Instructors: Dr. David Boucher  
Office: Science Center, Rm. 322 (3-6493)

Office Hours: Tuesday and Thursday 11-1, Wednesday 12-2, and by appointment.


Recommended Materials:  
b. Schaum’s Outlines: Mathematical Handbook of Formulas and Tables, M.R. Spiegel and John Liu, or a similar reference (recommended)

Course Description: Second semester of a one-year sequence. Basic principles of chemistry treated primarily from a theoretical viewpoint. Emphasis on introductory quantum mechanics, atomic structure, molecular bonding and structure and spectroscopy. Statistical thermodynamics of gaseous systems may be introduced. Uses multivariable calculus, differential equations and some linear algebra. Lectures three hours per week.

Prerequisites: CHEM 341 and CHEM 341L  
Co-requisite: CHEM 342L

Some comments: Physical chemistry sometimes 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 quantum chemistry, group theory, and spectroscopy. 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 a book to improve and clarify your understanding of the material in the lecture (and the lab), AND do the assigned problems.

This course is demanding; we will cover a large amount of material this semester. You must spend enough time to keep up with the lectures. If you fall behind it will be very hard to catch up because topics are interconnected. You will not be able to study for this class the night before an exam and expect to do well.

Physical Chemistry and the Curriculum: This course should help you meet several of the College’s curricular goals. The primary goal is to introduce you to modern chemical theory. By the time you are
finished you should have a better idea of how physical chemistry, particularly quantum chemistry, is different from other areas of chemistry. Physical chemistry operates at the interfaces between chemistry, physics and mathematics. We will use many ideas from physics and mathematics to explore chemical systems so you can see how chemistry is related to other scientific fields. Physical chemistry’s role in the chemistry curriculum is to provide you with a strong physical basis for understanding ideas that chemists use every day. In addition, learning to use advanced quantum mechanical theories is extremely good practice at solving difficult and unfamiliar problems as well as thinking analytically, critically and creatively.

**Learning Objectives:** Physical chemistry provides you with an opportunity to do lots and lots of quantitative reasoning, and at the end of Chemistry 342 you should be able 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, you 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 explain what you have done clearly and coherently so the person who asked the question has confidence that you know what it is you are doing. It would also be nice if, along the way, you gain some appreciation for the underlying beauty of the physical world. However, progress on this goal is hard for me to assess, so I’ll leave it up to you to decide how you are coming along.

At the end of this syllabus is a detailed list of subjects and knowledge requirements that you will encounter throughout the semester. Listed below are some of the general learning objectives for Chemistry 342:

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.
4. Learn selected history of science pertaining to quantum mechanics with emphasis on the early development of this theory, the new concepts therein and the modifications of human reasoning toward the subatomic world.
5. Understand the postulates and structure of quantum mechanics.
6. Understand how to think about quantum mechanical systems and how to apply this knowledge to atomic and molecular structure, systems of chemical interest, and spectroscopy.
7. Be able to set up and solve simple quantum mechanical problems, identify and understand any assumption(s) needed to solve a problem, and discuss the properties of the solutions.
8. Learn the fundamentals of group theory and understand the basic applications of group theory to molecular symmetry, structure and spectroscopy.

**Logistics:** The lectures will be presented in Powerpoint format and the lecture notes 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 every single board scratch. Course handouts, lecture notes, homework sets, and homework solutions will be available on the OAKS course website.

**Attendance Policy:** Although the instructor will not be keeping a record of attendance, students are expected to attend all classes. Students are responsible for announcements and for understanding
material discussed in class, whether present or not. Attendance is required at exams. In case of unavoidable absence, speak with the instructor promptly.

**Classroom Conduct:** In order to foster a cordial and secure learning environment, please be respectful of your instructor and you 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, sending text messages, or surfing the web on your laptop. Please set cell phones on mute or vibrate before coming to lecture. Do not verbally abuse, threaten, intimidate, or ridicule your instructor or classmates. If you fail to comply with these simple requests you will be asked to leave the class and if the problems persist you will be referred to the Dean of Students for disciplinary action.

**Problem Sets:** Problem sets worth 50 points each will be posted the Thursday of each week and will be due for grading at the beginning of lecture the following Thursday. **A 5 point per day penalty will be assessed for late problem sets.** The graded problem sets will constitute one exam toward your final course grade. Problem sets will not be posted the week prior to an examination, but you will receive a set of problems to help you prepare for the examination. Although these extra problems will not be collected and graded, it is strongly recommended that you work through them as they will highlight the concepts and computational procedures that you will encounter on the exam.

**Exams:** Four in class examinations worth 100 points each will be given. The exams are scheduled for **FEB 9, MAR 2, MAR 30, and APR 20.** Absences from any exam must be arranged in advance. No make-up exams will be given. Students should contact the instructor as soon as possible regarding scheduling conflicts, e.g., courses or other exams are scheduled for the same times as the lecture exams. **The exam with the lowest grade will be dropped prior to calculating your final grade.**

**Final Exam:** A mandatory, comprehensive ACS final exam will be administered **8 am–11 am on Thursday May 4th.** The examination will be administered in the regular lecture room.

**Exam Regrades:** Students may return exams they believe to have significant grading errors for reconsideration within one week of receipt of the graded exam. 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.

**Grading:** Your final grade will be based on the following distribution,

- 20% 1st Hour Exam
- 20% 2nd Hour Exam
- 20% 3rd Hour Exam
- 20% Final Exam
- 20% Problem Sets

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

<table>
<thead>
<tr>
<th>DATE</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Monday, January 19</td>
<td>Martin Luther King, Jr. observation– no class</td>
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<tr>
<td>Thursday, February 9</td>
<td>EXAM #1</td>
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<tr>
<td>Thursday, March 2</td>
<td>EXAM #2</td>
</tr>
<tr>
<td>March 6-10</td>
<td>Spring Break Holiday– no class</td>
</tr>
<tr>
<td>Thursday, March 16</td>
<td>Midterm Grades Available</td>
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<tr>
<td>Thursday, March 23</td>
<td>Last Day to Withdraw with a Grade of “W”</td>
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<tr>
<td>Thursday, March 30</td>
<td>EXAM #3</td>
</tr>
<tr>
<td>Thursday, April 20</td>
<td>EXAM #4</td>
</tr>
<tr>
<td>Wednesday, April 26</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>Thursday, May 4</td>
<td>FINAL EXAM: 8-11 AM in SSMB 127</td>
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<tr>
<td>Tuesday, May 9</td>
<td>Final Grades Available</td>
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**Learning disabilities:** Any student with a documented learning disability is advised that the Chemistry Department is happy to work with you on accommodations. You should contact me early in the semester to discuss which accommodations would be appropriate.

**The Student Code of Conduct and Physical Chemistry:** 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 colleagues 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 during the exam but your instructor.

Below is the recommended language regarding the College of Charleston Honor Code and Academic integrity:

*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*