CHE 349, Fall 2008: Physical Chemistry for Life Science

Instructor: Jochen Autschbach

Syllabus Revision 1.15. Last updated: August 21, 2008

Time, Dates, Location, Office Hours, Contact Info

Class Room: NSC 216, North Campus
Lecture Times: M, W, F 10:00 - 10:50
First day of class: Mon, Aug. 25
Last day of class: Fri, Dec. 5

Office Hours: Mon & Tue, 4:00 to 5:00 pm, NSC Room **313**, 312, or 345

Holidays relevant for our M/W/F classes:
Labor Day Observed: Mon, Sep. 1
Fall Recess: Wed, Nov. 26 – Sat, Nov. 29

Deadline for course resignation: Fri, Nov. 7, 11 pm (**double check with official academic schedule**)

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Please use the office hours instead of sending email for questions and problems that require an elaborate answer. Feel free to call me if you cannot attend the office hours, or make a special appointment at a different time. I usually have some time right after class to answer quick questions.

Course web site at UBLearns, https://ublearns.buffalo.edu. The course web site will contain downloadable (PDF) versions of the syllabus, homework, and announcements regarding the course.

Students with special needs: Please inform me of any special needs and register with the Office of Disability Services (ODS) as soon as possible. See `http://www.student-affairs.buffalo.edu/ods/` for details.

Textbook

The required textbook for the course is:
Tinoco, Sauer, Wang, Puglisi, *Physical Chemistry: Principles and Applications in Biological Sciences*, 4th Ed., Prentice Hall (2002).

***Before** each lecture you need to to study the relevant pages in the textbook as indicated in the **Schedule** section below.* This will take an estimated 2 hours on average. You are strongly encouraged to calculate the examples in each chapter yourself. The lectures will be presented assuming that all students have prepared each lecture accordingly.

Overview, Goals

Physical Chemistry covers many topics that are important in Life Sciences. Why do some reactions proceed in one direction and not backwards? How can we quantify a chemical equilibrium? How fast are chemical reactions in living organisms? How can we measure this? How much energy does an organism consume? How can we detect bio–chemically relevant molecules? How can we measure their properties? How do we know the mass and the shape of a protein? Physical Chemistry provides the methods and the theoretical background to answer these and related questions.

By the end of the course you should have a clear understanding of the first and second law of thermodynamics, and of the methods of chemical kinetics by which to determine and analyze the rates of chemical reactions, in particular of enzyme reactions. Further, you will have acquired some basic knowledge of the theory of molecular structure and interactions, and of various spectroscopic methods that are used to detect molecules and to investigate their properties.

Please note: This course covers most of the undergraduate physical chemistry topics in one semester instead of the usual two semester course *and* has additional life–science related topics. Although we will not discuss many of these topics in as much depth as in the regular two–semester course, our one–semester course has to proceed at a fast pace. **It is therefore essential that you prepare each lecture as mentioned above and do your homework. We won't have much time to review mathematical techniques. There is a Math section at the end of most chapters in the textbook that you should consult in case you forgot how to take, e.g., derivatives and simple integrals**.

Schedule

August	25	Course organization, Introduction, Scope, Chapter **1**
August	27	1st law of thermodynamics, Chapter **2**, 14 – 24
August	29	1st law of thermodynamics, Chapter **2**, 24 – 36
September	1	**Labor Day**
September	3	1st law of thermodynamics, Chapter **2**, 36 – 46
September	5	1st law of thermodynamics, Chapter **2**, 47 – 61
September	8	2nd law of thermodynamics, Chapter **3**, 68 – 77
September	10	2nd law of thermodynamics, Chapter **3**, 77 – 87
September	12	2nd law of thermodynamics, Chapter **3**, 87 – 97
September	15	2nd law of thermodynamics, Chapter **3**, 97 – 113
September	17	Thermodynamics: The Gibbs energy, Chapter **4**, 120 – 139
September	19	Thermodynamics: The Gibbs energy, Chapter **4**, 139 – 151
September	22	Thermodynamics: The Gibbs energy, Chapter **4**, 151 – 165
September	24	Thermodynamics: The Gibbs energy, Chapter **4**, 165 – 179
September	26	Thermodynamics: Physical equilibria, Chapter **5**, 186 – 206
September	29	Thermodynamics: Physical equilibria, Chapter **5**, 206 – 227
October	1	**Exam 1: Chapters 2, 3, 4, 5**
October	3	Thermodynamics: Physical equilibria, Chapter **5**, 227 – 244
October	6	X–Ray crystallography & Macromolecular structure, Chapter **12**, 666 – 679
October	8	X–Ray crystallography & Macromolecular structure, Chapter **12**, 679 – 699
October	10	X–Ray crystallography & Macromolecular structure, Chapter **12**, 699 – 708
October	13	Molecular motion and transport properties, Chapter **6**, 252 – 266
October	15	Molecular motion and transport properties, Chapter **6**, 267 – 283
October	17	Molecular motion and transport properties, Chapter **6**, 283 – 306
October	20	Kinetics: Rates of chemical reactions, Chapter **7**, 314 – 334
October	22	Kinetics: Rates of chemical reactions, Chapter **7**, 334 – 350

October	24	Kinetics: Rates of chemical reactions, Chapter **7**, 351 – 371
October	27	Kinetics: Rates of chemical reactions, Chapter **7**, 372 – 387
October	29	Enzyme kinetics, Chapter **8**, 400 – 412
October	31	Enzyme kinetics, Chapter **8**, 413 – 426
November	3	**Exam 2: Chapter 6, 7, 8**
November	5	Molecular structures and interactions: Theory, Chapter **9**, 436 – 458
November	7	Molecular structures and interactions: Theory, Chapter **9**, 459 – 479
November	10	Molecular structures and interactions: Theory, Chapter **9**, 479 – 503
November	12	Molecular structures and interactions: Theory, Chapter **9**, 503 – 523
November	14	Molecular structures and interactions: Spectroscopy, Chapter **10**, 530 – 543
November	17	Molecular structures and interactions: Spectroscopy, Chapter **10**, 543 – 554
November	19	Molecular structures and interactions: Spectroscopy, Chapter **10**, 554 – 567
November	21	Molecular structures and interactions: Spectroscopy, Chapter **10**, 567 – 579
November	24	Molecular structures and interactions: Spectroscopy, Chapter **10**, 579 – 588
		Fall Recess Nov. 26 – 29
December	1	Molecular structures and interactions: Spectroscopy, Chapter **10**, 588 – 601
December	3	**Exam 3: Chapters 9 and 10**
December	5	Summary: What have we learned?

Exams, Homework, Grades, Policies, Miscellaneous

The course's grade will be based on the average percentage of the two best of 3 mid–term exams. I do not explicitly grade your attendance. However, each class of the course builds upon the material covered until that point. Thus, you can expect difficulties if you do not attend the lectures. Moreover, the textbook contains much more material than what is relevant for the exams and you should attend the lectures to find out which topics were emphasized and which ones were skipped. In the past years a grade of A− or better was generally not given for scores lower than about 80%. The cut–off for B− was typically around 65%, C− around 50%, D around 40%. **The final grading scheme to determine a *letter grade* will be fixed at the end of the course when I have all percentages for the 3 exams available**. I will post an *approximate* letter grading for the first exam which you can use as a guide line to assess your performance in the course. Unless exams 2 and 3 yield significantly different results than exam 1 (on average) I will apply a similar formula in order to determine the final letter grade. I will *not* assign individual letter grades for the exams.

How can you get an "A" in this course? You need to learn *and practice, practice, practice, . . .* how to carry out correct calculations. You need to be able to state a correct definition of a physical chemical phenomenon or process that was discussed in class, and understand the qualitative behavior of graphs and equations that were shown in the lectures or that were part of the homework. In addition, you need to understand the *motivation* behind the concepts introduced in this course. You will be able to show that you can *transfer* your knowledge in order to solve problems that are not exactly the same as problems that were discussed in the lecture or as part of an assignment. Most importantly, you will learn from your mistakes made in the homework and the practice exams and not make them again.

For each exam, you are allowed to bring one (1) letter–size page of hand written notes (equations, def-

initions) and a pocket calculator. You will have to hand in the page of notes along with the exam. This equation sheet will not be returned — make a copy before the exam. ***You can write anything you want on this sheet (one side only!)****.*

Practice exams will be posted at UBLearns about a week before the test is scheduled. *Relevant exam material covers everything mentioned in class or what was part of the homework, not just questions posted in the practice test.* However, the types of problems (e.g. there will be few multiple choice questions) and difficulty levels will be similar.

Bring a pocket calculator to the exam. I do not have spare calculators. You will need a pocket calculator.

Exams will *not* be returned but kept in my office. I will post the grades on–line and at my office door. **You are encouraged to take a look at your corrected exam during the office hours (see page 1)**. It takes typically about 1.5 weeks before grades are posted on–line.

Make–up exams may be taken only in exceptional cases (medical emergencies, car accidents on the way to the campus, etc.) in which case you need to provide proper **documentation** (letter from your physician, police report, etc.). *Getting up too late does not qualify for taking a make–up exam! Don't ask me to take a make–up exam if don't have a serious excuse — I* ***cannot*** *make any exceptions*.

You should finish your homework before the lecture one week after the questions were handed out. I will discuss the answers in class but you will get the most out of this when you have worked on the problems yourself beforehand. Homework is voluntary but nonetheless extremely important — **you need to practice calculations**. Homework will not count for the course grade. "Bonus work", e.g. additional homework, in order to compensate for low grades will *not* be available for this course. Regarding incomplete grades, see `http://undergrad-catalog.buffalo.edu/policies/grading/explanation.shtml#incomplete`

Academic integrity as defined in UB's official guidelines will be strictly enforced. Make sure you know what is meant by "academic integrity" according to these guidelines. See `http://undergrad-catalog.buffalo.edu/policies/course/integrity.shtml`

Grade details:

There will be three mid–term exams, ~ 50 minutes, during regular class hours. See course schedule. Individual exam scores will be posted as a percentage of the highest possible score. The *two best* of these exams will be used to determine the final grade. Example: If you score 85, 70, and 75 % in the three tests the percentage score used for determining the final letter grade will be 80% (the average of 85 and 75 from the two best test results).

The first exam will cover Chapters 2 – 5 (thermodynamics, chemical and physical equilibria), the second exam will cover chapters 6 – 8 (transport properties and chemical kinetics), the third exam will cover Chapters 9 and 10 (quantum theory and spectroscopy).

There is *no final exam* after the last day of classes, even if a time and room assignment is listed.

Important: Equal and fair treatment of each student in this class is of paramount importance. Regarding the final grades this has the following consequences: Unless you find an error in my calculation of the grade or the percentages do not ask me to change an assigned letter grade, even if it is infinitesimally close to the cut–off percentage for the next better grade. Likewise, a grade will not be adjusted because someone intends to apply to law/medical/dental/etc. school.

Now: sit back, relax, and enjoy the course.