CHM 152: GENERAL CHEMISTRY II

Department of Chemistry
College of Engineering and Natural Sciences
Northern Arizona University

Spring Semester 2006

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Section	Class no.	Time	Room
2	3216	M, W, F 10:20 a.m.–11:10 a.m.	88–130

Recitation Sections:

W 5:10–6:00 p.m. Chem., Room 106 Class no.: 3227

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

Office Hours:

M, T, W, Th 3:00–4:00 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:

Required: *CHEMISTRY*, Raymond Chang & Brandon J. Cruickshank; McGraw-Hill, Inc., 8th edition (2005).
Course Pack to Accompany CHM 152, Brandon J. Cruickshank (2005)
E-instruction serial response pad

Optional: *Student Solutions Manual to Accompany CHEMISTRY*, Brandon J. Cruickshank & Raymond Chang; McGraw-Hill (2005).

Reading:

It is of utmost importance that you read the text and complete example problems in the text as assigned. The lectures alone will not suffice.

Time Expectations:

The typical student will need to spend 2 hours studying for every hour in class. That amounts to an average of 6 hours of studying each week for a 3-credit class. This number will vary depending on ability, and the material covered that week. Weeks with exams will require more study time. You should organize your schedule to study in small time blocks (approx. 1 hour each) throughout the week, particularly focusing on reviewing material immediately following lecture. Studying in groups is highly recommended. Homework that relates to material covered in a particular lecture should be completed as soon as possible. It is not recommended to study in one huge time block or to complete the homework in one long session shortly before the deadline.

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 20^{th} 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 .

Important Dates:

January 27	Deadline to add a class. Deadline to change from audit to credit, from credit to audit, and file for grade replacement
February 10	Deadline to drop/delete a class
March 17	Deadline to drop with a "W"
March 20-24	Spring Break (no classes)
May 1-5	Reading Week
May 9	Final Exam (10:00 a.m.-12:00 p.m.)

GRADING POLICY

Homework: On-line homework assignments will be given each week. Homework will count 12.5% of your grade. (**http://naua0.chm.nau.edu**)

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

1/27, 2/3, 2/10, 2/24, 3/3, 3/10, 3/31, 4/7, 4/14, 4/28, 5/5

Each quiz will count 25 pts.

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

Friday, February 17
Friday, March 17
Friday, April 21

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. 225), **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 23
Thursday, March 30
Thursday, April 27

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 9, 2006.

Grading Scale:

	Best 9 of 11		% of grade
Quizzes	(9 × 25 pts each)	225 pts	28.1%
Homework		100 pts	12.5%
Class Participation		25 pts	3.1%
Exams	(3 × 100 pts each)	300 pts	37.5%
Final Exam		150 pts	18.75%
		800 pts	

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

Reminders:

1. You may drop a course through the ninth 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 ninth weeks, a grade of W (withdrawal) is recorded. The university deadline to drop with a "W" is **Friday, March 17, 2006**.

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. 6: Review ΔH
Ch. 18: Entropy, Free Energy
Sec 18.1-18.5, 18.7

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. 15: Acids and Bases
Ch. 16: Acid-Base Equilibria and Solubility Equilibria
Ch. 18: *Sec 18.6*. Free energy and chemical equilibrium.

IV. *Electron Transfer Reactions*

Ch. 19: Electrochemistry

V. *Nuclear Processes*

Ch. 23: Nuclear Chemistry