Chem 308-01: General Chemistry II for Life Sciences

Spring 2011, TT 11:00 am – 12:20 pm, ISC 1127
Blackboard course ID: Chem308-01-S11

Instructor: Professor Deborah C. Bebout; ISC 2039; 221-2558; dcbebo@wm.edu
Help Sessions: Wednesday 2:30 – 3:30 pm & Friday noon – 1:50 pm in ISC 2018

COURSE CATALOG DESCRIPTION: (3 credits; Prerequisite Chem 103) A continuation of the study of the principles of chemistry begun in Chemistry 103. Topics include thermodynamics, nuclear chemistry, chemical kinetics, descriptive inorganic chemistry, and acid-base chemistry. Recommended for students expecting to major in the life sciences, geology, and physics.

Chem 305, 308 and 335 are interchangeable for the purposes of meeting biology, chemistry, geology, neuroscience and physics major degree requirements, chemistry and biochemistry minor degree requirements, as well as admission requirements for medical school. **********Students are only permitted to take ONE of these courses for credit.********** There is no coordination between these courses, nor between the two sections of Chem 308. Students enrolled in Chem 308 Section 01 should plan to consult Professor Bebout regarding all issues related to this course. A complementary laboratory course (CHEM 354 or CHEM 356) is offered separately; review degree and post-baccalaureate plans to see if enrollment in the laboratory course is needed.

At William and Mary, the course sequence Gen Chem I, Orgo I, Orgo II, Gen Chem II is normal for those planning to take two years of college chemistry since Orgo I is only taught in the spring and summer. However, Chem 308 does not have a organic chemistry as a prerequisite and may be taken immediately after Gen Chem I for those only planning to take two semesters of college chemistry.

Course Objectives:

1. Study the content, principles and methods of chemistry;
2. Develop an appreciation for the relevance of chemistry in our daily lives;
3. Improve analytical and problem solving skills.

Texts and other resources:

Required Text:
McMurry & Fay, General Chemistry: Atoms First, First Edition, Pearson Prentice Hall, 2010
This text was required for CHEM 103 in Fall 2009 and Fall 2010.

Recommended Optional Texts:
Topich & Topich, Selected Solutions Manual for text above

Course related Electronic Resources:
1. CHEM 308-01 Blackboard site: Course documents such as solutions to homework problems and study problems
2. http://www.masterinchemistry.net homework and tutorial system. Based on conversations with technical support, all MasteringChemistry accounts should be active for two-three years from date of activation, therefore only students who had a different text for CHEM 103 than McMurry & Fay or did not register for MasteringChemistry previously should have to purchase access to MasteringChemistry for this course. The first two homeworks must be submitted by 5 pm, Sunday January 30. Please make sure you are able to make electronic submissions prior to that time.

Student Course Responsibilities & Course Policies:

Time commitment: Excelling in college level course work typically requires on average three to four hours per credit per week. Since this is a three credit course, in addition to almost three hours spent in class each week you should expect to spend six to nine hours on average reading the textbook, doing homework and otherwise preparing for this class on a weekly basis.

Attendance: Class attendance is expected for all scheduled meetings and required on scheduled exam dates. Students are responsible for everything that is covered during class including demonstrations and other visual aids. Students missing class for any reason are expected to get notes from a peer in the class and check Blackboard for any important announcements that they might have missed.

Classroom Behavior: Students attending lecture are expected to be attentive and refrain from activities that would distract other students in the class. Please refrain from eating, cell phone and laptop use during class.

Preparation for class: A brief review of relevant textbook sections before class is recommended.

Homework Assignments: Working problems is important for reinforcing the chemical principles emphasized in the lecture and text. There will be twelve MasteringChemistry homework assignments, each worth 10 pts. Your overall homework score will be based on the ten highest scores; any additional homework submissions will count as extra credit. Answers to homework assignments must be submitted via MasteringChemistry before 5 pm every Sunday (for Spring Break due Monday, March 15th @ 5 pm) and weeks with mid-terms scheduled on Thursday. **Answer keys for homework will be posted as Blackboard course documents at 5 pm the Sunday they are due, so there will be NO CREDIT FOR LATE HOMEWORK**. Each student must have personal access to MasteringChemistry to submit homework responses. Each homework assignment will consist of 5-10 problems posted at least one week in advance. Five attempts to submit the correct answer will normally be permitted on each problem part. Assignments are set up so they can be started, saved and resumed later numerous times. One or two bonus points will be awarded to each student earning more than five or more than eight points, respectively, on individual homework assignments.
In other words: There are a total of 144 homework points available, 44 of which are extra credit, enough to bump your grade

Practice Problems: There are numerous problems and exercises within and at the end of each chapter. Answers for all in-chapter problems and (red) even numbered end-of-chapter problems are found in the back of the text and detailed solutions to these problems are found in the optional *Selected Solutions Guide*. Many of these red problems are very similar to those assigned in the homework sets. You should practice in chapter problems and red end-of-chapter problems if you are having difficulty with an assigned problem.

Review Sessions: Review sessions will be held at 9 pm in ISC 1127 two days before each midterm and the final (Tuesdays February 16th, March 22nd and April 12th and on Sunday, May 1st). Review session attendance is optional but encouraged.

Grading Policies

Grading: Point totals required for specific grades will be calculated based on proportion of points earned from:

100 pts Homework: Top ten scores on homework assignments. Maximum 10 each (bonus points accumulate separately).
200 pts Each of three mid-terms
300 pts Final (50% material after 3rd mid-term + 50% cumulative = 62.5% material after 3rd mid-term + 37.5% earlier material)
Up to 44 points are available in extra credit for adjustment of point totals after determination of grade breaks.

Mid-Terms: All mid-terms will be closed-book, closed-note, independent exercises. **NO MAKE-UP MID-TERM EXAMS WILL BE GIVEN.** For excused absences, the remaining exams and final will be weighted more heavily (25% and 40%, respectively) to account for the missed exam. If you know that you will have a conflict with a scheduled exam due to a College function such as varsity sports, choir, etc., please notify me **in advance** of your absence. Detailed documentation for *severe* illness must be obtained from the Health Center or other medical professional. Documentation for deaths in the family and other extraordinary circumstances must be obtained from the Dean of Students. Unexcused absences for scheduled mid-terms, including early departures or late returns from weekends/spring break, fraternity/sorority functions, family reunions, etc. will result in a grade of zero for the missed exam.

Final Exam: The final exam for this section of Chem 308 is scheduled for Tuesday, May 3rd from 2:00 – 5:00 pm. Since I do not teach the MWF section of this course, plan on taking the exam at the scheduled time unless you meet the limited criteria for rescheduling a final (three consecutive examination periods on consecutive days or a conflict between scheduled examinations). The Office of the Dean of Students handles deferral requests from students unable to take their examinations at the time scheduled on account of documented illness or other extenuating circumstances (such as a death or other family emergency, conflict with a religious holiday, or participation in activities by a student representing the College). Final examinations that are deferred will be scheduled for the beginning of the Fall 2011 semester.

Class Climate, Culture and the Honor System
The College of William and May has an Honor System detailing the academic responsibilities of all students. Students may work with other students on the homework but are required to submit their own answers through MasteringChemistry. Exams will be closed book, closed note and independent. Please let me know if you have documented disabilities that require specific accommodation to minimize their impact on your performance in this class.

Anticipated Course Calendar:

Date	Topic & Readings	Recommended Study‡ & Required Homework Problems†
Jan 20	Course Outline; 14.1, 2,16	
Jan 23	MC HW #1 "due" @ 5 pm (Key posted Jan 30)	1.71, 1.81, 3.69, 6.63, 7.91, 7.75, 8.69, 12.149, 13.41, 13.81 & Intro to MasteringChemistry if needed
Jan 25	14.3-14.9	
Jan 27	14.10-14.13	
Jan 30	MC HW #2 due @ 5 pm	
Feb 1	14.14-14.15	
Feb 3	15.1-15.4	
Feb 6	MC HW #3 due @ 5 pm	
Feb 8	15.5-15.9	
Feb 10	15.10-15.14	
Feb 13	MC HW #4 due @ 5 pm	
Feb 15	16.1-16.6; *Review Session 9:00 pm ISC 1127*	
Feb 17	**Mid-term 1: Chapters 14 & 15**	
Feb 20	*Test week, no homework due, no Friday help session*	
Feb 22	16.6-16.9	
Feb 24	16.10-16.11	
Feb 26	MC HW #5 due @ 5 pm	
Mar 1	Enzyme kinetics	Study problems posted on Blackboard
Mar 3	17.1-17.5	
Mar 5	*First Sunday of Spring break… nothing due*	
Mar 8	*Spring break*	
Mar 10	*Spring break*	
Mar 14	MC HW #6 due @ 5 pm (this is a Monday)	
Mar 15	17.6-17.8	
Mar 17	17.9-17.14 & biochemical redox reactions	
Mar 20	MC HW #7 due @ 5 pm	
Mar 22	5.12-5.14; *Review Session 9:00 pm ISC 1127*	
Mar 24	**Mid-term II: Chapter 16& 17, Enzyme kinetics**	
Mar 25	*Last day to withdraw from a course with grade of W*	
Mar 27	*Test week, no homework due, no Friday help session*	
Mar 29	5.15-5.16 (Substitute lecturer likely)	
Mar 31	19.1, 19.2, 4.11, 4.12, 19.3-19.9; Some Chapter 18	
Apr 3	MC HW #8 due @ 5 pm	
Apr 5	19.10-19.15	
Apr 7	9.9, 18.12	
Apr 10	MC HW #9 due @ 5 pm	
Apr 12	2.7-2.9, 12.6; *Review Session 9:00 pm ISC 1127*	
Apr 14	**Mid-term III: Chapter 9, 19, 20**	
Apr 17	*Test week, no homework due… get started on #12*	
Apr 19	More nuclear chemistry	Study problems posted on Blackboard
Apr 20	Metal spectroscopy ; 3.1, 3.2,	Study problems posted on Blackboard
Apr 24	MC HW #10 due @ 5 pm	
Apr 26	20.1-20.4	
Apr 28	20.5-12	
May 1	MC HW #11 due @ 5 pm *Review Session 9:00 pm ISC 1127*	
May 3	Extra Credit MC HW #12 due @ 2 pm **Final 2:00 – 5:00 pm**	62.5% Chapters 18, 21 & Metal spectroscopy 37.5% Chapters 9, 14-17, 19 &20 & Enzyme kinetics

‡ **For all even numbered textbook problems, answers are provided in the back of the textbook and complete solutions are provided in the student solution guide.**

† Answers to problem sets will be posted on Blackboard as Course Documents at the time they are due

Overview of Critical General Chemistry I and Math Knowledge

Symbols & Abbreviations

∴ Therefore

Rxn = reaction	E = Energy	T = Temperature	K = equilibrium constant	eq = equation
Soln = solution	H = Enthalpy	t = time	k = rate constant	

Arrows: $\longrightarrow$ used if reaction goes to completion; $\rightleftharpoons$ used for equilibria; $\leftrightarrow$ used for resonance

[A] = Molar concentration of A (moles A/liter solut)

${}^{A}_{Z}X$ = Atomic symbol where A = Mass Number = # protons + # neutrons, Z = Atomic number = # protons, X = element symbol

Significant Figures

Rounding: Carry all the digits available through calculations to avoid round off error. If $\geq$ 5, round up; if < 5 round down.
Addition & Subtraction: Modify the result to have the same number of *decimal places* as the number with the *fewest decimal places*.
Multiplication & Division: Modify the result to have the same number of *significant figures* as the number with the *fewest sig. figs.*
Combined calculations: Apply above rules in the same order as their respective operations in performing calculation.
Logarithms: Number of decimal places in the log is equal to the number of significant figures in the original number.
Approximations: $100 - x \cong 100$ when $x << 100$

Nomenclature

General: Cations first by element name(oxidation state) then simple anions Xide; Compounds are **neutral**
Number prefixes: 1-10 = mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona-, deca-
Oxyanions: if only two XO_n = Xite, XO_{n+1} = Xate; if four XO = hypoXite; XO_2 = Xite; XO_3 = Xate; XO_4 = perXate

Important types of solution reactions

Acid-base reactions: involve a transfer of H^+ ions
Precipitation reactions: formation of a solid occurs
Oxidation-reduction reactions: involve electron transfer [organic: reduction (oxidation) gain H (O) OR lose O (H), not both!]

Bonding

Ionic bond: electrons are transferred to form ions
Covalent bond: equal sharing of electrons
Polar covalent bond: unequal electron sharing
Electronegativity: Relative ability of atom to attract shared e^-; polarity of bond depends on relative electronegativity of bonded atoms
VESPR Model: Valence shell Electron Pair Repulsion model = minimization of electron pair repulsion dictates geometry

Thermodynamics

First law of thermodynamics: Energy is conserved.
State functions: Functions which are path independent and only depend on endpoints (eg. energy, enthalpy)
Standard state: 1 M concentrations, 1 atm, 25 °C
Exothermic: Energy as heat flows out of system; opposite of endothermic

$\Delta H^\circ_{rxn} = \Sigma n_p \Delta H^\circ_f(\text{products}) - \Sigma n_r \Delta H^\circ_f(\text{reactants})$ (elements omitted since $\Delta H^\circ_f(\text{element}) = 0$)

Kinetics

Differential Rate Law: $\text{Rate} = -\frac{\Delta[A]}{\Delta t} = k[A]^n$ where A = reactant; k = rate constant; n = order of rxn (NOT coefficient in balanced eq)

Integrated Rate Law: For a reaction of type aA → products for which Rate = $k[A]^n$

n = 0: $[A] = -kt + [A]_0$ n = 1: $\ln[A] = -kt + \ln[A]_0$ n = 2: $[A]^{-1} = kt + [A]_0^{-1}$

These equations have the form y = mx + b, the value of k can be determined from the slope of the plot of appropriate [A] vs t plot

Arrhenius equation: $k = Ae^{-E_a/RT}$

Equilibria

K = Equilibrium Constant = [product]/[reactants] = $[C]^c[D]^d/[A]^a[B]^b$ for the reaction $aA + bB \rightleftharpoons cC + dD$
Q = Equilibrium Quotient ; If Q > K, rxn will shift toward reactants, if Q < K rxn will shift toward products
Le Châtelier's Principle: when a stress is placed on a system at equilibrium, the system shifts in the direction that relieves the stress
Dynamic State: At equilibrium, reactants and products are interconverted continually; Forward rate = Reverse rate