

Department:

Chemistry

Course Description:

This course provides college-level chemistry content and is intended for students pursuing science careers. Course topics include atomic theory, electronic structure, chemical periodicity, ionic and covalent compounds, molecular structure and polarity, calculations with chemical formulas and chemical reactions, gases, and thermochemistry. The course also covers the chemistry of acid-base, oxidation-reduction, and precipitation reactions.

Course Competencies:

The learning outcomes and competencies detailed in this syllabus meet or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Groups for this course as approved by the Kansas Board of Regents. (Kansas Regents Shared Number Course and Title: **KSRN Course CHM 1010 Chemistry I for Majors & Lab.**)

Upon completion of the course, the student should be able to:

1. Identify and differentiate between atoms, pure elements, compounds, and ions, and correlate chemical formulas with chemical names.
2. Construct balanced chemical equations given a set of reactants and/or products, use a balanced chemical equation to solve stoichiometry problems, and analyze chemical reactions with regards to stoichiometry and thermochemistry.
3. Identify predominant species present in an aqueous solution and identify the reactants and/or products of common aqueous reactions: acid/base, redox, precipitation, etc.
4. Relate the periodic properties of the elements to their electronic structure using the quantum mechanical model.
5. Apply VSEPR and/or Valence Bond Theory to predict the three-dimensional structure of molecules and relate macroscopic physical and chemical properties of matter to its atomic scale chemical bonding, intermolecular forces, and three-dimensional structure.
6. Apply the Kinetic Molecular Theory to describe an ideal gas and use the ideal gas law to calculate a state variable for a given set of conditions.
7. Describe the relationships between heat, work, internal energy, and energy changes for chemical reactions and perform calculations involving these concepts.
8. Apply dimensional analysis and mathematical techniques to solve chemical problems, including significant figures throughout calculations in all content learning outcomes.
9. Execute laboratory skills in accordance with proper laboratory and chemical safety practices.
10. Collect, evaluate, and interpret qualitative and quantitative data from laboratory procedures in a productive and meaningful manner.

Course Content:

- A. Scientific method
- B. Measurement
 1. Significant figures

2. SI and Imperial unit conversions
3. Density
- C. Atoms
 1. Current model of the atom
 2. Atomic symbols
 3. Ions
 4. Average atomic mass
 5. Common periodic table categories
- D. Electromagnetic spectrum
 1. Relationship between wavelength, frequency, and energy of a photon
 2. Calculations with wavelength, frequency, and energy of a photon
 3. Absorption and emission of light by electrons
- E. Quantum mechanics and quantum numbers
 1. Double-slit experiment and quantum mechanics
 2. Valid sets of n , ℓ , m_ℓ , and m_s
 3. Orbital shapes and associated spdf letters for ℓ values 0, 1, 2, and 3
- F. Electron configurations and orbital diagrams
 1. Hund's rule and Pauli exclusion principle
 2. Full or shortcut electron configuration for any ground-state element
 3. 3d and 4d electron configuration exceptions
 4. Full or shortcut electron configuration of ions in main group elements or transition metals
- G. Periodic trends
 1. Radii of neutral atoms
 2. Radii of ions
 3. Ionization energy
 4. Electron affinity
 5. Importance of noble gas electron configurations
- H. Names and formulas of compounds
 1. Diatomic molecular compounds
 2. Ionic compounds with predictable ions
 3. Ionic compounds with variable metal ions
 4. Ionic compounds with polyatomic ions
- I. Chemical quantities
 1. Convert between grams, moles, and number of atoms of a pure element
 2. Molar mass of a compound
 3. Convert between grams, moles, and number of molecules of a compound
 4. Empirical and molecular formulas
- J. Lewis structures and VSEPR
 1. Draw Lewis structures with common nonmetal elements
 2. Formal charge
 3. VSEPR
- K. Hybridization
 1. sp^3 , sp^2 , sp hybridizations
 2. Sigma and pi bonds
- L. Polarity
 1. Electronegativity
 2. Nonpolar and polar covalent bonds
 3. Nonpolar and polar molecules
 4. Dipole moment vector
 5. Polarity and solubility, hydrophilic and hydrophobic
- M. Intermolecular forces

1. Dispersion, dipole-dipole, and hydrogen bonding
 2. Rank molecules by strength of IMFs and boiling point
- N. Solutions
1. Solution terms
 2. Molarity
 3. Solubility of ionic compounds
 4. Species in solution for soluble ionic compounds and molecules
- O. Balance chemical reactions
- P. Precipitation reactions
1. Predict products of a precipitation reaction
 2. Write balanced molecular reactions, complete ionic equations, and net ionic equations
- Q. Acid-base reactions
1. Strong and weak acids and bases
 2. Identify Brønsted-Lowry acids and bases in a reaction
 3. Titrations
- R. Oxidation-reduction reactions
1. Oxidation states of pure elements, ionic compounds, molecules, and polyatomic ions
 2. Identify oxidation and reduction, reducing agent and oxidizing agent
- S. Stoichiometry
1. Stoichiometric calculations using grams, moles, and number of atoms or molecules
 2. Percent yield
 3. Limiting reactant
- T. States of matter
- U. Gases
1. Kinetic molecular theory
 2. Ideal gas law
- V. Thermodynamics
1. Thermodynamics definitions
 2. Specific heat capacity
 3. Heat of reaction
- W. Laboratory experiments should be held in a majority of course weeks. Laboratory experiments can explore any topic above.

Learning Assessments:

Competencies will be evaluated by multiple measures, including homework assignments, lab assignments, quizzes/exams, and a final exam.

Instructional Materials:

Textbook: Flowers, P., Neth, E.J., Robinson, W.R., Theopold, K., and Langley, R. (2019). *Chemistry: Atoms First* (2nd ed.). Houston, TX: OpenStax. ISBN: 978-1-947172-63-0

Lab manual: PS 111 College Chemistry I HCC Custom Lab Manual, Pearson. ISBN: 978-1-323-72841-3

Guidelines for Requesting Accommodations Based on Documented Disability or Medical Condition

It is the intention of Highland Community College to work toward full compliance with the Americans with Disabilities Act, to make instructional programs accessible to all people, and to provide reasonable accommodations according to the law.

Students should understand that it is their responsibility to self-identify their need(s) for accommodation and that they must provide current, comprehensive diagnosis of a specific disability or medical condition from a qualified professional in order to receive services. Documentation must include specific recommendations for accommodation(s). Documentation should be provided in a timely manner prior to or early in the semester so that the requested accommodation can be considered and, if warranted, arranged.

In order to begin the process all students **must** complete the “Disabilities Self-Identification Form” on our [Disability Services website](#).

This form can also be accessed at the Highland Community College homepage under Students Services/Student Resources/Disability Service or by contacting the Disabilities Coordinator.

A Note on Harassment, Discrimination and Sexual Misconduct

Highland Community College seeks to assure all community members learn and work in a welcoming and inclusive environment. Title VII, Title IX, and College policy prohibit harassment, discrimination and sexual misconduct. Highland Community College encourages anyone experiencing harassment, discrimination or sexual misconduct to talk to report to the Vice President for Student Services, the Human Resources Director or complete an [online report](#) about what happened so that they can get the support they need and Highland Community College can respond appropriately.

There are both confidential and non-confidential resources and reporting options available to you. Highland Community College is legally obligated to respond to reports of sexual misconduct, and therefore we cannot guarantee the confidentiality of a report, unless made to a confidential resource. Responses may vary from support services to formal investigations. As a faculty member, I am required to report incidents of sexual misconduct and thus cannot guarantee confidentiality. I must provide our Title IX coordinator with relevant details such as the names of those involved in the incident. For more information about policies and resources or reporting options, please review our [Equity Grievance Policy](#).