Instructors:
Professor Roseanne J. Sension 4529 Chemistry rsension@umich.edu
Office Hours: Monday 11-12, Thursday 3-4 (May be revised)
Professor Nils Walter 4821 Chemistry nwalter@umich.edu
Office Hours: Tuesday 3-4, Wednesday 11-12

GSIs: (Office Hours TBA)
Al Cole 653 Chemistry colea@umich.edu
Jose Santos 3000 Chemistry jsantos@umich.edu
Amanda Culbertson 4721 Chemistry culberts@umich.edu

Prerequisites:
Chem. 215/216, Math. 115, and prior or concurrent Phys. 140 (125 ok).

Text Book:
Peter Atkins The Elements of Physical Chemistry 3rd Edition

Class Schedule:
Section 100 meets MWF 10-11 in 1200 Chem., Section 200 meets MWF 1-2 in 1300 Chem.
Attendance and participation in lecture is expected.

Exam Monday Feb. 12 6:00 - 8:00 pm

Grading:
Exam 150 pts. 100 pt exam multiplied by 1.5 scale factor for Chem 261
Homework 75 pts. 3 Assignments: 25 pts. each.
Quizzes 15 pts. Up to 3 unannounced quizzes at 5 pts. each may be given in class.

Total 240 pts.

For the exam you should bring several pencils and your calculator. You may also bring and use a 3" by 5" note card containing any information you wish.

Please note that 30% of your grade is based on homework. Homework may be discussed in groups and with the GSIs and Professors. However, each student must turn in an independent completed assignment and should be prepared to defend all responses orally. Homework assignments are due in class on the dates listed. Late assignments will be docked 5 pts. per hour. If you are going to have a problem meeting a deadline for a justifiable reason talk to a GSI or Professor before the assignment is due. No excuses will be accepted after the due date.
Outline for Chem 261:

I. Quantum Mechanics and Atomic States: (L1-L5)

Chapter 12, Quantum Theory, Chapter 13 Atomic Structure
- The failure of classical physics
- Introduction to quantum mechanics
- Postulates of quantum mechanics
- Solution of the Particle in a 1-d box problem
- Expectation values and the uncertainty principle
- Solution to the Hydrogen Atom problem (results only)
- Spin
- The electronic configurations of the elements

II. Interaction Between Atoms: (L6-L10)

Intramolecular Interactions: Chapter 14
- Molecular Orbitals
- Valence Bond Theory

Intermolecular Interactions: Chapter 16.1-16.7
- Dipole Moments
- Electrostatic Interactions
- Structure of Liquids

III. Interaction Between Light (EM radiation) and Matter: (L11-L15)

Molecular Spectroscopy: Chapters 17-19
- Introduction to light and radiation
- Principles of spectroscopy
- Rotations
- Vibrations
- Electronic Transitions
- NMR
Useful Constants and Quantities:

<table>
<thead>
<tr>
<th>Constant or Quantity</th>
<th>SI units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avogadro's Number ($N_A$)</td>
<td>$6.02214 \times 10^{23}$ mol$^{-1}$</td>
</tr>
<tr>
<td>Boltzmann's Constant ($k$)</td>
<td>$1.38066 \times 10^{-23}$ J K$^{-1}$</td>
</tr>
<tr>
<td>Faraday Constant ($F=N_Ae$)</td>
<td>$9.6485 \times 10^4$ C mol$^{-1}$</td>
</tr>
<tr>
<td>Electron Charge ($e$)</td>
<td>$1.602177 \times 10^{-19}$ C</td>
</tr>
<tr>
<td>Electron Mass ($m_e$)</td>
<td>$9.10939 \times 10^{-31}$ kg</td>
</tr>
<tr>
<td>Neutron Mass ($m_n$)</td>
<td>$1.67493 \times 10^{-27}$ kg</td>
</tr>
<tr>
<td>Gas Constant ($R=N_Ak$)</td>
<td>$8.31451$ J K$^{-1}$ mol$^{-1}$</td>
</tr>
<tr>
<td></td>
<td>$0.0831451$ L bar K$^{-1}$ mol$^{-1}$</td>
</tr>
<tr>
<td></td>
<td>$0.0820578$ L atm K$^{-1}$ mol$^{-1}$</td>
</tr>
<tr>
<td></td>
<td>$62.364$ L Torr K$^{-1}$ mol$^{-1}$</td>
</tr>
<tr>
<td>Planck Constant ($h$)</td>
<td>$6.62608 \times 10^{-34}$ J s</td>
</tr>
<tr>
<td>$(h=\hbar/2\pi)$</td>
<td>$1.05459 \times 10^{-34}$ J s</td>
</tr>
<tr>
<td>Proton Mass ($m_p$)</td>
<td>$1.67262 \times 10^{-27}$ kg</td>
</tr>
<tr>
<td>Rydberg Constant ($R=m_e^4/8\hbar^3c\varepsilon_o^2$)</td>
<td>$1.09677 \times 10^5$ cm$^{-1}$</td>
</tr>
<tr>
<td>Speed of Light in a Vacuum ($c$)</td>
<td>$2.99792458 \times 10^8$ m s$^{-1}$</td>
</tr>
<tr>
<td>Vacuum Permittivity ($\varepsilon_o$)</td>
<td>$8.85419 \times 10^{-12}$ J$^1$ C$^2$ m$^{-1}$</td>
</tr>
<tr>
<td>$(4\pi\varepsilon_o)$</td>
<td>$1.11265 \times 10^{-10}$ J$^1$ C$^2$ m$^{-1}$</td>
</tr>
<tr>
<td>Bohr Magneton ($\mu_B=e\hbar/2m_ec$)</td>
<td>$9.27402 \times 10^{-24}$ J T$^{-1}$</td>
</tr>
<tr>
<td>nuclear Magneton ($\mu_N=e\hbar/2m_pc$)</td>
<td>$5.05079 \times 10^{-27}$ J T$^{-1}$</td>
</tr>
<tr>
<td>Atomic Mass Unit ($u$)</td>
<td>$1.66054 \times 10^{-27}$ kg</td>
</tr>
<tr>
<td>Acceleration of Gravity ($g$)</td>
<td>$9.80665$ m s$^{-2}$</td>
</tr>
<tr>
<td>Bohr Radius ($a_o=4\pi\varepsilon_o\hbar^2/m_ec^2$)</td>
<td>$5.29177 \times 10^{-11}$ m</td>
</tr>
</tbody>
</table>

Conversion Factors:

<table>
<thead>
<tr>
<th></th>
<th>1 atm</th>
<th>1 cm$^{-1}$</th>
<th>1 eV</th>
<th>1 kcal mol$^{-1}$</th>
<th>1 Tesla</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>101.325 kPa</td>
<td>$1.98648 \times 10^{-23}$ J</td>
<td>8065.5 cm$^{-1}$</td>
<td>4.184 kJ mol$^{-1}$</td>
<td>1 N s C$^{-1}$ m$^{-1}$</td>
</tr>
<tr>
<td></td>
<td>760 Torr</td>
<td>$1.60219 \times 10^{-19}$ J</td>
<td>349.75 cm$^{-1}$</td>
<td>1 Weber m$^{-2}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.01325 bar</td>
<td>96.485 kJ mol$^{-1}$</td>
<td></td>
<td></td>
<td>$10^4$ Gauss</td>
</tr>
</tbody>
</table>
Homework Assignments:

Required problems are due on the date indicated, recommended problems are not to be turned in.

HW1 Due 1/19/01:

Required: Ch. 12:2,12,14,16,22,24,26,30,34
           Ch. 13:2,4,8,10

Recommended: Ch. 12:1,3,9,11,13,15,17,18,19,20,21,25,33,35
             Ch. 13:1,3,5,6,7,9

HW2 Due 2/02/01:

Required: Ch. 13:14,20,22,24,26
           Ch. 14:2,4,6,8,12,16,18,20,24
           Ch. 16:2,4,12

Recommended: Ch. 13:11,13,15,21,23,25
             Ch. 14:3,5,7,9,10,13,17,19,21,22,23,25,26,27,30
             Ch. 16:1,3,5,6,7,8

HW3 Due 2/12/01:

Required: Ch. 17:2,4,6,8,13,14,20,22,26
           Ch. 18:2,4,8,10,16
           Ch. 19:4,6,8,12,14

Recommended: Ch. 17:3,5,7,9,17,18,19,21,23,24,25
              Ch. 18:1,3,7,9,12,13,14,15,17,18,19
              Ch. 19:1,2,3,5,7,9,10,11,15,16,18,19,20

For full credit each problem must be completed with a statement of the problem, an annotated solution and an answer, with the correct units specified. The GSIs may deduct points for problem sets that are messy and difficult to follow. We will not be checking significant figures rigorously, but answers that retain several insignificant figures or omit several significant figures will be considered incorrect. Note that an explanation of your answer may also be necessary. Several sample problems are given on the next page.