CHM 152: GENERAL CHEMISTRY II
Northern Arizona University

Spring Semester 2004
Instructor: Dr. Brandon Cruickshank  Office: Chem: Rm 121  Phone: 523-9602
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Section  Class no.  Time  Room
2  1401  M, T, W  10:20 a.m.–11:10 a.m.  20–106
3  1402  M, T, W  11:30 a.m.–12:20 p.m.  20–106

Recitation Sections:
T  2:00–3:00 p.m.  Chem., Room 106  Class no.: 1414
T  3:00–4:00 p.m.  Chem., Room 106  Class no.: 1415

Recitation sections are graded pass/fail based on attendance and participation.

Office Hours:
M  2:00–3:00 p.m.  Chem., Room 121
T  5:00–6:00 p.m.  Chem., Room 121
Th 12:00–1:00 p.m.  Chem., Room 121
Other times by appointment

Course Prerequisite:
CHM 151

Distribution Block:
3-hours of Science/Applied Science credit (CHM 152 only)
4-hours of Laboratory Science credit if taken with the lab (CHM 152 and CHM152L)

Texts:


Reading:
It is of utmost importance that you read the text as assigned. The lectures alone will not suffice. You will be held accountable for the reading materials.

Course Description
CHM 152 is the second semester of a 1-year sequence appropriate for pre-professional science and engineering majors. As a liberal studies course, CHM 152 continues to develop the fundamental principles of chemistry – the science of change. The course addresses the following liberal study themes and essential skills:
**Themes:**

**Environmental Consciousness.** Equilibrium, thermodynamics and kinetics are of key importance in understanding chemical reactions that occur in the Earth’s hydrosphere and atmosphere. Introductory aspects of these topics are presented in CHM 152. The student learns to interpret and examine the likelihood, rate and amount of product produced in chemical reactions. For example, acid-base reactions are critical for understanding water quality (and biological processes ultimately tied to water quality) and kinetically controlled processes ultimately dictate the fate of ozone in the stratosphere.

**Technology and its Impact.** Chemistry has a profound impact on the technological developments of the 20th century. Many chemical discoveries have improved the quality of life (pharmaceutical drugs, laser technologies and the semiconductor industry) while others have threatened it (CFCs, pesticides and PCBs). Whenever possible, this course will illustrate how modern technology has been influenced by the fundamental science taught in CHM 152.

**Essential Skills:**

**Scientific Inquiry:** Chemistry is an empirical science. What is taught in CHM 152 represent knowledge that has been acquired over the past 3 centuries through application of the scientific method, a systematic approach to research. Scientific theories will be examined in light of this process which includes the formulation of a hypothesis, observations, symbolic representation of data, interpretation and conclusions.

**Quantitative Analysis:** Quantitative Analysis is at the root of the physical sciences. Specific skills the CHM 152 student will learn include writing equilibrium expressions and using them to predict the outcome of chemical processes, the derivation of equations for predicting the rate of chemical reactions, and calculations to quantify the concentration of specific chemical species in aqueous solution.

**Critical Thinking:** Successful chemical problem solving requires the ability to follow a logical, sequential thought process, understand abstract and symbolic language, discriminate between relevant and superfluous data and question underlying assumptions about cause and effect relationships.

**Course Outcomes (linked to theme and skills)**

Following successful completion of this course, students will be able to:

1. Determine the likelihood of a reaction based upon thermodynamic principles (**Critical Thinking, Quantitative Analysis**)
2. Utilize mathematical skills to calculate the free energy change associated with chemical processes (**Quantitative Analysis, Critical Thinking**)
3. Utilize kinetic data to evaluate the nature of molecular interactions (**Critical Thinking, Scientific Inquiry, Quantitative Analysis**)
4. Predict the rate of chemical reactions using rate equations derived from empirical data (**Quantitative Analysis, Critical Thinking, Scientific Inquiry**)
5. Evaluate the concentration of reactants and products at equilibrium in aqueous solutions (**Quantitative Analysis, Critical Thinking**)
6. Calculate the pH of aqueous solutions and recognize its application to acid rain (**Critical Thinking, Quantitative Analysis, Scientific Inquiry, Environmental Consciousness**)
7. Describe the interconversion of electrical and chemical energy (**Critical Thinking, Scientific Inquiry**
8. Recognize nuclear processes and discuss their impact on the technological and environmental changes in today’s world (Critical Thinking, Scientific Inquiry, Environmental Consciousness, Technology and its Impact)

Assessment of Outcomes (linked to themes and skills)
Assessment of student learning outcomes will be evaluated using examinations, quizzes and/or homework. These evaluation methods will test the student’s knowledge of scientific principles, their ability to identify and solve problems, and their ability to analyze scientific data. Quiz and exam questions will require students to:

1. Analyze data presented in graphs or tables, theoretical models, or results from empirical studies to draw correct hypotheses or conclusions (Scientific Inquiry, Critical Thinking)
2. Perform multi-step calculations using appropriate equations and formulas (Quantitative Analysis, Critical Thinking)
3. Utilize proper symbolic representation of atoms, molecules, ions and chemical reactions (Scientific Inquiry, Critical Thinking)
4. Determine if a reaction will occur (free energy) and how fast it will go (kinetics). Use these results to estimate impact of a reaction on the environment (Quantitative Analysis, Critical Thinking, Environmental Consciousness)
5. Determine the pH of a aqueous solution – apply this calculation to the pH of a lake or stream (Quantitative Analysis, Critical Thinking, Environmental Consciousness)
6. Identify the steps in a nuclear reaction. Explain the impact on the environment. (Environmental Consciousness, Technology and its Impact)

Learning Portfolio:
Students are encouraged to retain their exams and quizzes as evidence that they developed skills in scientific inquiry, critical thinking and quantitative analysis. Students also are encouraged to write a reflective essay that describes how the principles of introductory chemistry have increased their awareness of the environment.

GRADING POLICY

Homework: On-line homework assignments will be given each week. Homework will count 10% of your grade.

Quizzes: There will be eleven quizzes. Quizzes will be given during the final 20 minutes of the class period on the following Wednesdays:

1/21, 1/28, 2/4, 2/18, 2/25, 3/3, 3/31, 4/7, 4/21, 4/28

Each quiz will count 20 pts.

Exams: 60 minute exams will be given in class on the following dates:

Wednesday, February 11
Wednesday, March 10
Wednesday, April 14

Each exam will concentrate on material covered since the previous exam. Each exam will count 100 points.
Re-Tests: Re-tests will be given on Thursday evening (7:00-8:00 p.m., Bldg. 20, Rm. 106), one week after the original exam. Re-tests are optional (e.g., if you are happy with your score on the first exam, you do not have to take the re-test). Your best score from the two exams will count for your grade. Make sure to mark the following dates on your calendar. There are no make-ups of re-tests.

Thursday, February 19
Thursday, March 25
Thursday, April 22

My number one goal is to have all of my students succeed in this course. My objectives with re-tests are to have you take course feedback seriously and to learn from your mistakes. After taking the original exam, you will have one week to learn the material that you did not understand on the first exam. I will hold a special help session on Monday evening following the original exam. We will work through any questions that you have about the exam. Take the original exam seriously; do not rely on the re-test to determine your grade.

Make-up Quizzes: There are none. Scores for quizzes missed for legitimate reasons will be generated from the average of all of your other quizzes. Legitimate reasons include:

1. Personal or Family Emergency.
2. University institutional excuse.

Final Exam: The final exam is scheduled from 10:00 a.m. to 12:00 p.m. on Tuesday, May 4.

Grading Scale: The best 10 of 11 % of grade

<table>
<thead>
<tr>
<th>Category</th>
<th>Best 10 of 11</th>
<th>% of grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>(10 × 20 pts each)</td>
<td>200 pts</td>
</tr>
<tr>
<td>Homework</td>
<td>75 pts</td>
<td></td>
</tr>
<tr>
<td>Exams</td>
<td>(3 × 100 pts each)</td>
<td>300 pts</td>
</tr>
<tr>
<td>Final Exam</td>
<td>150 pts</td>
<td>725 pts</td>
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</tbody>
</table>

A ≥ 90%  D ≥ 50%
B ≥ 80%  F < 50%
C ≥ 65%

Important Dates:

January 26   Deadline to add a class.
             Deadline to change from audit to credit, from credit to audit, and file for grade replacement
February 6   Deadline to drop/delete a class
March 12     Deadline to drop with a “W”
March 15-19  Spring Break (no classes)
Apr. 26-30   Reading Week
May 4        Final Exam (10:00 a.m.-12:00 p.m.)

Notes:
1. You may drop a course through the eighth week of the semester with the approval of your academic advisor. If you drop a course through the fourth week, the course is deleted from your permanent record; between the fourth and eighth weeks, a grade of W (withdrawal) is recorded. The university deadline to drop with a “W” is **Friday, March 12, 2004**.

2. Remember, a drop/add is not complete until it has been processed through the Registrar's office.

**LECTURE TOPICS**

I. **Will a reaction occur?**
   - Ch. 18: Entropy, Free Energy
     - *Sec 18.1-18.4, 18.6*

II. **If a reaction occurs, how fast will it go?**
    - Ch. 13: Chemical Kinetics

III. **Most reactions eventually reach a state of equilibrium.**
    - Ch. 14: Chemical Equilibrium
    - Ch. 18: *Sec 18.5. Free energy and chemical equilibrium.*
    - Ch. 15: Acids and Bases
    - Ch. 16: Acid-Base Equilibria and Solubility Equilibria

IV. **Electron Transfer Reactions**
    - Ch. 19: Electrochemistry

V. **Nuclear Processes**
    - Ch. 23: Nuclear Chemistry