DEPARTMENT OF CHEMISTRY, GEOLOGY & PHYSICS

CHEM 102
GENERAL CHEMISTRY
Section01, Three Credits

Instructor:	Nicholas Pullen	**Semester**:	Spring 2012
Office Location:	207-E JSC	**Days:**	TR
Office Telephone:	(252) 335-3821	**Time:**	9:30am-10:50am
Office Hours:	TWR 1:30pm-3:30pm **And by appointment**	**Class Location:**	138 JSC

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All students enrolled in this course are required to use their assigned ECSU e-mail account when e-mailing Dr. Pullen.

Required Text: ***Chemistry: The Central Science*. (12th ed.) Brown, LeMay, *et al*.**
(Pearson-Prentice Hall, Pub.)

General Description: Second course of a three semester sequence. Deals with topics such as the electronic structure of atoms, periodic properties of the elements, basic concepts of chemical bonding, molecular geometry and bonding theories, gases, intermolecular forces, modern materials, and properties of solutions. Three (3) credit hours. (Prerequisite: CHEM 101/L; Corequisite: CHEM 102L).

Learning Outcomes:
At the completion of this course, the successful student will be able to:

- Compare and contrast the properties of the three basic states of matter: gas, liquid and solid.
- Explain the Kinetic Molecular Theory of Gases and list the assumptions of this theory.
- Calculate volume, temperature or pressure of a gas sample that undergoes changes in its initial conditions using the combined gas law.
- Use the ideal gas law in stoichiometric calculations.
- Compare the solubility of various common compounds.
- Define the terms: solution, solute and solvent.
- Calculate the molarity of solutions.
- Explain at least two examples of colligative properties.
- Write electronic configurations of the first 50 elements; show the diagrams of their electronic structure, and indicate the spin of each electron.
- Sketch the shape of the s, p and d orbitals.
- Identify the 4 quantum numbers for any electron in an atom.
- Predict which atoms or ions are paramagnetic and which are diamagnetic using the electronic configurations.
- State the Pauli Exclusion Principle, Hund's rule, and the Aufbau principle.
- (R) Define ionization energy and be able to rank using the periodic table.
- Use ionization energy trends to predict the stability of electronic configurations and the tendency for outer shell electrons to undergo changes in order to form compounds.
- (R) Define electronegativity: show how it varies with respect to the periodic table.
- (R) Use electronegativity to estimate the polarity of bonds.
- Show the trends of atomic and ionic sizes on the periodic table.
- State the octet rule, including exclusions.
- Write Lewis electron dot structures for simple covalent compounds and polyatomic ions.
- Use double and triple bonds to show structures of molecules and ions; use resonance to describe equivalent bonds.

- Use the Valence Shell Electron Pair Repulsion theory to describe electron pairs geometry, molecular geometry, hybridization, and bond angles.
- Predict the polarity of bonds and molecules.
- Define bond order and bond dissociation energy; use bond energies to estimate reaction enthalpies.
- Calculate the formal change of an atom in a molecule or ion, and use it to predict the most reasonable resonance structures.
- Explain the difference between oxidation number and formal change.
- Explain simple valence bond theory.
- Use the concepts of orbital overlap, sigma and pi bonds, hybrid orbitals to explain the strength and orientation of covalent bonds.

Methods of Assessing Learning Outcome

The aforementioned learning outcomes will be assessed by performance on chapter outlines, homework exercises, jig-saw activities, quizzes, one-minute papers, mid-term and final examinations, and a project.

CHAPTER 6. ELECTRONIC STRUCTURES OF ATOMS

Be able to:

- Describe the wave properties and characteristic speed of propagation of radiant energy (electromagnetic radiation)
- Use the relationship $\lambda\nu = c$, which relates the wavelength (λ) and the frequency (ν) of radiant energy to its speed (c)
- Explain the essential feature of Planck's quantum theory, namely, that the smallest increment, or quantum of radiant energy of frequency, v, that can be emitted or absorbed is hv, where h is Planck's constant
- explain all the observations about the photoelectric effect using Einstein's model.
- Explain the origin of the expression line spectra
- List the assumptions made by Bohr in his model of the hydrogen atom
- Explain the concept of an allowed energy state and how this concept is related to the quantum theory
- Calculate the energy differences between any two allowed energy states of the electron in hydrogen
- Explain the concept of ionization energy
- Calculate the characteristic wavelength of a particle from a knowledge of its mass and velocity
- Describe the uncertainty principle and explain the limitation it places on our ability to define simultaneously the location and momentum of a subatomic particle, particularly an electron
- Explain the concepts of orbital, electron density, and probability as used in the quantum-mechanical model of the atom
- Describe the quantum numbers, n, l, m_l, used to define an orbital in an tom and list the limitations placed on the values each may have
- Describe the shapes of the s, p, and d orbitals
- Explain why electrons with the same value of principal quantum number (n) but different values of the azimuthal quantum number (l) possess different energies
- State the Pauli exclusion principle and Hund's rule, and illustrate how they are used in writing the electronic structures and the elements
- Write the electron configuration for any element
- Write the orbital diagram representation for electron configurations of atoms
- Describe what we mean by the s, p, d, and f blocks of elements
- Section to be covered: 6.1-6.9

Chapter 7. Periodic Properties of the Elements

Be able to:

- Explain the development of the periodic table
- Define effective nuclear charge
- Define atomic and ionic sizes, ionization energy and electron affinity and explain their periodic trend
- Describe metals, nonmetals and metalloids and explain group trends in active metals and selected nonmetals.

- Sections to be covered: 7.1-7.8

Chapter 8. Basic Concepts in Chemical Bonding

Be able to:

- Describe the types of bonds, Lewis structures and the octet rule
- Explain energies of ionic bonds
- Write electron configurations for ions
- Describe the types of covalent bonds
- Explain polarity; Explain and give periodic trends of electronegativity
- Draw Lewis structures for molecules and polyatomic ions
- Determine formal charge
- Explain and draw resonance structures
- Explain the exceptions to the octet rule and write Lewis structures for molecules and ions that do not obey the octet rule
- Define bond enthalpy and use it to calculate enthalpies of reactions
- Explain the relationship between bond enthalpy, bond strength and bond length.
- Sections to be covered: 8.1-8.8

Chapter 9. Molecular Geometry and Bonding Theories

Be able to:

- Explain the molecular shape
- Explain the VSEPR model
- Determine molecular shape and molecular polarity
- Explain covalent bonding in terms of orbital overlap
- Describe hybrid orbitals and determine hybrid orbitals for molecules and ions
- Explain multiple (π) bonding;
- Describe molecular orbitals
- Determine molecular orbitals, electron configurations and bond order for diatomic molecules.
- Sections to be covered: 9.1-9.7

Chapter 10. Gases

Be able to explain:

- Explain the characteristics of gases
- Define pressure and its units
- Determine pressures using barometers and manometers
- Explain the gas laws: Boyle's law, Charles law and Avogadro's law
- Describe the ideal-gas equation
- Explain the relationship between the gas laws and the ideal gas equation
- Use the ideal gas equation to determine densities, molar masses and volumes of gases
- Explain partial pressures and mole fractions
- Describe the kinetic-molecular theory and how it is applied to the gas laws
- Explain and determine molecular effusion and diffusion for gases
- Define Graham's law of effusion
- Define real gases and explain how they deviate from ideality
- Describe the van der Waals equation.
- Sections to be covered: 10.1-10.9

Chapter 11. Intermolecular Forces, Liquids and Solids

Be able to:

- Define the molecular forces
- Describe ion-dipole forces, dipole-dipole forces
- London dispersion forces and hydrogen bonding
- Determine the molecular force(s) acting in molecules
- Describe viscosity and surface tension
- Explain phase changes and heating curves
- Explain vapor pressure

- Explain phase diagrams
- Describe the structures of solids
- Explain the bonding in solids.
- Sections to be covered: 11.1-11.8

Chapter 13. Properties of Solutions

Be able to:

- Describe the solution process
- Define saturated solutions and solubility
- Give the factors that affect solubility
- Express concentrations in mass percentage, ppm, ppb, mole fraction, molarity and molality
- Interconvert concentrations from the different units
- Describe colligative properties: lowering vapor pressure, boiling point elevation, freezing-point depression and osmosis
- Determine molar mass
- Describe colloids
- Explain hydrophilic and hydrophobic colloids
- Sections to be covered: 13.1-13.6

EVALUATION

During the semester, various methods will be used to evaluate and to ensure that the objectives of the course are being achieved. However, for the determination of a course grade for each student, the following point system will be used unless an alternative grade system is announced to the class at least two weeks prior to the end of the semester. Students will be graded on the basis of their average performance. Students are expected to attend all class meetings. Participation in class discussions is a major component of the course.

One-Minute Papers may be administered at any time during a class meeting. One-Minute papers, also known as the half-sheet response, provide a quick and simple way to collect written responses/feedback from students concerning class lectures/activities/course content. Students will be asked to write their responses to one or two questions/statements on half-sheets of paper (hence the second name), or index cards that Dr. Pullen will provide. Students will have only one (1) minute to begin and complete their response(s). Unless there are extenuating circumstances, the score for each missed *One-Minute Paper* will be recorded as a zero (0). The *One-Minute Papers* will be used to calculate the student's participation points. **Each *One-Minute Paper* will be worth 1 pt.**

There will be a minimum of three (3) examinations (of which one will be a mid-term) based on class lectures, assigned readings, and homework. Additionally, students will be required to work in small groups in order to complete and present research on approved topics.

Various problems and exercises will be assigned throughout the semester. Students are expected to complete all homework exercises and problem sets. (The homework exercises from the course text book are located at the end of the course outline.) Students will be expected to solve assigned problems and exercises and able to explain their solutions. Students are encouraged to seek help during class meetings **and** outside of class. Homework problems/exercises should be kept in some type of notebook or ring binder and brought to each class meeting. Unannounced and announced quizzes will be administered in order to ensure that students study the material covered in class consistently.

A final comprehensive examination will also be administered, scheduled to take place May 3, 2012, 8:00am-9:50am.

SURVEYS:

As part of an ongoing project on science education funded by the National Science Foundation, you will be required to complete several surveys via the web. You will need to complete the surveys within a certain period of time (usually a week). Each completed survey will count as **ten (10) points** toward your final grade. If you do not complete an assigned survey by its deadline, you will receive a **zero (0)** for that survey. There are no make-up surveys. One example is the Learning and Studying Questionnaire (LSQ) which is administered once

near the beginning of the semester, counting for ten points. Another example is the Views About Science Survey (VASS) which is administered once near the beginning and again near the end of the semester, each time counting **five (5)** points for a **total of ten (10) points**. It is important to note that these are not content examinations – **there are no wrong answers; all you need to do is complete them.**
All survey responses are anonymous; there will only be a record of survey completion, based upon the last five digits of your student ID number, so that credit can be awarded.
More information about the project can be found here:
https://www.msu.edu/~first4/Index.html

THE FINAL GRADE WILL BE DETERMINED BY:

1. **Three** tests @110 points each	330	points
2. **Five** Homework Checks @ 10 points each (Unannounced)	50	points
3. Oral Presentation (Group Work)	120	points
4. NSF Surveys	40	points
5. **Three** announced quizzes @ 25 points each	75	points
5. **Two** unannounced quizzes @ 25points each	50	points
6. **Five** Problem Sets @ 20 points each	100	points
7. Participation (*e.g.*, One-Minute Papers)	35	points
8. Spring 2012 Review Assignment	80	points
9. Final Examination	120	points
Total possible points	1000	points

GENERAL EQUIVALENCE BETWEEN NUMERICAL AND LETTER GRADES

Total points	Grade for the Semester
900 and above	A
899-800	B
799-700	C
699-600	D
599 and below	F

Tentative Class Schedule (Please adhere to the following schedule unless instructed otherwise)

Date	Readings/Task Assigned	Assignment/Reading Due	Notes/Tests/Quizzes
01-10-12	• Chapter 6 Reading (Sections 6.1-6.9)		• Introduction and expectations
01-12-12	• Chapter 6 Homework Exercises	• Chapter 6 Reading (6.1-6.5)	
01-17-12	• Problem Set 1 • Chapter 7 Reading (Sections 7.1-7.8)	• Chapter 6 Reading (6.6-6.9)	• **Late registration ends** • Classes resume, 8:00 am • **Drop/Add period ends**
01-19-12	• Chapter 7 Homework Exercises	• Chapter 6 Homework • Chapter 7 Reading (7.1-7.4)	
01-24-12		• **Problem Set 1** • Chapter 7 Reading (7.5-7.6)	**ANNOUNCED QUIZ #1**
01-26-12	• Problem Set 2	• Chapter 7 Reading (7.7-7.8)	
01-31-12	• Chapter 8 Reading (Sections 8.1-8.8)	• Chapter 7 Homework	
02-02-12		• **Problem Set 2**	• Review for Test 1
02-07-12			**TEST 1**
02-09-12	• Chapter 8 Homework Exercises	• Chapter 8 Reading (8.1-8.4)	
02-14-12	• Problem Set 3	• Chapter 8 Reading (8.5-8.8)	
02-16-12	• Chapter 9 Reading (Sections 9.1-9.5) • Chapter 9 Homework Exercises	• Chapter 8 Homework	
02-21-12	• Topic Search	• **Problem Set 3** • Chapter 9 Reading (9.1-9.3)	
02-23-12	• Problem Set 4	• Chapter 9 Reading (9.4-9.5)	
02-28-12	• Chapter 10 Reading (Sections 10.1-10.7)	• Chapter 9 Homework	
03-01-12		• **Problem Set 4**	**ANNOUNCED QUIZ #2**
03-06-12			• MID-TERM Review • Last day to remove "I"

			grades
03-08-12			**MID-TERM EXAMINATION (Chap. 6-9)**
03-13-12	• Chapter 10 Reading and Chapter 10 Homework Exercises		NO CLASS SPRING RECESS
03-15-12			NO CLASS SPRING RECESS
03-20-12		• Chapter 10 Reading (10.1-10.4)	
03-22-12	• Problem Set 5	• Chapter 10 Reading (10.5-10.7)	•
03-27-12		• Chapter 10 Reading (10.8-10.9) • Chapter 10 Homework	• **Last day to Withdraw with a "W"**
03-29-12	• Chapter 11 Reading (Sections 11.1-11.3) • Chapter 11 Homework Exercises	• **Problem Set 5**	• Review for Test 3
04-03-12			**TEST 3**
04-05-12	• Group Presentation	• Chapter 11 Reading (11.1-11.3)	
04-10-12	• Chapter 13 Reading (13.1-13.4) • Chapter 13 Homework Exercises	• Chapter 11 Reading (11.4-11.8) • Chapter 11 Homework	
04-12-12	• Group Presentation	• Chapter 13 Reading (13.1-13.4)	
04-17-12	• Group Presentation	• Chapter 13 Homework • Chapter 13 reading (13.5-13.6)	
04-19-12		• Group Presentation	**ANNOUNCED QUIZ #3**
04-24-12		• Group Presentation	
04-26-12		• Group Presentation • Review Assignment	LAST CHEM 102 CLASS, WRAP-UP
05-03-12			**FINAL EXAMINATION (all chapters) 8:00am-9:50am**

IMPORTANT UNIVERSITY-WIDE DATES

January 9	Official Registration
March 3-9	Mid-Term Week
March 6	Last day to remove "I" grades
March 12-17	Spring Recess
March 26-April 6	Academic Advisement/Pre-Registration for Summer/Fall 2012
March 27	Last day to withdraw with a "W" grade
April 6-9	Easter Holiday
April 13	Last day to withdraw and receive a "WD" grade
April 21-25	Final Exams, graduating seniors
April 26	Last Day of Classes
April 28	Final Exams for weekend/evening/graduate programs
May 1-7	Final Exams, all other students
May 5	Commencement

Special Notes

1. Please be on time and attend every class.
2. Study and review everyday.
3. Complete the homework problems and/or exercises.
4. Write formulas, work out problems, etc, as you study.
5. Test yourself to determine what you do not know.
6. Make it a habit to come to class prepared to ask questions.
7. **Each student will need a calculator. Students will not be allowed to share calculators. Please bring it to every class meeting. (Students will not be allowed to use the cell phone built-in calculator feature.)**
8. No student will be allowed to wear headphones during class, unless documentation is presented for consideration as to why this should be allowed.
9. **Each student is to bring a pencil with a workable eraser, along with paper and the assigned text to every class meeting.**
10. Assignments will not be accepted late, unless there are extenuating circumstances- instructor's discretion.
11. Missed tests, quizzes, and/or exercises, etc. will be recorded as a zero (0) unless there are extenuating circumstances - Instructor's discretion. Missed tests, exercises, quizzes (unannounced or announced), etc. will not be re-administered without a firm, legitimate, documented (written) excuse. Discretion is with the instructor as to whether the absence will be deemed excused or not.
12. Please visit the instructor for assistance when facing difficult course material/assignments/readings. Office hours are listed; however feel free to ask for a meeting outside that time. Dr. Pullen is generally available (8am-7pm) Tuesday-Thursday.

Homework Exercises from Textbook

***Students should complete each of the homework exercises listed below. Students are encouraged to work ahead. The exercises should be completed and brought to each class meeting. Homework checks and many, if not most, of the One-Minute Papers will be based on the Homework Exercises and similar problems**

Chapter	Pages	Exercises
6	241-244	6.12; 6.14; 6.16; 6.22; 6.24; 6.34; 6.36; 6.45; 6.49-6.52; 6.64; 6.68; 6.72; 6.73-6.74
7	280-283	7.20; 7.22-7.27; 7.30; 7.33-7.34; 7.42; 7.44; 7.46; 7.54; 7.60; 7.64; 7.66; 7.70
8	322-325	8.1; 8.14; 8.16; 8.18; 8.24;8.30; 8.37-8.40; 8.46; 8.50; 8.62; 8.66
9	373-376	9.1; 9.16; 9.21-9.22; 9.25; 9.27; 9.31; 9.36; 9.40; 9.48; 9.49-9.50
10	416-420	10.13; 10.18; 10.24; 10.26; 10.32; 10.48; 10.64; 10.68; 10.74
11	453-457	11.1-11.3; 11.8; 11.9-11.12; 11.16-11.18; 11.29-11.30; 11.34-11.39; 11.44
13	548-551	13.1,13.6, 13.12-13.14, 13. 13.18, 13.20-13.22, 13.28, 13.35-13.38, 13.47-13.48

Problem Sets

Problem sets pertaining to the respective chapters will be assigned.

Problem Set	Chapters of Interest
1	6
2	7
3	8
4	9
5	10

***Additional problem sets may be assigned.**

Topic_____
Date_____
Group Members_____ _____

_____ _____

_____ _____

	CHEM 102—General Chemistry II				
	Presentation Rubric				
	5	**10**	**15**	**20**	**Total**
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow.	Student presents information in logical, interesting sequence which audience can follow.	
Subject Knowledge	Student does not have grasp of information; student cannot answer questions about subject.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student is at ease with expected answers to all questions, but fails to elaborate.	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration.	
Visual Aide(s)	Student uses superfluous graphics or no graphics	Student occasionally uses graphics that rarely support text and presentation.	Student's graphics relate to text and presentation.	Student's graphics explain and reinforce screen text and presentation.	
Mechanics	Student's presentation has four or more spelling errors and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has no misspellings or grammatical errors.	
Eye Contact	Student reads all of report with no eye contact.	Student occasionally uses eye contact, but still reads most of report.	Student maintains eye contact most of the time but frequently returns to notes.	Student maintains eye contact with audience, seldom returning to notes.	
Elocution	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	
				Total	/120

REFERENCES:

1. The companion website is located at *http://wps.prenhall.com/esm_brown_chemistry_9/*

The following steps should be followed to access this website:

   (a) Log to the website
   (b) Select a chapter by clicking the arrow next to "Jump to…" (upper left corner)
   (c) Click on "Problem Solving Center" (left window)
   (d) Choose a homework or quiz. Answer questions.
   (e) If assigned, submit answers by entering your name, your e-mail address and instructors e-mail address. E-mail results.

2. Petrucci, R. H., Harwood, W. S. and Herring, F. G., "General Chemistry", 8th Ed., Prentice Hall, New Jersey, 2002
3. McMurry, J. and Fay, R.C., "Chemistry", 3rd Ed., Prentice Hall, New Jersey, 2001.
4. Ebbing, D. D. and Gammon, S. D., "General Chemistry", 7th Ed., Houghton Mifflin, 2002
5. Umland, J. B. and Bellama, J. M., "General Chemistry", 3rd Ed., Brooks/Cole Publishing Co., 1999
6. Burns, R. A., "Fundamentals of Chemistry", 2nd Ed., Prentice Hall, New Jersey, 1995.
7. *Journal of Chemical Education* (online website: *http://jchemed.chem.wisc.edu*)