

## CHEM 165 – Introduction to Physical Chemistry

**Time:** 10:05 - 11:20AM TR

**Room:** HILLS AGRI SCI 122

**Lecturer:** Jianing Li ([jianing.li@uvm.edu](mailto:jianing.li@uvm.edu), Discovery W309)

**Office Hour:** TBA

**Grader:** Jonathon Ferrell ([Jonathon.Ferrell@uvm.edu](mailto:Jonathon.Ferrell@uvm.edu), Discovery W327)

### Summary

Chem 165 is the first semester of the year-long course in physical chemistry. During this first semester, all aspects of physical chemistry will be covered at an introductory level. In broad strokes, the topics comprise: quantum mechanics, spectroscopy, thermodynamics, and kinetics.

In physical chemistry, the general objective is to understand the underlying theory of many of the facts and rules you have learned in prior chemistry courses. This, in turn, requires math/physics familiarity, rather than knowledge of chemistry in the form of molecular formulas and their reactions. For example, it is a fact that atomic orbitals are the basis of bonding, but do you know why a p-orbital has a “dumbbell” shape? [This was not plucked out of thin air.] It is also a fact that the energy contained in bonds is the basis for chemical reactions, but do you know why two hydrogen atoms would rather get together to form a molecule than exist apart? [Saying that two orbitals “overlap” is fuzzy, and is not a real answer.] At the thermodynamics end, we know that spontaneity is connected to lowering entropy, but is that always true? (Think of amino acids spontaneously forming DNA.) And how did “entropy get invented anyway? Why do there seem to be two worlds, the macroscopic which we track with thermodynamics vs. the microscopic where quantum mechanics is the coin of the realm?

It is the goal of this course to help you to understand how a study of physical chemistry provides clear answers to the above questions, and in the process, demystify these subjects for you.

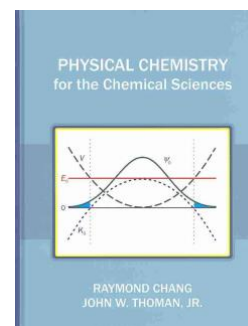
### Textbooks

#### Required:

- *Physical Chemistry for the Chemical Sciences*, by Raymond Chang and John W. Thomas, JR

In this course (Chem 165), we will mainly cover

- Chapter 10: Quantum mechanics
- Chapter 11: Applications of Quantum Mechanics to Spectroscopy
- Chapter 12: Electron structure
- Chapter 3: First law of thermodynamics
- Chapter 4: Second law of thermodynamics
- Chapter 5: Gibbs energy applications
- Chapter 8: Chemical equilibrium
- Chapter 15: Chemical kinetics



There are ~30 lectures in the semester. On average, each of these chapters will take about 4 lectures to cover.

While this textbook closely approximates our pedagogic approach, you should understand that for most upper level courses the textbook is an aid, not the “bible”. Depending on the material/chapter, various sub-topics will not be covered in class (or the reverse). The rule of thumb to use in this course is that if a concept is not discussed in lecture, you don’t need to know the corresponding passage of a chapter unless I assign some reading on your own. Conversely you are responsible for all material discussed in class.

Also, be aware that much of the content may be presented by me differently from the way the author has done a given topic. Having said all this, I want to emphasize that trying to learn the subtleties of physical chemistry just from attending lectures and reviewing my notes is probably not going to cut it. There is real value to reading a textbook with wording that is different from the way the instructor presents it – and it is a good book to reference for any future chemistry topic.

#### *Exercises*

The content in this course is pretty challenging, and cannot be mastered without blood, sweat, and tears as you review the material and do the exercises. Exercises will be assigned at the beginning of each topic, but will not need to be collected. The solutions will be posted in Blackboard after the topic is completed.

#### *Exams*

There will be two mid-term exams on March 6 and April 2, and the final exam on May 7 (13:30 to 16:15). Students that have time conflict can contact me at least ONE WEEK before the exam and take the exam within FIVE DAYS BEFORE the scheduled date.

#### *Grading*

The numerical grade will be based on the mid-term exams (20% each), final exam (50%), in-class quizzes (10%). Bonus points (max 2 pts) can be awarded for active participation in the Blackboard Discussions. The average numerical grade corresponds to a B- letter grade.

**Student Learning Accommodations:** In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact ACCESS, the office of Disability Services on campus. ACCESS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations via an accommodation letter to faculty with recommended accommodations as early as possible each semester.

Contact ACCESS: A170 Living/Learning Center; 802-656-7753; [access@uvm.edu](mailto:access@uvm.edu);  
[www.uvm.edu/access](http://www.uvm.edu/access)

UVM's policy on disability certification and student support:  
[www.uvm.edu/~uvmppg/ppg/student/disability.pdf](http://www.uvm.edu/~uvmppg/ppg/student/disability.pdf)

**Religious Holidays:** Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the end of the second full week of classes. You will be permitted to make up work within a mutually agreed-upon time.

**Academic Integrity:** The policy addresses plagiarism, fabrication, collusion, and cheating.  
<http://www.uvm.edu/~uvmppg/ppg/student/acadintegrity.pdf>

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**Grading:** For information on grading and GPA calculation, go to [www.uvm.edu/academics/catalogue](http://www.uvm.edu/academics/catalogue) and click on Policies for an A-Z listing.

**Code of Student Rights and Responsibilities:**  
[www.uvm.edu/~uvmppg/ppg/student/studentcode.pdf](http://www.uvm.edu/~uvmppg/ppg/student/studentcode.pdf)

**FERPA Rights Disclosure:** The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974.  
<http://www.uvm.edu/~uvmppg/ppg/student/ferpa.pdf>

**Promoting Health & Safety:**

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*Center for Health and Wellbeing* <http://www.uvm.edu/~chwb/>

*Counseling & Psychiatry Services (CAPS)* Phone: (802) 656-3340

*C.A.R.E.* If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at <http://www.uvm.edu/~dos/>

**Final exam policy:** The University final exam policy outlines expectations during final exams and explains timing and process of examination period.  
<http://www.uvm.edu/academics/catalogue2013-14/?Page=allpolicies.php&SM=policymenu.html&policy=Exams>