INSTRUCTOR: Prof. David S. Perry  
Office: KNCL 302  
Phone: 375-6825  
E-mail: DPerry@UAkron.edu  
Skype name: davidsidneyperry  
http://gozips.uakron.edu/~dperry

LECTURES: 1:10 -2:00 PM  
Mon, Tues, Wed., and Fri.  
in Arts & Sci 144

OFFICE HOURS: Mon., Tues 2:00 – 3:00 PM in KNCL 302

PREREQUISITES:  
Principles of Chemistry I&II (3150:151, 153)  
Organic Chemistry I&II (3150:263, 264)  
Physics - 3650:291, 292 or 261, 262 (Elementary Classical Physics I&II  
or Physics for Life Sciences I&II)  
Mathematics - 3450:222 (through Calculus II)

If you do not have credit in one or more of the above prerequisites, or if you are unsure of your background, then please discuss your situation with me. If you do not have all of the prerequisites, you need my permission before starting the course. You should keep your notes and texts from these courses handy so that you can review important parts of the prerequisite material as needed.

WEB:  
Course Site: http://gozips.uakron.edu/~dperry/Chem305/Chem305Home.html  
Springboard: https://springboard.uakron.edu

OVERVIEW: This course presents the physical principles that govern molecular structure and chemical reactivity in chemical and biochemical systems. We will answer questions such as, “How do we know whether a chemical reaction will occur?”, “How fast will it go?”, “Will it consume or produce energy?”, “Why do atoms stick together to form molecules?”, “How do we determine the primary, secondary, and tertiary structures of biomolecules?”, and “How can we understand those structures?” The course will involve lectures, homework problems, quizzes, and examinations.

Although physical chemistry is inherently mathematical, I develop as many of the concepts as I can with qualitative arguments, such as the behavior of waves, or with elementary math skill such as counting. The homework problems will use your math skills, but even there essential math fluency is more important than high-level math skills.

You will also need to have available a good freshman general chemistry text. Tinoco’s text is weak on colored illustrations and it assumes that you already know a lot, so keep your freshman text handy. For this purpose, Silberberg’s *Chemistry - The Molecular Nature of Matter and Change* (3rd, 4th or 5th edition.) is best because it has many great biochemical applications and illustrations. Silberberg’s *Principles of General Chemistry* also covers the core background material that you will need.

**ASSIGNMENTS:** Regular problem assignments will be an important part of the course. Assignments will not be graded, but the examinations and quizzes will include many questions similar to the assigned problems.

**QUIZZES:** Ten-minute quizzes will be given weekly. Each quiz will contain one problem or a few short answer questions. Your average score on the quizzes will be constructed by first dropping the 2 lowest scores and then averaging the remainder. If you are absent for a particular quiz, then that quiz will be one of the 2 dropped from your average. Please bring a calculator and a ruler to each quiz.

**EXAMINATIONS:** Two midterm exams will be given plus a comprehensive final exam. Please bring a calculator and a ruler to each exam. A schedule for the exams is given below. Any changes will be announced at least one week in advance.

- **Midterm Exam I**
  - MGH 204
  - Friday, Oct. 2
  - 1:10 pm – 2:10 pm

- **Midterm Exam II**
  - MGH 204
  - Friday, Nov. 6
  - 1:10 pm – 2:10 pm

- **Final Exam**
  - MGH 204
  - (tentatively Thursday, Dec. 10, 2:00 pm – 3:55 pm)

**EXPECTATIONS:**

1. Students will attend all lectures. We will cover many new and “strange” concepts, and your attendance at lectures is key to understanding them. In certain places, the text takes a different approach to the material, and you can easily find yourself totally lost if you miss an earlier lecture in a given section.
2. Students will read the text (Tinoco chapters 1-12) outside of class. Any sections within individual chapters that will not be covered in this course will announced in class or in the homework assignments.
3. Students will review the relevant freshman chemistry material as needed.
4. Students will complete all homework assignments. Students are encouraged to work together, but in the end, each student needs to be able to work the problems independently and with facility.
5. Students will seek extra help immediately when having difficulty. It is expected that most students will have difficulty at various points during the course.
6. On exams and quizzes, students will follow the highest standards of academic honesty. Students must write coherent answers that explain their reasoning and use good mathematical syntax.

**GRADING:** The final scores will be computed by one of the following schemes (whichever yields the higher score):

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Exam I</td>
<td>25%</td>
</tr>
<tr>
<td>Midterm Exam II</td>
<td>25%</td>
</tr>
<tr>
<td>Average Quiz Score</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>The higher score of Exams I &amp; II</td>
<td>25%</td>
</tr>
<tr>
<td>The lower score of Exams I &amp; II</td>
<td>dropped</td>
</tr>
<tr>
<td>Average Quiz Score</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Please do not miss any of the exams because NO MAKE-UP EXAMS will be given. If you miss one of the midterm exams, then your final total will be computed using the second of the two schemes above, in which the missed exam is dropped.

I have no fixed grading scale for assigning final letter grades (A, B, etc.) for the course. The break points between the different letter grades will depend on the difficulty of the exams, the level of the class performance, and the location of natural breaks in the distribution of numerical grades. Last year the median grade in the course was a B, but it could be higher or lower this year depending on the level of the class performance. When midterm exams are returned, I will post an approximate scale for each exam to let you know where you stand in the course.
Introduction.

I. Thermodynamics: To react or not to react?
   1. The First Law: Energy Is Conserved. [Chapter 2]
   2. The Second Law: The Entropy of the Universe Increases. [Chapter 3]
   3. The Chemical Potential and Chemical and Physical Equilibria. [Chapters 4, 5]

II. Quantum Chemistry and Spectroscopy: Structure at the molecular level
   1. The Quantum Theory [Chapter 9]
   2. Chemical Bonding [Chapter 9]
   3. Weak interactions [Chapter 9]
   4. Spectroscopy [Chapter 10]
   5. X-Ray Diffraction [Chapter 12]

III. Kinetics: How Fast?
   1. Molecular Distributions and Statistical Thermodynamics. [Chapter 11]
      A. The Random Walk
      B. Statistical Thermodynamics
      C. Using Distribution Functions
   2. Molecular Motion and Transport Properties. [Chapter 6]
      A. Pressure
      B. The Rate of Collisions between Molecules
   3. Rates Laws. [Chapter 7]
   4. How to Calculate Reaction Rates. [Chapter 7]
      A. Temperature Dependence of Reaction Rates
      B. Transition State Theory
   5. Examples. [Chapter 7]
   6. Enzyme Kinetics. [Chapter 8]
Chemistry 305 Physical Chemistry for the Biological Sciences
READING LIST

Other Physical Chemistry Texts written for Biochemists

- Physical Chemistry for the Life Sciences, P. Atkins and Julio de Paula, Freeman 2006.  QD453.3 .A74 2006

Standard Physical Chemistry Texts

*These cover the material in more depth and are more mathematically rigorous, but have fewer biological applications to illustrate the concepts.*

- Physical Chemistry, T. Engel and P. Reid, Prentice Hall 2006  (Text for Chem 313 and 314)
- Quantum Chemistry and Spectroscopy, T. Engel, Prentice Hall 2006  (Text for Chem 314)
Chemistry 305 Sign-Up Sheet  
3150:305  
Fall 2008

Name ......................................  
UA Student ID Number ..............................................

Major ......................................  
Phone ...........................  
Email ..................................

List the college-level courses that you have completed in each of these areas

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Mathematics (from Calculus I)</th>
<th>Biology</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>