CHEMISTRY 11 (98179) SANTA CLARA UNIVERSITY
GENERAL CHEMISTRY I SUMMER TERM, 2014

COURSE SYLLABUS

INSTRUCTOR: Dr. Steven L. Fedder
Phone: 554-4884 - voice mail after 5 rings
E-mail: sfedder@scu.edu
FAX: 554-7811

TIME AND PLACE: Alumni Science 120
MTWF – 12:15 – 3:15 PM

OFFICE HOURS: Office – DS104

Times – Monday, Wednesday & Friday from 10:00-11:00am
(primarily for students with TR morning lab and MWF afternoon lab)
Tuesday and Thursday from 10:00-11:00am
(primarily for students with MWF morning lab and MWF afternoon lab)

Other times may be possible by arrangement, including briefly after each class

REQUIRED MATERIALS:

2) A pocket calculator capable of scientific notation/logarithms, etc. Cost = $15
3) A 3-ring binder for notes to be interleaved with class handouts and extra problem sets.
4) For laboratory, a lab packet, a lab coat and a bound notebook are available in the Campus Bookstore. Safety goggles will be made available for sale at the Stockroom window (DS118) during a very narrow time range to be announced on the first day of class. Also, please note shorts and open-toed shoes are not allowed in the laboratory – hard to remember in summertime.

COURSE CONTENT:

Although most students enrolling in Chem 11 at SCU have taken a chemistry course in high school, it was often during the sophomore year and likely varied greatly in quality, so I assume minimal prior knowledge of chemistry but a high level of interest in learning about it. Chemistry 11 learning objectives include exposure to and an understanding of 1) the language of chemistry including chemical nomenclature, symbols and common units of measurement, 2) stoichiometry; the chemical arithmetic associated with the formulas for chemicals and with balanced chemical reactions, 3) the driving forces involved in reactions of aqueous solutions of strong electrolytes, 4) the internal structure of atoms, particularly the allowed energies of and behavior of an atom’s electrons, 5) the concepts of ionic and covalent bonding, 6) the accepted theory predicting the shapes of molecules including the concept of atomic orbital hybridization, 7) the heat changes associated with chemical reactions and physical processes. The information will be integrated as much as possible and will be presented using relevant examples from the consumer, medical and environmental arenas to provide a context for the learning.
**RECOMMENDED APPROACH**: Although everyone’s learning style is somewhat different, the following suggestions seem to help most people.

- Please **DON’T MISS CLASS**, unless it is absolutely unavoidable. If you do miss a class, please obtain class notes and any handouts for that day from a classmate.

- Do any **assigned reading** before class.

- Take **good notes**, but not at the expense of listening to what I am saying.
  - extensive use is made of interactive handouts to eliminate excessive note taking.
  - you may want to bring 2-3 different color pens or pencils or highlighters or some combination of the three for more effective note taking and labeling of handouts.

- If possible, please take 10 minutes before each class to **look over the notes from the previous class**; this is very valuable in resetting the context for the material.

- Do **assigned problems** faithfully, with an eye toward answering the question “What was the author trying to test my knowledge/understanding of with this question”?

- **Be coachable**: I’ve helped thousands of students learn chemistry over the years and certain approaches (like these suggestions here) really do work.

- **Ask questions** when you are confused; don’t let “the veil” descend and not attempt to immediately pull it back up.

- Don’t underestimate the importance of **repetition** in learning chemistry. In many ways, chemistry can be likened to a foreign language: by focusing on the things that are repeated frequently, you not only learn them, but get the idea that they must be more important than something you hear or read about only once. **Reading over your lecture notes** (even if there isn’t an exam coming up) helps with more repetition.

**HOMEWORK**:  

Although I don’t collect or grade homework, it is **crucial to do** it to convert the passive learning of the classroom and your readings into active learning. I’ll make homework assignments from textbook chapters as we move along through the course, and will likely give some of my own problem sets as well. The Study Guide/Solutions Manual that comes shrink-wrapped with your text is available to give you feedback on homework. If a question or problem still stumps you, even after consulting the Solutions Manual, that is when a visit to me during office hours is called for.
ASSESSMENT:

1) Midterm exams - 2 of them (1.5 hour long) - see lecture schedule for approximate dates
2) Final exam - Friday, July 4 – entire lecture period available, though not likely necessary, for exam.
3) Laboratory performance - contributes a small amount toward course grade – more about this is class.

GRADING:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 exams at 150</td>
<td>300</td>
</tr>
<tr>
<td>Final exam</td>
<td>150</td>
</tr>
<tr>
<td>Laboratory</td>
<td>small contribution</td>
</tr>
<tr>
<td>Total points</td>
<td>450</td>
</tr>
</tbody>
</table>

Letter grades are based on how I feel the class has done relative to the difficulty of the exams and relative to students in the same class over a period of years. I’ll include an approximate letter grade with each returned exam to give you a sense of what you’ve earned. Focus on the material and the grades will take care of themselves. Because + and - designations on letter grades carry numerical meaning at SCU, differences between one grade and another, e.g., an A- at 3.7 vs. a B+ at 3.3, are fairly small. This reduces the pressure on students and faculty.

ACADEMIC INTEGRITY:

Giving or receiving unauthorized aid in any form is not tolerated and can result in course failure. Academic dishonesty includes looking at another student’s paper during an exam, allowing another student to copy off your paper, the use of lecture notes, crib sheets or textbooks during an exam, the inappropriate use of programmable calculators and the use of text messaging to communicate during exams. Please make academic integrity a high priority for yourself throughout your years here at SCU.

CHEMISTRY DEPARTMENT PERFORMANCE STANDARD:

This course is a prerequisite for Chemistry 12. In order to satisfy this prerequisite and remain enrolled in the Chem 12 section this Summer, you must earn a grade of at least C- in Chemistry 11.

DISABILITY ACCOMMODATION POLICY:

To request academic accommodations for a disability, student must contact Disability Resources located in The Drahmann Center in Benson, Room 214, (408) 554-4111; TTY (408) 554-5445. Students must provide documentation of a disability to Disability Resources prior to receiving accommodations.

SOME IMPORTANT DATES:

- Tuesday, June 17 - last day to withdraw from course with 100% tuition refund.
- Wednesday, June 18 - last day to withdraw from course without a W appearing on transcript.
- Wednesday, June 18 - last day to withdraw from course with a 50% tuition refund.
- Friday, June 27 - last day to withdraw from course; a W will appear on transcript.
- Friday, July 4 - last day of classes - final exam
GENERAL LEARNING OBJECTIVES: The primary objective of the general chemistry sequence is to give you a solid foundation in both theoretical and descriptive chemistry. Special emphasis will be placed on development of problem solving skills as well as on the application of basic chemical concepts. We will accomplish this goal using a variety of activities. These will include lectures, laboratory experiments, problem solving, examinations, and A LOT of individual effort outside of the classroom. It is IMPERATIVE that you do as many of the end-of-chapter problems as possible.

The laboratory portion of the course will provide you with the opportunity to develop skills necessary for scientific discovery (e.g., critical thinking and observation skills, ability to handle chemical reagents and instruments safely). The laboratory experiments this quarter will include those designed to introduce you to topics not covered in lecture (enrichment) as well as those designed to reinforce or introduce some of the topics discussed in lecture.

Basic Learning Objectives:
The following is a list of specific learning goals and objectives for the course. A small number of additional “special topics”, chosen at the discretion of the instructor, may be added during the term. These will be announced in class.

Goal 1: Learn the fundamentals of the properties of matter, measurement and uncertainty.

Objectives:
- a. Be able to distinguish elements from compounds, pure substances from mixtures and homogeneous from heterogeneous mixtures (solutions). Learn rudiments of mixture separation into pure substances and the distinction between physical and chemical properties.
- b. Learn and be able to use SI units, derived SI units and metric prefixes, including the recognition of the uncertainty in measurements, the correct use of significant figures and routine employment of dimensional analysis in problem solving.
- c. Understand the difference between accuracy and precision.

Goal 2: Acquire a thorough understanding of the modern theory of atomic structure and atomic level phenomena.

Objectives:
- a. Be intimately familiar with the properties, atomic locations and interactions of protons, neutrons and electrons.
- b. Understand the concept of isotopes and factors affecting nuclear stability.
- c. Understand the implications of the uncertainly principle, wave mechanics and the quantization of electrons energies and spin, including quantum numbers, atomic orbital energies/shapes/electron capacity and writing of electron configurations for atoms and monatomic ions.
- d. Understand the phenomenon of atomic absorption and emission and be able to distinguish ground from excited state atoms.

Goal 3: Begin to learn the symbolism and terminology (language) of chemistry.

Objectives:
- a. Learn the symbols and names of dozens of the common chemical elements, realizing the foreign roots of some.
- b. Be able to name common cations and anions, ionic and binary covalent compounds given the chemical formula.
- c. Be able to write the formulas of common cations and anions, ionic compounds, and binary covalent compounds given the name.
Goal 4: Obtain a thorough introduction to modern chemical bonding theories and their implications.

Objectives:
- a. Understand the difference between ionic and covalent bonding and be able to recognize ionic compounds from formula.
- b. Be able to distinguish valence from core electrons, depict the former using representative element Lewis symbols and learn to draw Lewis structures, recognize resonance and predict both VSEPR and actual geometry for simple covalent molecules and polyatomic ions. Learn the atomic orbital hybridization model in relation to VSEPR theory.
- c. Learn the use of electronegativity as a predictor of ionicity in binary compounds and as a bond polarity predictor in covalent species and be able to predict if compounds have a zero or non-zero dipole moment.
- d. Learn the difference between sigma and pi bonding, know what atomic orbital overlap is associated with any covalent bond.
- e. Begin to learn the difference between the valence bond and molecular orbital theories of bonding.

Goal 5: Learn the organization and information conveyed by the periodic table of the chemical elements.

Objectives:
- a. Learn the rationale for the table’s structure and the special names of various columns or other groupings of elements.
- b. Know trends in metallic character, atomic radius, ionization energy, electrons affinity and electronegativity in the periodic table.
- c. Know the relationship between position in the periodic table and the likely chemical bonding behavior of an element.

Goal 6: Begin to learn and categorize selected types of chemical reactions.

Objectives:
- a. Learn to recognize acids, bases and salts and begin to learn to predict the products of acid/base reactions.
- b. Learn to recognize strong, weak and non-electrolytes and the role of non-electrolyte and weak electrolyte formation as a driving force for reactions of solutions of strong electrolytes with one another and selected solid ionic compounds.
- c. Begin to learn about oxidation/reduction terminology and reactions, particularly metal replacement reactions.

Goal 7: Understand the quantitative implications of chemical formulas and chemical reactions, including processes occurring in solution.

Objectives:
- a. Learn the importance and use of Avogadro’s number and the mole concept in relating the atomic/molecular level to the macroscopic level.
- b. Be able to determine empirical and actual formulas of chemical compounds from elemental analysis data.
- c. Be able to make gram/mole conversions and calculations relating to chemical reactions, including limiting reactant/theoretical yield/percent yield calculations and including reactions occurring in solution.
- d. Begin the learn chemical concentration units, particularly molarity.
**Goal 8:** Understand the various forms of energy and the various roles energy plays in physical processes and chemical systems and reactions.

**Objectives:**

a. Become very familiar with the characteristics of electromagnetic radiation and how it interacts with matter.
b. Be able to complete and balance combustion reactions of C,H,O,N,S containing compounds.
c. Understand the methods and calculations of basic calorimetry.
d. Learn the First Law of Thermodynamics and its chemical implications.
e. Learn and use Hess’s Law as applied to physical processes and chemical reactions.
f. Learn the role of enthalpy in physical and chemical processes, including the meaning and the manipulations of enthalpies of formation.
g. Learn about the energy content of food types and chemical fuels.

**Natural Science Core Learning Goals and Objectives:**

**Goal: Scientific Inquiry, Complexity, Critical Thinking, Mathematical and Quantitative Reasoning**

**Objectives:**

a. Demonstrate an understanding of the theory and concepts central to the study of a particular area or topic treated by the natural sciences.
b. Understand how to formulate a testable hypothesis and design an informative experiment to explain phenomena observed in the natural world.
c. Be able to interpret data from scientific experimentation both qualitatively and quantitatively, in order to derive conclusions appropriate to the scope and quality of data.
d. Be able to recognize limitations of experimental and observational methods and understand concepts of probability, causation, and correlation.
**LECTURE SCHEDULE**

**Note:** We may cover material at a slightly faster pace than this; treat this as a rough calendar. I’ll be more specific at the end of each class as we move through the course.

<table>
<thead>
<tr>
<th>DAY</th>
<th>DATE</th>
<th>CHAPTER</th>
<th>PAGES</th>
<th>TOPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>JUNE 16</td>
<td>Introductory Remarks - Chapter 1</td>
<td>1-31</td>
<td>Chem in perspective, elements, compounds, mixtures. Chemistry basics: units, dimensional analysis, metric prefixes, significant figures in calculations.</td>
</tr>
<tr>
<td>T</td>
<td>JUNE 17</td>
<td>2</td>
<td>38-68</td>
<td>Simple atomic structure, isotopes, atomic and mass numbers, atomic weights, intro to periodic table. Molecular versus ionic compounds, predicting ion charges, naming ionic and binary molecular compounds.</td>
</tr>
<tr>
<td>W</td>
<td>JUNE 18</td>
<td>3</td>
<td>76-99</td>
<td>Types of chemical reactions, writing chemical equations. Formula weights, intro to mole concept, Avogadro’s #. Determining empirical formula from analysis data. Empirical versus molecular formula.</td>
</tr>
<tr>
<td>R</td>
<td>JUNE 19</td>
<td>3</td>
<td>99-104</td>
<td>Limiting reactant, theoretical yield and % yield.</td>
</tr>
<tr>
<td>F</td>
<td>JUNE 20</td>
<td>4</td>
<td>114-124</td>
<td>Strong, weak and non-electrolytes. Precipitation as an aqueous reaction driving force. Solubility rules for ionic compounds in water.</td>
</tr>
</tbody>
</table>

Ah, the weekend!!

=================================================================================================

| M   | JUNE 23 | EXAM I (CHAPTERS 1-3) | 124-130 | Weak/non-electrolyte formation as a driving force. |
| T   | JUNE 24 | 4 | 131-149 | Molarity as a concentration unit; solution stoichiometry. Intro to redox via the activity series of metals. |
| W   | JUNE 25 | 5 | 158-172, 175-180 | Thermodynamic terminology and perspective. Specific heat, heat capacity and calorimetry. |
| F   | JUNE 27 | 6 | 206-222 | Properties/quantization of radiant energy. Atomic absorption/emission, Bohr atom, electrons as waves, quantum numbers, atomic orbitals. |

Ah, the weekend!

=================================================================================================

| M   | JUNE 30 | EXAM II (CHAPTERS 4-5 AND ELECTROMAGNETIC RADIATION) | 222-238 | Orbital shapes and energies, electron configurations, core vs valence electrons. |
| T   | JULY 1  | 7,8 | 248-264 | Periodic trends in IE, EA, etc., related to binary ionic compound formation and the Born/Haber cycle. |
| W   | JULY 2  | 8,9 | 288-321 | Lewis symbols, octet rule, ion sizes and electronegativity. Drawing Lewis structures, resonance concept, formal charge as a tool. VSESR theory. |
| R   | JULY 3  | 9 | 330-364 | Bond vs molecular polarity, dipole moment. Atomic orbital hybridization, sigma vs pi bonds. Intro to molecular orbitals (bonding vs antibonding), bond order, delocalization of electrons. |
| F   | JULY 4  | FINAL EXAM (CHAPTERS 1-9) | | |