanics. (5.5 weeks)
Postulates of quantum mechanics. Observables and operators, wave functions and eigenvalues, the uncertainty principle, Schrödinger's equation. Quantization of energy, a particle in a box, harmonic oscillator. Quantization of the angular momentum, rotation in two and three dimensions. Hydrogen atom. Electron spin, Pauli principle. Atomic orbitals. Molecular structure, rotation and vibration, Born-Oppenheimer approximation.

2. Spectroscopy. (2 weeks)
Transitions and selection rules. Vibrational and rotational transitions. Electronic transitions. Optical spectroscopy. Applications to biomolecules: absorption, circular dichroism, fluorescence techniques. Magnetic resonance spectroscopy, applications to biomolecular structure and interactions.

3. Statistical thermodynamics. (3 weeks).
Configurations, micro- and macrostates. The Boltzmann distribution. The concept of partition function. The concept of ensemble. From partition function to thermodynamic functions. Applications to binding equilibria, single- and multicomponent systems, phase transitions. Statistical mechanics of biomolecules as polymer chains. Helix-coil transition, protein folding.

4. Molecular motion. (1.5 weeks)
Kinetic theory of gases. Maxwell-Boltzmann. Transport phenomena, Fick's laws, diffusion equation. Applications to biochemistry: dialysis, liquid chromatography, sedimentation, electrophoresis.

5. Chemical and biochemical kinetics. (1.5 weeks)
General kinetics. Differential and integrated rate laws. Mechanisms of chemical and biochemical reactions, enzyme kinetics. Transition state theory. Diffusion-limited processes. Kinetics methods in biochemistry.

Class format. Lecture attendance is important and expected. The lectures will supplement the textbook with new material, emphasize important conceptual and technical issues and clarify tricky points. You are responsible for both the material covered in the lectures and the assigned reading.

Examinations will be given on the following dates (These exam dates are firm**):**

I	Thursday, March 8
II	Thursday, April 26
Final exam:	**Monday May 14, 8:00-10:00 am**

Grading Policies. Each exam during the semester will be worth 100 points and the final exam will be 130 points. Exams during the semester will include only the material covered since the previous exam but will inevitably draw on information from earlier in the semester. The final will cover the entire course material. The exams will include material covered in the lectures and in the corresponding sections of the textbook. Problem sets and quizzes will be given as

homework regularly: these are optional, however, they are designed to encourage your regular reading of the material and completing them is likely to be *very helpful* in your preparation for the exams. You will be allowed to use calculators on the exams for computation only.

Your final letter grade will be based on your total on the two mid-term exams, and on the final exam (maximum 330 points). Grading will be done on a *curve* based on the overall distribution of the *class scores*. You will be guaranteed an A if your total score is 85% or better, a B if it is 60% or better and a C if it is above 30% of the class. In addition, students who scored ≥ 280 points will be guaranteed an A, and those with ≥ 150 points will be guaranteed a passing grade, *independent of the curve*. Final grading will then be done using the "+/-" grading system, as follows. The cut-offs for A, B, etc grades will be determined first. Then each letter-range will be divided into three groups: all students whose scores are in the upper third of, e.g. B range will be given a B+, those in the middle will receive a B, and the lower third will receive a B-, and so on.

Regrades.
If you think a mistake has been made in grading your work, you *must* submit it to me for regrading no later than one week after the date on which the work was returned to the class, with a written explanation of your reasons for desiring a regrade. The entire exam is subject to regrading, which often decreases the total score. After that, the grade will be considered final. Arithmetic errors in the grading can be corrected without regrading.

Make-up exam policy.
Do not miss any of the exams. If you miss an exam, **you will have a score of "0" on the exam until it is made up.** Only students with **legitimate excuses** as determined by the University policy will be given a make-up exam. For a make-up exam you will need a written documentation of the emergency or illness.

It is your responsibility to contact me promptly to schedule a make-up exam. In any case, YOU MUST CONTACT ME WITHIN 24 HOURS OF MISSING AN EXAM.

All students must take the final exam.
Please notify me as soon as possible if you know ahead of time that you will miss an exam for any reason, including previously scheduled events, religious observances, etc. According to the University policy you must tell me no later than February 6 (the last day of schedule adjustment period).

Teaching assistance.
The teaching assistant for this course is *Mr. Ming-Yih Lai*, a 2nd year graduate student in the Biochemistry program.
We are happy to help you with the material during office hours. If necessary, we will arrange other times to meet. A review session will be scheduled before the final exam. If you believe a mistake has been made in lecture (I guarantee this will happen), please speak up or inform me afterward. **Please ask questions in lecture if something is not clear.**

Academic integrity.

"The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html." Students are responsible for knowing and understanding the content of the Code.

There will be zero tolerance to violations of the *Code of Academic Integrity*. Suspected cases will be reported immediately to the appropriate authorities. The standard penalty for violations of the *Code of Academic Integrity* is a grade of "XF". Specific guidelines relevant to this course include:

1. All work that you submit for grading in this course (i.e. examinations) must be the original work of the student whose name is on the work.
2. You may use a calculator for most in-class exams, but **only** for computation. Any other use is a violation of the University's *Code of Academic Integrity*.
3. Other actions such as falsification of excuses for missed exams or submission of an altered, graded examination for regrading, etc., are also violations of the *Code of Academic Integrity* or the *Code of Student Conduct.*