Biophysical Chemistry – CH 4403 / Fall 2014
Course Syllabus

Nicholas Fitzkee [nfitzkee (@) chemistry (.) msstate (.) edu]
Office: Hand Lab 3310

Course Description

As our understanding of life has grown, it has become increasingly important to quantify the behavior of biological systems. Such characterization not only allows us to explain in increasing detail how these systems function, but it also allows us to intervene when something goes awry. The fundamental principles that govern life are the same as those that govern all of chemistry: thermodynamics, kinetics, and quantum mechanics. In this class, we will examine how these physical principles apply to the chemistry of life. When you have completed the course, you will understand how scientists are using physical chemistry to study the myriad of reactions inside the living cell.

Meeting Times / Attendance

The course will meet Tuesdays and Thursdays from 12:30 to 1:45 PM in Hand Lab 3324. Although the primary format for the class will be lecture, opportunities will be given for students to present their problem set solutions and work examples in class. Other forms of group participation will also be encouraged. A specific schedule of meeting times is given below. Because of the interactive nature of the lectures, attendance is mandatory for the course. Please contact me if you must miss a class meeting. I reserve the right to deduct up to 5% from your final grade if you have more than two unexcused absences.

Reading / Textbook

The textbook for the class is *Physical Chemistry: Principles and Applications in the Biological Sciences* (5^{th} ed.) by Tinoco, Sauer, Wang, Puglisi, Harbison, and Rovnyak (2013 Prentice-Hall, Inc., ISBN 978-0-1-3605606-5). The book is available in the bookstore, but it may be cheaper for you to purchase it online (try www.addall.com). In addition, there will be supplemental readings throughout the semester of papers and additional handouts. It is expected that you come to class having read the material.

While previous editions of this text (and international editions, etc.) are available, working with them is not recommended. I simply do not have time to translate page numbers, problem numbers, etc. between editions, so if you go this route, you're on your own.

An optional text is also suggested for students wanting to brush up on their mathematics skills. This book is *Applied Mathematics for Physical Chemistry* by James R. Barrante (2004 Prentice-Hall, Inc., ISBN 0-13-100845-5). This text includes a review of integral and differential calculus, logarithms, and basic differential equations. It can be very useful to have this material handy (along with worked examples and practice problems) without having to search the internet, although the book is not strictly required.

Homework

Throughout the course, you will have ten weekly problem sets to test you on the material taught. These assignments are collected and constitute 30% of your final course grade. This large percentage reflects two facts: (1) The problem sets will take a significant amount of time to complete. (2) Solving problems in a relaxed environment on your own is probably the best way for you to learn the course material. It is therefore essential for you to be able to complete each problem set and understand the correct answers. To help with this, detailed solutions will be provided when you turn in the problem sets.

Homework assignments are due at 4:00 pm sharp on Friday (unless otherwise specified). Late assignments will not be accepted unless prior arrangements with me are made. In these cases, there must be extenuating circumstances (not simply an exam in another course scheduled for the same day).

You are encouraged to work in a study group to complete the homework assignments; it is known that this can lead to better learning outcomes if all members are contributing equally. However, your final submitted assignment must be your own work and not copied from someone in your group. Written answers must be in your own words. Additionally, note that passive observation (instead of active participation) in a group will likely hurt your performance, not improve it. As a guideline, discussing the strategy for solving a problem is fine; copying someone else's worked problem is not.

Grade Distribution

The grades for the course will be calculated according to the table below. Although attendance is not explicitly included, I may deduct up to 5 percentage points from your final course grade if you have more than three unexcused absences.

Course Component	Percentage
In-Class Exams (3)	50%
Homework (10)	30%
Final Exam	20%

If the distribution of grades necessitates it, the final grades will be curved. However, if all students do well, they should not expect to receive poor grades simply because of a forced bell curve on the final distribution. Students are encouraged to concentrate on learning, which has lifelong benefits, rather than grades, which are useful to your mid-twenties at best. No student who has shown discipline in pursing educational excellence will fail this course.

In-Class Exams

Three in-class (non-cumulative) exams will be used to assess your performance in the class. These exams will focus on problem solving, in the spirit of your homework assignments. The best way to study for these exams is to review your homework solutions and to practice similar problems on your own. Answers to several of the book problems are given as an appendix (p. 639), and this would be a good place to start. You will also be given an example exam from a prior year. Note that, if a class is cancelled, I reserve the right to reschedule for an out-of-class exam.

Final Exam

The final exam is a cumulative assessment of your understanding of the course. Although it would be far preferable for you demonstrate your mastery of the material in some other way, a final exam is the time-tested means of assessing your performance in the course. The exam will cover all the course material, starting from day one, and it will emphasize "higher levels" of understanding: analysis, application, and synthesis of ideas. While there will be multiple choice portions of the exam, because the class is so small, you should not expect the exam to be entirely multiple choice. You will receive an example exam from a previous year to help you study.

Office Hours

I will be available for course help in my office on most Tuesday and Wednesday mornings from 9:00 am to 10:00 am. If you are unavailable then and wish to schedule an alternative time to meet, please send me an email. Drop-in appointments are also possible, but if I am busy I will ask you to reschedule.

Course Web Page

The web page for this course is located at http://fitzkee.chemistry.msstate.edu/ch4403/. Please check this site frequently for course updates. You will be able to find PDF copies of this syllabus and other important course materials at this site. You can also subscribe to the course RSS feed to receive updates; however most course news will be disseminated by email.

Academic Integrity

Collaboration is encouraged in this course, but all students are expected to complete their own assignments and submit their own work. Failure to do so not only cheats the system, but also diminishes your own understanding of the material. An example of acceptable collaboration is meeting in a study group to discuss problem solving strategies, then actually solving the problems on your own. Instances of plagiarism and cheating will be addressed according to the Student Honor Code. In severe cases of academic dishonesty, students will be dropped from the class with an XF grade and will be required to take a class in academic integrity to have the "X" sanction removed. You are encouraged to read the Student Honor Code, available on the Honor Code Office website, http://www.honorcode.msstate.edu/.

Honors Credit and Graduate Course (H01 section and CH 6403 01)

It is possible to take this class for graduate credit (CH 6403), and undergraduates can take CH 4403 to receive honors credit as well (through the H01 section). The requirements for both students are the same and are outlined in the supplemental syllabus handout for CH 6403. Note that the decision to take a class for honors credit must be made within the first two weeks of class. For more information, please see the syllabus supplement.

Course Schedule and Topics Covered

Week 1			
Date	**Description**	**Reading**	**Assignment**
August 19	Syllabus, Protein structure #1	Chapter 1; *Molecules of Life*, Chapter 1*	PS #1 out
August 21	Protein structure #2, DNA structure		
Week 2			
Date	**Description**	**Reading**	**Assignment**
August 26	Thermodynamics: The first law and internal energy	Chapter 2	
August 28	Enthalpy, heat capacity, and chemical reactions		PS #2 out, PS #1 due
Week 3			
Date	**Description**	**Reading**	**Assignment**
September 2	Transformation of internal energy and enthalpy; phase changes		
September 4	The second law and entropy I	Chapter 3	PS #3 out, PS #2 due
Week 4			
Date	**Description**	**Reading**	**Assignment**
September 9	Entropy II, the third law and Gibbs energy		
September 11	Partial derivatives		PS #4 out, PS #3 due
Week 5			
Date	**Description**	**Reading**	**Assignment**
September 16	The chemical potential, molar Gibbs energy, and equilibrium	Chapter 4	
September 18	Exam #1: Classical Thermo and Biomolecules (Chapters 1-3, *Molecules of Life* Chapter 1)		
Week 6			
Date	**Description**	**Reading**	**Assignment**
September 23	**No Class:** Gibbs Conference		
September 25	Standard states and activities		PS #5 out, PS #4 due

Week 7			
Date	**Description**	**Reading**	**Assignment**
September 30	Equilibrium: Van't Hoff, DNA Hybridization		
October 2	Electrochemistry and applications	Chapter 7	PS #6 out, PS #5 due
Week 8			
Date	**Description**	**Reading**	**Assignment**
October 7	Statistical approaches to molecular binding	Chapter 5 and pp. 206-213	
October 9	Statistical weights, binding, and allostery		
Week 9			
Date	**Description**	**Reading**	**Assignment**
October 14	Biophysical models, helix-coil theory		
October 16	Chemical kinetics concepts	Chapter 9	PS#7 out, PS #6 due
Week 10			
Date	**Description**	**Reading**	**Assignment**
October 21	Exam #2: Equilibrium and Statistical Thermo (Chapters 4-5, 7, and pp. 206-213)		
October 23	**No Class:** Fall Break		
Week 11			
Date	**Description**	**Reading**	**Assignment**
October 28	Reaction mechanisms		
October 30	Rate laws		PS #8 out, PS #7 due
Week 12			
Date	**Description**	**Reading**	**Assignment**
November 4	Transition state theory, activation energy		
November 6	Perturbation and very fast kinetics		PS #9 out, PS #8 due

Week 13			
Date	**Description**	**Reading**	**Assignment**
November 11	Marcus theory, diffusion controlled reactions, and chemical kinetics problems		
November 13	Enzyme kinetics #1		PS #9 due
Week 14			
Date	**Description**	**Reading**	**Assignment**
November 18	Exam #3: Chemical kinetics (Chapter 9)		
November 20	Enzyme kinetics #2	Chapter 10	PS #10 out
Week 15			
Date	**Description**	**Reading**	**Assignment**
November 25	Application: Protein folding kinetics		
November 27	**No Class:** Thanksgiving Break		
Week 16			
Date	**Description**	**Reading**	**Assignment**
December 2	Make up, single molecule kinetics		PS #10 due

Unless otherwise noted, readings are from *Physical Chemistry: Principles and Applications in the Biological Sciences (4th ed.)*. Additional readings will be assigned throughout the course. The schedule is subject to change, but all scheduling updates will be posted to the course web page and sent out via email.

* The *Molecules of Life* reading is assigned from a textbook by John Kuriyan, Boyana Konforti, and David Wemmer. Chapter 1 is available for free at the link below, and it may serve as a useful refresher for you. Parts A and C of this chapter are assumed: your introductory chemistry and biology prerequisites covered basic chemical interactions and the central dogma. We will review Part B in class.

The link is: http://www.garlandscience.com/res/pdf/9780815341888_ch01.pdf .

MISSISSIPPI STATE UNIVERSITY
2014 FALL ACADEMIC CALENDAR

All deadlines are at 12:00 midnight unless otherwise stated.

All dates and deadlines are subject to change.

August 15	New freshmen and transfer student orientation
	New graduate student orientation
August 18	Classes begin
August 19	Freshman Convocation
August 22	Last day to drop a course without a grade (5th class day)
August 25	Last day to register or add a course (6th class day)
	Last day to request undergrad academic forgiveness via myState
August 25 – October 15	Apply online via myState for December 2014 degree - $50 fee
September 1	Labor Day Holiday - no classes scheduled
September 16……	Deadline for students receiving incomplete grades in a previous semester to submit the coursework.
September 22 - October 17	Report progress grades on line
September 29	Last day to drop a course with a "W" grade (30th class day) 5:00 p.m.
October 6	Mid-point of semester
October 15	Last day to apply for December 2014 degree via myState - $50 fee
October 16 – October 31	Late December 2014 degree application via myState - $50 fee plus $50 late fee
	** Account balance must be paid before application is accepted
October 20 – October 31	Faculty advising for pre-registration
October 23 and 24	Fall Break – no classes scheduled (subject to change)
November 3 – 14	Pre-registration period for spring semester
November 13	Last day to withdraw from University (ten days of classes remaining)
November 1 – December 2	Very late December 2014 degree application via myState - $50 fee plus $200 late fee
	** Account balance must be paid before application is accepted
November 26, 27, 28	Thanksgiving holiday – no classes scheduled
December 1	Classes resume
December 2	Deadline to apply for December 2014 degree via myState - $50 fee plus $200 late fee
	** Account balance must be paid before application is accepted
December 2	Classes end
December 3, 5	Reading Days (No mandatory class assignments, requirements, meetings)
December 4, 8-11	Final examinations
December 12	Last day for December 2014 degree applicants to pay account balance
December 13	Starkville Campus Commencement 10:00 a.m. – All Colleges
December 15	**Final Grades Due 12:00 noon**
December 23- January 2	Winter Holidays

6/12/2014