

**Physical Chemistry with Biological Applications**  
**CHEM 4411/5411**  
**Fall 2005**

**Eklc E1B50**  
**Tuesday/Thursday 9:30 - 10:45 am**

Instructor: Prof. Lin Chen  
Cristol Chemistry 232c  
735-0071 (office)  
Lin.Chen@colorado.edu

Office Hours:  
Fri. 9:30-11:00 am  
Place: Cristol Chemistry 232c

Special Help Sessions            In Class, Exam weeks

TA: Scott Wren  
TA contact info: [scott.wren@colorado.edu](mailto:scott.wren@colorado.edu)

TA office hours  
Wed. 1:30-3:00 pm  
Place: TBA

**Text:**

Required:

*Physical Chemistry for the Life Sciences*  
Peter Atkins and Julio de Paula  
Freeman, Oxford University Press, 2006  
ISBN: 0-7167-8628-1

Chapters 1 – 5

Supplemental:

1. *Physical Chemistry for the Chemical and Biological Sciences*

Raymond Chang

University Science Press, Third Edition, 2000

2. *Physical Chemistry: Principles and Applications in Biological Systems*

Tinoco, Sauer, Wang, and Puglisi (Third or Fourth Edition)

**Overview:**

This course is an introduction to thermodynamics and its application. We will apply physical chemical concepts to examples from biochemical and biological systems to further our understanding of both physical chemistry and biochemistry.

The material presented in this course can *only* be learned by hands-on experience. Working the homework problem sets is essential to success. The homework sets will be collected on Tuesday, and one question, selected at random, graded pass/fail to inform you on your understanding of the material. In addition, short (15-20 min) quizzes will be administered weekly on Thursdays. The quiz will consist of one problem that is closely related to a problem on the homework set. To do well, you need to have completed the homework and understood the concepts involved in solving these problems.

**Exams and Grading:**

10% Homework  
20% Quizzes (best 8 of 9)  
40% Hour Exams (2)  
30% Final Exam

Quizzes cannot be rescheduled, but note that one quiz score will be discarded. Rescheduling of an exam will be considered only in exceptional circumstances, and requires prior approval of the instructor.

**CHEM 5411:**

Students enrolled in 5411 must write a 10-page paper (double space) examining the thermodynamic aspects of a research problem.

10/4 Description of proposed topic due (1 page)  
11/22 First draft submitted  
12/8 Final version due

1. If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and [www.Colorado.EDU/disabilityservices](http://www.Colorado.EDU/disabilityservices).
2. Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See full details at [http://www.colorado.edu/policies/fac\\_relig.html](http://www.colorado.edu/policies/fac_relig.html).
3. Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at [http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\\_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code).
4. All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council ([honor@colorado.edu](mailto:honor@colorado.edu); 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>.
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**Physical Chemistry with Biological Applications**  
**CHEM 4411/5411**  
*Syllabus*

| Date                              | PS/QZ #                                | Lecture Topic                      | Reading   |
|-----------------------------------|--|------------------------------------|-----------|
| <b>Prologue and Fundamentals</b>  |  |                                    |           |
| 8/23                              | -                                      | Introduction of Physical Chemistry | 1 - 6     |
| 8/25                              | PS#1 (out)                             | Fundamentals                       | 7 - 17    |
| 8/30                              | PS#1 (due)                             | Kinetic gas model                  | 17 - 23   |
| <b>Biochemical Thermodynamics</b> |  |                                    |           |
| 9/1                               | QZ#1 (PS#2 out)                        | The First Law (work and heat)      | 27 - 42   |
| 9/6                               | PS#2 (due)                             | Internal Energy and enthalpy       | 43 - 50   |
| 9/8                               | QZ#2 (PS#3 out)                        | Physical Change                    | 50 - 56   |
| 9/13                              | PS#3 (due)                             | Chemical Change                    | 56 - 72   |
| <b>The Second Law</b>             |  |                                    |           |
| 9/15                              | QZ#3 (PS#4 out)                        | Entropy (I)                        | 76 - 83   |
| 9/20                              | PS#4 (due)                             | Entropy (II) and the Third Law     | 83 - 91   |
| 9/22                              | QZ#4 (PS#5 out)                        | The Gibbs Energy                   | 91 - 101  |
| <b>Phase Equilibrium</b>          |  |                                    |           |
| 9/27                              | PS#5 (due)                             | Phase transition                   | 104 - 115 |
| 9/29                              | -                                      | <b>HOUR EXAM I</b>                 | 1- 103    |
| 10/4                              | PS#6 out                               | biopolymers                        | 115 - 124 |
| 10/6                              |  | Chemical potential                 | 124 - 134 |
| 10/11                             | PS#6 (due) (PS#7 out)                  | Colligative properties             | 134 - 146 |
| 10/13                             | -----Fall Break, No Class -----        |                                    |           |
| <b>Chemical Equilibrium</b>       |  |                                    |           |
| 10/18                             | PS#7 (due)                             | Reaction Gibbs Energy              | 151 - 156 |
| 10/20                             | QZ#5 (PS#8 out)                        | Reactions at Equilibrium           | 156 - 164 |
| 10/25                             | PS#8 (due)                             | Conditions affecting equilibrium   | 164 - 174 |
| 10/27                             | Quiz#6 (PS#9 out)                      | proton equilibria                  | 174 - 181 |
| 11/1                              | PS#9 (due)                             | polyprotic acids                   | 181 - 189 |
| 11/3                              | QZ#7 (PS#10 out)                       | buffers                            | 189 - 193 |
| 11/8                              | PS#10 due                              | Review                             |           |
| 11/10                             |  | <b>HOUR EXAM II</b>                | 104 - 199 |
| <b>Ion and Electron Transport</b> |  |                                    |           |
| 11/15                             | -                                      | Biological Membrane                | 200 - 208 |
| 11/17                             | PS#11 out                              | Redox reactions                    | 208 - 214 |
| 11/22                             | PS#11 due (PS#12 out)                  | Nernst equation                    | 214 - 223 |
| 11/24                             | *** Thanksgiving Holiday, No class *** |                                    |           |
| 11/29                             | PS#12 due                              | Applications of Electrochemistry   | 223 - 227 |
| 12/1                              | QZ #8 (PS#13 out)                      | Electron transfers                 | 227 - 232 |

12/6 PS#13 due Review  
12/8 Review

Final: **Time and location TBA**