CHE 337 – Thermodynamics and Kinetics – Fall 2018

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Office: HSC 364
Office Hours: 10am-12pm Tuesday, 2-3pm Wednesday, 10:30-11:30am Friday, or by appointment

Course Description (from Westminster undergraduate catalog)
Thermodynamics and kinetics is a study of the macroscopic behavior of matter. Topics include the application of the laws of thermodynamics, the thermodynamic behavior of pure substances and mixtures, as well as the kinetic theory behind time-dependent processes and mechanisms. Prerequisites: CHE 117 and MTH 150 and 152 and PHY 142 or 152.

Course Outcomes
The outcomes of this course are:

- Describe and explain the physical concepts involving the four fundamental laws of classical thermodynamics.
- Describe and explain how these four laws are applied and incorporated to applications of physical and chemical equilibria.
- Describe and explain the principles of chemical kinetics and time-dependent processes.
- Solve mathematical problems based on physical chemical principles and connect the numerical results with these principles.

Textbook
The text for this course is Physical Chemistry, 10th Ed. by Atkins and de Paula. Readings and problem set questions will be assigned from this text. You are strongly urged to get a copy of this textbook and complete all the assigned readings and homework.

Outline of Topics
(Chapters are from Physical Chemistry, 10th Ed. by Atkins and de Paula)

1. The properties of gases (Ch. 1)
   A. Ideal gases
   B. The kinetic model
   C. Real gases

2. The 1st Law of Thermodynamics (Ch. 2)
   A. Work, heat, internal energy, calorimetry
   B. Enthalpy
   C. Thermochemistry
   D. Exact and inexact differentials
   E. Adiabatic processes

3. The 2nd and 3rd Laws of Thermodynamics (Ch. 3)
   A. Entropy, The Second Law
   B. Measurement of entropy, The Third Law
   C. Gibbs and Helmholtz energies
   D. Maxwell relations

4. Phase diagrams (Ch. 4)
   A. Phase diagrams of pure substances
   B. Thermodynamics of phase transitions

5. Thermodynamics of mixtures (Ch. 5)
   A. Thermodynamic description of mixtures
   B. Properties of mixtures
   C. Phase diagrams
   D. Activities
   E. Activities of ions

6. Chemical equilibrium and electrochemistry (Ch. 6)
   A. Equilibrium constant
   B. Response of equilibria to conditions
   C. Electrochemical cells
   D. Electrode potentials
7. Chemical kinetics (Ch. 20)  
   A. Rates of chemical reactions  
   B. Integrated rate laws  
   D. Arrhenius equation, catalysis  
   E. Reaction mechanisms  
   F. Enzymes  

8. Statistical Thermodynamics (Ch. 15)  
   A. The Boltzmann distribution  
   B. Partition functions  
   C. Molecular energies  
   D. The canonical ensemble  
   E. The internal energy and the entropy

**Course Evaluation /Assessment**
All course outcomes will be assessed through completion of assigned problem sets from the textbook, reading quizzes, take-home problems (BPP) and Just-In-Time (JIT) surveys, three class exams as well as a comprehensive final exam.

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<tr>
<th>Grade Scale (out of 100%)</th>
<th>Point Distribution</th>
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<tbody>
<tr>
<td>A 90-100%</td>
<td>Problem sets</td>
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<td>B+ 87-89%, B 83-86%, B- 80-82%</td>
<td>JIT surveys</td>
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<td>C+ 77-79%, C 73-76%, C- 70-72%</td>
<td>Big pchem problems</td>
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<tr>
<td>D+ 67-69%, D 63-66%, D- 60-62%</td>
<td>Reading quizzes</td>
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<td>F &lt; 60%</td>
<td>Exams</td>
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<td>Final exam</td>
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<td>ACS Exam</td>
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<tr>
<th>Problem Sets</th>
<th>Extra credit</th>
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<td>Problem sets will be posted on D2L one week before they are due. Problem sets will be checked for completeness (+2/+1/0). You will be responsible for checking the correctness of your own solutions using answer keys posted on D2L. All work is due at the start of class on the assigned day. Late problem sets will be penalized 10% of the total possible points for each day the assignment is late (any time after lecture counts as one day late).</td>
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**Participation-JIT Surveys**
Just-in-time (JIT) surveys will be posted on D2L periodically throughout the semester, you are expected to complete these surveys before arriving to class. Failure to complete these surveys will result in a loss of points.

**Big Pchem Problems (BPP)**
Throughout the semester you will be given large, homework style problems to work on over a period of days. These problems will be graded on correctness. The same late policy applies as with the problem sets.

**Reading Quizzes**
Reading quizzes will be posted on D2L. Keeping up on concepts covered in the textbook is your responsibility as I may not cover all details and definitions in class. This frees up time to work on problems and engage in discussion during lecture.

**Exams**
There will be three exams given during the class period, with an optional start at 11:40 am the day of the exam. Tentative dates are Wednesday, September 19th, Wednesday, October 17th, and Wednesday, November 14th. You will be allowed to write your own equation sheet for the exam, you do not need to memorize physical constants or large numbers of equations. If you have a have an official conflict, you must make arrangements at least one week in advance.

**Lecture will be heavily problem-based; therefore, class participation is critical not only for individual student understanding but for the success of the class as a whole. Failure to work actively during the class period will affect your comprehension and my support in the class**
**Academic Integrity**
Academic dishonesty will not be tolerated. The first citation of academic dishonesty will result in a grade of zero for the specific assignment. The second citation will result in a failing grade for the course. All citations of academic dishonesty will be reported to the Dean of the College, in accordance with college policy. Academic dishonesty takes several forms, including, but not limited to, plagiarism, cheating, and misrepresentation of facts or experimental results. Refer to the Student Handbook for more information about academic dishonesty.

**Additional Help**
Westminster College actively strives for the full inclusion of all our students. Students with disabilities who require access solutions for environmental or curricular barriers should contact Disability Resources, located in 209 Thompson-Clark Hall.

**Strategies for Success in Physical Chemistry**
Although each student is unique and undoubtedly has different ways of mastering new material, experience has shown that there are some strategies that are particularly helpful to successfully mastering physical chemistry.

A. Complete all the problem sets and quizzes.
Actively working through problems is a great way to master physical chemistry and internalize the principles presented in lecture. If you really wanted to learn to play piano, would you read about piano and watch someone else play, or would you sit down at the piano yourself and practice?

B. Don’t get lost in the units!
Use dimensional analysis whenever you can and always put units on the solutions to your calculations on problem sets and exams. Carefully keeping track of units can help prevent many problems in this course.

C. Review your lecture notes after class and read supporting textbook sections.
Read the book. Seriously. This is vital. The chapters are listed in the "Outline of Topics" and will be repeated on Problem Sets and in lecture as the semester proceeds. If this book doesn’t make sense, try another! Reading about a concept from another authors’ point of view is often helpful. There are numerous other physical chemistry textbooks out there. Personally, I have four texts that I use to make sense of it all!

D. Form a study group.
Find a group of other students in the class and discuss material covered in lecture and work together on the problem sets. Scheduling a regular time to meet each week with a study group can help you keep up a disciplined schedule throughout the semester.

E. Seek out help when you need it!
Come to office hours. Be proactive about your learning. Do not wait until the night before exams or problem sets to figure out you are stuck.

F. Assumptions aren’t always bad.
In modern research, we rarely have all the information. Assumptions are a part of chemistry and you will use them frequently in this course. If you get lost, or stuck, make an assumption and see what happens. Follow your assumption to its natural conclusion and evaluate. Soon, you will know the difference between a good or bad assumption and knowing is half the battle.

G. Don’t Panic!
Physical Chemistry can be a daunting or otherwise scary course. Fear not! You too can get through it! Please, ask questions and feel free to express your ideas on topics. Through question and discussion you will overcome!