Physical Chemistry I
Chemistry 341, Section 1
Fall 2022

Instructor: Assoc. Prof. David Boucher
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Lecture schedule: MWF 9:00-9:50, SSMB 138

Office hours: M 12-1, T 11-12, W 12-2, F 12-2, or by appointment.

Textbook
CHEM341 Lecture Notes, is available as a pdf on OAKS. Additionally, there are several options for additional textbooks. Dr. Boucher recommends (1) Physical Chemistry: Thermodynamics, Structure, and Change, 10th Ed., (Atkins and DePaula), or (2) Thermodynamics, Statistical Thermodynamics, & Kinetics, 2nd Ed. (Engel and Reid).

Course Description
Basic principles of chemistry treated primarily from a theoretical viewpoint. The major topics covered are elementary classical and statistical thermodynamics, properties of gases, liquids, and solids, theories of solution, homogeneous and heterogeneous equilibria, electrochemistry, surface chemistry, transport processes, and chemical kinetics. Lectures three hours per week. Prerequisites: CHEM 221 and MATH 220; MATH 221 is strongly recommended. Co-requisite: CHEM 341L

Office Hours
Dr. Boucher will be available for in-person office hours M 12-1, T 11-12, W 12-2, F 12-2, or by appointment. If you would like a one-on-one help session, please e-mail Dr. Boucher to reserve a block of time during the office hours. If you have a problem attending one of the regular office hour periods additional appointments can be made upon request. Dr. Boucher will respond within 24 hours to e-mails and sent Monday-Friday, and within 48 hours to discussion board posts and e-mails sent on Saturday or Sunday.

Course Webpages
All important information regarding this course, e.g., exam dates, assignment due dates, etc., will be available on the OAKS webpage. This information includes all announcements and postings, lecture schedule and suggested reading assignments, lecture notes, exam answer keys, handouts. We will also make extensive use of the dropbox features on OAKS to submit written assignments, e.g., exams, quizzes, and problem sets.

Assignment Submission Policy
All assignments, e.g., problem sets, quizzes, exams, etc., should be submitted as a pdf using the Dropbox on the course OAKS page. All assignments are to be completed and turned in on time. Late assignments will result in a reduced grade of 10% for each day late.
Please note, computer failure or unavailability does not constitute an excuse for not completing assignments by the due date. It is your responsibility to ensure you have internet access required to successfully complete this course. This may require you to be creative in cases where your original plan for network access falls through (i.e. go to a library, coffee shop, etc. if your internet goes out at home).

Logistics and Continuity of Learning
A majority of the lectures will be presented in Powerpoint format. The lecture notes and Powerpoint presentation will be posted on OAKS. This practice is intended to free your hands and minds to concentrate on the material during the lectures. This practice is also intended to encourage questions as you will not have to worry about writing down everything written on the board. Course handouts, lecture notes, homework sets, and homework solutions will be available on the OAKS course website.

Some General Comments
Physical chemistry has an intimidating reputation. This is partly because it requires you to think about chemistry in new ways. In organic chemistry you were able to use powerful symbolic ways of thinking about how molecules behave to qualitatively understand molecular behavior in synthetic chemistry. In physical chemistry we use the language of mathematics to quantitatively calibrate the intuition you have developed thus far in your career as a chemist. During this semester we will learn to use the powerful tools of thermodynamics, kinetics, and statistical mechanics to understand in a fundamental way why some molecules exist and others do not and why some molecules react with each other and others do not. As when learning any new language or skill, the key to success in physical chemistry is practice. You can study rules of grammar for years on end, but you will not be able to carry on a conversation unless you actually practice talking to people. In physical chemistry you can gain general familiarity with physical concepts like energy, entropy, and chemical potential, but unless you practice working problems you will not be able to use your familiarity with these concepts to your advantage. The goal of this class is neither to develop vague familiarity with trendy concepts like entropy nor to mindlessly plug numbers into formulas until you get a number that agrees with the answer key. Rather, the goal of this course is to gain a solid knowledge of the physical basis of chemical phenomena and to turn that knowledge into a tool for doing chemistry. In short, you need to attend the lectures, read the book, AND do the problems.

Physical Chemistry and the Curriculum
This course will help us meet several of the College’s curricular goals. By the time we are finished we should have a better idea of how physical chemistry is different from other areas of chemistry. Physical chemistry operates at the interfaces between chemistry, physics and mathematics, and we will use many ideas from physics and mathematics to explore chemical systems and how chemistry is related to other scientific fields. Physical chemistry’s role in the chemistry curriculum is to provide a strong physical basis for understanding ideas that chemists use every day: energy, enthalpy, equilibrium, and reaction rates. The ideas we look at this semester are the basis for how chemists understand whether or not a reaction or process will happen (thermodynamics), to what extent it will happen (equilibrium), and how long it will take (kinetics).

Learning Outcomes
Physical chemistry provides us with an opportunity to do lots and lots of quantitative reasoning, to use the tools of mathematics and physics to solve problems in chemistry and biochemistry. If someone poses a question about the physical basis of some chemical phenomenon, then, as a chemist, we should be able to apply your knowledge of physical chemistry to suggest the appropriate theory or model to apply, be able to do the calculations necessary to apply the model, and we should be able to clearly and coherently
explain what we have done so the person who asked the question has confidence that we know what it is we are doing. It would also be nice if, along the way, this course gives us an appreciation for the underlying beauty of the physical world.

At the end of this syllabus is a detailed list of subjects and knowledge requirements we will encounter throughout the semester. Listed below are some of the general learning outcomes for Chemistry 341:

1. Apply the basic concepts of calculus and physics to concepts in chemistry.
2. Be proficient in reading and interpreting complex graphs and figures presenting experimental data.
3. Be comfortable reading advanced physical chemistry textbooks and find the necessary information in the textbooks needed to solve a particular problem.
5. Develop the ability to use original thought (and logic) in the solutions of problems and the derivations of equations.
6. Apply critical thinking skills to solve new chemistry problems that are different than ones you have already solved.
7. Understand the physical basis of the gas laws used to describe real and ideal gas behavior.
8. Discuss the Three Laws of Thermodynamics and their development.
9. Be able to derive relationships between thermodynamic quantities.
10. Understand thermodynamic state functions and their dependence on the state variables.
11. Interpret phase diagrams and discuss phase equilibria in terms of the chemical potential.
12. Explain the origin of the equilibrium constant and its relation to activity.
13. Understand gas phase collisional and transport properties and their dependence on fundamental molecular and macroscopic properties.
14. Understand how statistical thermodynamics is used to describe the microscopic properties of matter and to determine bulk thermodynamic quantities

Attendance Policy

Although the instructor will not be keeping a record of attendance, students are expected to attend all classes. If in-person classes are suspended, faculty will announce to their students a detailed plan for a change in modality to ensure the continuity of learning.

In order to foster a cordial and secure learning environment, please be respectful of your instructor and your classmates. Do not obstruct or disrupt the teaching and learning processes by carrying on conversations on your cell phone or with other students in the class.

Assessment

There will be no in-class examinations in this course. Instead, there will be approximately seven problem sets assigned throughout the semester, one every two weeks. Short (~10 minutes) in-class quizzes will also be administered. The dates of the quizzes will be determined by the pace of the course. Most of your course grade (70%) will be based on these problem sets and quizzes. Absences or an inability to complete the problem set on time should be arranged in advance when possible and students should contact the instructor as soon as possible regarding scheduling conflicts. If you miss a problem set due to illness, you and your instructor will meet to discuss if there is a reasonable accommodation for making up the assignment. **Problem sets must be submitted as a single pdf in the dropbox on the course OAKS page. Late assignments will not be accepted.**
**Regrades:** Students may return problem sets and quizzes they believe to have significant grading errors for reconsideration within one week of receipt of the graded assignment. Students must submit clear and succinct explanations of the grading error(s) in question along with the exam to be regarded. The explanation should establish that the answer key is incorrect or incomplete, that the answer given by the student is an equivalent or equally valid solution to that given on the key, or that the student gave the same answer as the key but it was not recognized as such. No markings or other alterations should be made on the exam itself.

**Final Exam:** A mandatory, comprehensive final exam will be administered **10:30 am–12:30 pm** on Monday, December 12th.

**Grading and Assessment**

Your final grade will be based on the following distribution,

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<th>Score/%</th>
<th>Grade</th>
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<tr>
<td>&gt;75</td>
<td>A</td>
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<tr>
<td>71-74</td>
<td>A-</td>
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<tr>
<td>61-70</td>
<td>B+</td>
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<tr>
<td>63-66</td>
<td>B</td>
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<td>59-62</td>
<td>B-</td>
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<td>55-58</td>
<td>C+</td>
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<tr>
<td>51-54</td>
<td>C</td>
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<tr>
<td>47-50</td>
<td>C-</td>
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<tr>
<td>43-46</td>
<td>D+</td>
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<tr>
<td>39-42</td>
<td>D</td>
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<tr>
<td>35-38</td>
<td>D-</td>
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<td>&lt; 35</td>
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Graded problem sets will be returned using the “Feedback” feature in the OAKS dropbox.

Letter grades will be assigned based on straight grading scale shown in the table above.

The instructor reserves the right to increase a student’s grade if the instructor feels that it is warranted. Periodically you will be made aware of your class standing so that you can assess your progress and to help you avoid any surprises at the end of the semester.

**Disabilities/Access**

The College will make reasonable accommodations for persons with documented disabilities. Students should apply for services at the Center for Disability Services/SNAP located on the first floor of the Lightsey Center, Suite 104. Any student eligible for and needing accommodations because of a disability is requested to speak with the professor during the first two weeks of class or as soon as the student has been approved for services so that reasonable accommodations can be arranged.
Student Code of Conduct

The Honor Code of the College of Charleston forbids lying, cheating, stealing, plagiarism, and failing to report an Honor Code violation. The Student Code of Conduct can be found in the Student Handbook.

Science is inherently collaborative. If you go on to work in industrial or academic laboratories you will work with other scientists as a collaborator, as a mentor, and as a student throughout your career. Learning to work effectively with other people is therefore an important part of your undergraduate training. You may choose to work together on homework problems with your classmates, but you should not merely copy out their answers to homework questions. Working together means working together. There are two reasons for this. The first is that you will not really understand how to do the problem simply by copying it out, and understanding the problems should be your chief goal. Secondly, your peers will get tired of your mooching. If you do work with people on your assignments, please include the name(s) of your partner(s) on your work.

When we have exams, you should not talk to anyone except your instructor during the exam. Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved. Incidents where the instructor determines the student’s actions are related more to a misunderstanding will handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The intervention, submitted by form and signed both by the instructor and the student, will be forwarded to the Dean of Students and placed in the student’s file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

Students should be aware that unauthorized collaboration—working together without permission—is a form of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or test, no collaboration during the completion of the assignment is permitted. Other forms of cheating include possessing or using an unauthorized study aid (which could include accessing information via a cell phone or computer), copying from others’ exams, fabricating data, and giving unauthorized assistance.

Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor. Students can find the complete Honor Code and all related processes in the Student Handbook at http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php

Statement on Religious Accommodation for Students

(1) Faculty/Administration Manual VIII.A.10

The College of Charleston community is enriched by students of many faiths that have various religious observances, practices, and beliefs. We value student rights and freedoms, including the right of each student to adhere to individual systems of religion. The College prohibits discrimination against any student because of such student’s religious belief or any absence thereof.
The College acknowledges that religious practices differ from tradition to tradition and that the demands of religious observances in some traditions may cause conflicts with student schedules. In affirming this diversity, like many other colleges and universities, the College supports the concept of “reasonable accommodation for religious observance” in regard to class attendance, and the scheduling of examinations and other academic work requirements, unless the accommodation would create an undue hardship on the College. Faculty are required, as part of their responsibility to students and the College, to ascribe to this policy and to ensure its fair and full implementation.

The accommodation request imposes responsibilities and obligations on both the individual requesting the accommodation and the College. Faculty members are expected to reasonably accommodate individual religious practices. Examples of reasonable accommodations for student absences might include: rescheduling of an exam or giving a make-up exam for the student in question; altering the time of a student’s presentation; allowing extra-credit assignments to substitute for missed class work or arranging for an increased flexibility in assignment dates. Regardless of any accommodation that may be granted, students are responsible for satisfying all academic objectives, requirements and prerequisites as defined by the instructor and by the College.