CHEM 1210

Principles of Chemistry

MWF, 10:30 am - 11:20 am, ESLC 053

Instructor: David Farrelly

Email: david.farrelly@usu.edu
Office: Maeser Lab. 153
Office Hours: TBD and by appointment. Drop by OK and encouraged.
Tel: (435) 797-1608

This syllabus is subject to revision.

Course Description: Chemistry 1210 is the first of a two semester sequence of general chemistry for chemistry majors. The course will cover topics presented in chapters 1 - 7 and 9 - 12 of the text.

Prerequisite(s): Previous or concurrent enrollment in Math 1050 or higher.

Recitation: All students must register for, and attend, the recitation section(s) listed in the USU Schedule of Classes. The recitation is designed to help to develop problem solving skills needed for the examinations, and also to reinforce your understanding of concepts covered in class. Recitation sections will begin the second week of classes.

Credit Hours: 4

Text: *Principles of Modern Chemistry*, by D. W. Oxtoby, H. P. Gillis and A. Campion, 6^{th} edn. recommended, ISBN 978-0-534-49366-0

Course Learning Objectives: These are listed in the various modules on the course webpage and also at the end of this syllabus.

Learning Management System (LMS): Canvas Instructure will be used for the management of Chem. 1210. Importantly, you will take Quizzes AND Exams online using Canvas. Quizzes are open book and may be taken on any computer. Exams can only be taken in the USU Testing Center. To log on to Canvas, go to the web address: canvas.usu.edu. Your USERNAME is your BANNER login and your default PASSWORD is your BANNER password. Canvas has many useful features (your assignment scores, a chat room, discussion page, email, etc.) and you should take the time to explore them from within the course webpages.

Online Quizzes: There will be 12 graded online quizzes. Each quiz counts 10 points and is open book. You will take the quizzes online through Canvas. Quizzes will start the second week

of classes. You will have 30 minutes to take each quiz. You have an unlimited number of attempts and your highest score will be kept. Note that each time you take a quiz you will receive a slightly different version, covering the same concepts but with different questions. Quizzes do not have deadlines but you should aim to complete the relevant quiz within one week of having finished the corresponding chapter in class.

Homework: I will assign 10 homework sets. These will (usually) consist of 10 problems which are longer and harder than a typical quiz problem. You are encouraged to work with other students to solve these problems and we will spend some class and recitation time discussing them. I will select, at random and in class, one of the 10 problems to be handed in for grading. Your homework should be legible and should show all of the important steps as well as notes explaining your reasoning. Each problem should be done on a separate sheet or sheets. A correct answer that does not follow these rules may score ZERO whereas an ultimately incorrect answer that does abide by these rules may score some, possibly maximum, points depending on how well you show your steps and logic. Each homework will be worth 20 points. The Final exam will contain some questions based DIRECTLY on homework problems and so you must make sure that you actually understand how to solve every problem, even though only 1 problem will be graded from each homework set.

Midterm Exams: TWO 90-minute exams (150 points each) consisting of 40 multiple choice questions will be available during specified time windows – see schedule below. The exams are based on material covered in class and quizzes. They will closely match the difficulty level and content of the practice exams. You are strongly urged to take the online practice exams several times. Practice exams are graded as quizzes (but worth 15 points each) and your highest score will be retained. Midterm exams should be taken in the USU Testing Center. Note that each student will receive a slightly different midterm exam, both in terms of question order and content. Questions will be drawn randomly from a test bank. YOU ARE RESPONSIBLE FOR FINDING AN OPEN TIME IN THE TESTING CENTER TO TAKE THE EXAM. If you leave it to the last minute and cannot find a spot in the Testing Center you will receive a ZERO for that exam.

Final Exam: The two-hour Final Exam will be comprehensive and will follow the same procedures as for the Midterms. However, it will consist of 50 questions and is worth 200 points. It will be available throughout Finals week and should be taken in the USU Testing Center. There will not be a practice final but the questions will be similar to those on the practice midterms and quizzes **and Homeworks.** YOU ARE RESPONSIBLE FOR FINDING AN OPEN TIME IN THE TESTING CENTER TO TAKE THE EXAM. If you leave it to the last minute and cannot find a spot in the Testing Center you will receive a ZERO.

Missed Exams: Because midterm exams are available during time windows 2 weeks it is unlikely that you will be unable to take an exam. However, if you do miss one of the in-class midterms exam due to illness or emergency, I will offer you the opportunity to take the exam at another time. If at all possible you should notify me of the reason for missing the midterm in advance. Missed midterms may require written documentation from a doctor or other authority at my discretion.

Grading:

Homework Problems	200 pts
Quizzes and Practice Midterms	150 pts
Midterm Exams	300 pts
Completion of Course Evaluation	50 pts
Final Exam	200 pts
TOTAL	900 pts

Letter Grade Distribution:

>= 93.00	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	60.00 - 66.99	D
80.00 - 82.99	B-	<= 59.99	F
77.00 - 79.99	C+		

Based on the overall class average, the percentage cuts for the various grades may shift *lower* than the above cuts. In other words, a better grade may be assigned for lower percentages than those indicated above, a scenario that is in your favor. The percentages will never shift higher than the above, so you are assured of the above indicated, or higher grade.

Course Policies:

- **General**
  - Quizzes are open book, open notes but should be done independently.
  - Homeworks are open book, open notes and may be done in collaboration with other students. However, final written-up solutions should be done independently.
  - Exams are closed book, closed notes.
  - **Makeup quizzes and exams will be permitted only in exceptional circumstances (illness, emergency, etc.). Discretionary events (e.g., vacations) do not qualify.**
- **Grades**
  - Grades will be maintained in the LMS course shell. Students are responsible for tracking their progress by referring to the online grade book.
  - Very Important Note: **the Canvas grade book assigns a percentage based ONLY on quizzes/exams taken. For example, if someone took only 1 quiz during the class and scored 100% the Canvas grade book would show the overall percentage as 100% and your grade as an A. Obviously, when I grade the course all missed assignments will score ZERO and the person who took only 1 quiz would get an F.**

Academic Honesty Policy Summary:

> In addition to skills and knowledge, USU aims to teach students appropriate Ethical and Professional Standards of Conduct. The Academic Honesty Policy exists to inform students and Faculty of their obligations in upholding the highest standards of professional and ethical integrity. All student work is subject to the Academic Honesty Policy. Professional and Academic practice provides guidance about how to properly cite, reference, and attribute the intellectual property of others. The administration of Chem 1210 will adhere strictly to the academic policies outlined in the current USU General Catalog.

Course Assessment: Students in this class are expected to develop proficiency in the principles listed on the class web page and the attached list of Learning Objectives. Embedded questions on midterms, quizzes, and homework sets will be used to assess your understanding of these principles. The formats to be used for assessment will include instructor-designed questions. Please note that assessment is a tool used by the Department of Chemistry and Biochemistry to improve the quality of instruction and proficiency of our students. Your grade will be based on your performance on the assignments indicated above, some of which will also be used for course assessment.

Americans with Disabilities Act: In accordance with the Americans with Disabilities Act, reasonable accommodations will be provided for all persons with disabilities in order to ensure equal participation in Chem 1210. In cooperation with the Disability Resource Center, reasonable accommodation will be provided for students with disabilities. Please meet with the instructor during the first week of class to make arrangements. Alternative format print materials, large print, audio, diskette or Braille, will be available through the Disability Resource Center.

Tentative Course Outline:

The weekly coverage might change as it depends on the progress of the class.

Week	Material
Week 1 (Aug. 29)	• Introduction to the class • Chap. 1: Introduction to Atomic Structure • Appendices A and B (accuracy, precision, significant figures, units)
Week 2 (Sep. 5)	• No class (Labor Day) • Chap. 2: Moles, Empirical Formulas, Nomenclature. • Chap. 2: contd.
Week 3 (Sep. 12)	• Chap. 3: Potential energy and periodic trends • Chap. 3: IE, EA, EN and ionic bonding • Chap. 3: Covalent bonding and polarity
Week 4 (Sep. 19)	• Chap. 3: Lewis dot structures • Chap. 3: VSEPR • Chap. 4: Waves and quantization of energy
Week 5 (Sep. 26)	• Chap. 4: The Bohr model • Chap. 4: Quantum theory • Chap. 4: Particle in a box
Week 6 (Oct. 3)	• Chap. 4: contd. • Chap. 5: H atom and orbitals • Chap. 5: Orbitals contd.
Week 7 (Oct. 10)	• Chap. 5: Many-electron atoms, QM and Periodic Table • Chap. 5: contd. • Chap. 6: QM of the chemical bond
Week 8 (Oct. 17) EXAM 1 OPENS	• **EXAM 1 WINDOW OPENS: CHAPS. 1 - 5** • Chap. 6: LCAO, MO and homonuclear diatomics • Chap. 6: LCAO, Heteronuclear diatomics, polyatomics • FALL BREAK
Week 9 (Oct. 24) EXAM 1 CLOSES	• Chap. 6: Polyatomics and organic molecules • Chap. 6: contd. • Chap. 7: Bonding in organic molecules • **EXAM 1 WINDOW CLOSES (FRIDAY)**
Week 10 (Oct. 31)	• Chap. 7: contd. • Chap. 9: Gases: Ideal gases • Chap. 9: Kinetic model of gases
Week 11 (Nov. 7)	• Chap. 9: Gases contd. • Chap. 10: Intermolecular forces • Chap. 10: Intermolecular forces • Chap. 10: Condensed phases and Phase diagrams
Week 12 (Nov. 14) EXAM 2 OPENS	• **EXAM 2 WINDOW OPENS (CHAPS. 6, 7, 9, 10)** • Chap. 10: contd. • Chap. 11: Solutions • Chap. 11: Reactions in solution
Week 13 (Nov. 21) EXAM 2 OPEN	• Chap. 11: Volatile/nonvolatile solutes • No class (Thanksgiving) • No class (Thanksgiving)
Week 14 (Nov. 28) EXAM 2 CLOSES	• Chap. 12: Thermodynamics: First Law • Chap. 12: Heat Capacity, Enthalpy • Chap. 12: Thermochemistry, reversible and irreversible processes • **EXAM 2 WINDOW CLOSES (FRIDAY)**
Week 15 (Dec. 5)	• Catch-up and review • Catch-up and review • Catch-up and review
Week 16 (Dec. 12)	• FINAL EXAM (CHAPS. 1 - 7, 9 -12)

Learning Objectives

Define matter and classify it from the level of mixtures and compounds to elements

Differentiate physical and chemical properties and changes and intensive and extensive properties.

List and define the base S.I. units of mass, length, time, temperature and amount of a substance, and manipulate the base units to give derived SI units
Use the principles of dimensional analysis and conversion factors to convert quantities expressed in one unit to another unit.

Express numbers in different units by using the prefix and exponential notation methods.

Explain the difference between precision and accuracy, and relate these terms to the concept and usage of significant figures in experimental measurements.

Explain the atomic theory of matter, emphasizing the composition of the atom, and what defines the identity of a given element.

Explain the relative sizes, masses, and charges of the proton, neutron, and electron, and how they assemble to form an atom.

Define the term isotope, and be able to discern the subatomic composition of an atom given its atomic and mass numbers. Represent the atom using the element symbol with superscript and subscript denoting the composition.

Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity. Predict common ion charges of group 1A, 2A, 3A, 6A, and 7A elements based on position in the periodic table.

Name and predict ions formed from the elements, and recognize and be able to name common polyatomic cations and anions.

Differentiate between ionic and molecular compounds, and empirical and molecular formulas.

Given the chemical formula for an ionic compound or molecule, provide a proper unambiguous systematic name for the compound. Conversely, given the compound name, write the single chemical formula that matches the name.

Given the reactants and products for a chemical equation, balance the equation using whole number coefficients.

Recognize the following common chemical reactions: combustion, decomposition, combination.

Given the atomic weights and relative abundances of naturally occurring isotopes, calculate the average atomic weight of an element.

Use average atomic weights from the Periodic Table to calculate formula weights and molecular weights for compounds.

Use the concepts of the mol, molar mass and Avogadro?s number and conversion factors derived from their relationships to interconvert between mass, mols, and numbers of particles for atoms and molecules.

Explain the basis for the mass defect seen when an experimentally determined molar mass for an atom is compared to the sums of the masses of the subatomic particles in that atom.

Use the stoichiometric relationships between atoms in molecules, and the stoichiometric coefficients on reactants and products in chemical reactions, to interconvert between numbers of particles, mols, and masses within compounds and for chemical changes.

Given the molar mass of an unknown compound and it?s elemental composition in mass percent, determine the empirical and molecular formulas for the compound.

Given a chemical reaction and masses of reactants, determine the limiting reagent if the reaction goes to completion, and calculate the masses of products formed and excess reagent remaining at the conclusion of the reaction.

Understand solution composition and the terms solvent and solute. Differentiate between weak and strong electrolytes and non-electrolytes. Define and differentiate strong and weak acids and bases.

Define solubility and miscibility and understand the factors that make a solute soluble in water.

Define and write representative equations for aqueous reactions involving neutralization, precipitation, gas generation, and oxidation/reduction.

Define and write representative equations for molecular equations, complete ionic equations, net ionic equations.

Recognize spectator ions in aqueous reactions.

Define solution concentration in units of molarity and use dimensional analysis to interconvert molarity, mass, mols, and volume.

Define energy in terms of work and radiation (heat), and differentiate the following types of energy and the terms that relate to it: kinetic, potential, thermal, chemical energy; conservation of mass, system and surroundings, state function.

Describe energies, energy changes and associated signs referenced relative to the system of interest.

Define enthalpy and exothermic and endothermic reactions.

Determine the enthalpy for a reaction given information from a standard table of enthalpies of formation or using specific heat and calorimetry data.

Apply Hess s law to determine enthalpies of reaction.

Describe the properties of electromagnetic radiation, and use the appropriate equations that interrelate energy, frequency, wavelength, Planck s constant, and the speed of light.

Explain the concept of photons and quanta and the dual nature of radiant energy.

Explain the Bohr model of the hydrogen atom and use the Rydberg equation to determine the energies associated with electronic transitions.

Explain the dual nature of matter (wave and particle).

Explain how the Heisenberg uncertainty principle and Schrödinger models relate to electronic structure.

Describe electronic structure in terms of orbitals, with associated quantum numbers and explain how these quantum numbers relate to the energies, shapes, orientations, and spins of electrons in atoms.

Use the above principles of quantum chemistry together with the Pauli exclusion principle and Hund s rule to predict the electronic configurations of multi-electron atoms.

Predict periodic properties, including relative sizes of atoms, ionization energies, and electron affinities using the principles outlined in class.

Understand and describe chemical bonding at the level presented in class, with particular emphasis on understanding and applying the following terms/concepts: Lewis symbols and atoms, Ionic bonding, Lattice energy, isoelectronic series, covalent bonding, electronegativity and bond polarity, Lewis structures, formal charges, resonance, octet violations, bond strengths, oxidation numbers.

Apply valence shell electron pair repulsion theory to properly-drawn Lewis structures to predict bond angles and geometries about atoms in molecules.

Use valence bond theory to describe covalent bonding in terms of orbital overlaps and hybridizations.

Describe the properties of a gas in terms of the variables P, V, n, and T. Use the Ideal gas law to interconvert between P, V, n, and T for a gas. Understand and explain Kinetic-molecular theory.

Explain the factors that lead to non ideal behavior for a gas.

Understand and identify the intermolecular forces important in different solids and liquids.

Describe the processes by which states of matter are changed.

Define vapor pressure and boiling point.