HIGHLAND COMMUNITY COLLEGE

Syllabus

PS 111 College Chemistry I with Lab
Prerequisite: MAT 103 or Instructor Permission
5 Credit Hours (Lecture and Lab)
Revision Date: 03/09/2018

Department:

Chemistry

Course Description:

This course provides a college-level introduction to chemistry and is intended for students going into technological, scientific, or medical fields. The course will focus on chemical compounds, their properties and reactions, and the scientific laws that determine their behavior. Course topics will include basic chemical concepts, calculations with chemical formulas and equations, chemical reactions, thermochemistry, modern theories of the atom and electronic structure, chemical periodicity, and chemical bonds.

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: **KRSN Course CHM 1010 Chemistry I for Majors & Lab**.)

Upon successful completion of this course the student will be able to:

Lecture Portion

1. Explain the processes involved in the scientific method, and be able to apply it to investigate natural phenomena and solve problems.
2. Explain the design and significance of experiments that led to the adoption of modern atomic theory.
3. Recognize and interpret isotopic notation; understanding the relationship between average atomic masses and isotopic masses (example: calculating the average mass of an element given isotopic masses and natural abundance).
4. Relate atomic mass to composition in terms of subatomic particles.
5. Descriptive chemistry of ionic and covalent compounds.
    a. Learn the names and symbols (or formulas) for often-used elements, simple and polyatomic ions, Arrhenius acids and bases, and simple ionic and covalent compounds.
    b. Describe and identify Arrhenius, Bronsted-Lowery, and Lewis acids and bases.
    c. Identify conjugate acids and bases.
    d. Determine the valence electron configuration of the s and p block elements and the 3d metals.
    e. Determine oxidation states and assign oxidation numbers of atoms in simple ions, and the central atoms of polyatomic ions and covalent compounds.
    f. Use the valence electron configuration to predict common oxidation numbers of group 1, 2, 13, 16, and 17 elements. g. Define periodic trends in electronegativity, ionization energy and electron affinity, and relate them to the electron configuration of the element.
6. Solutions
    a. Describe general properties of solutions.

b. Understand the forces that affect the aqueous solubility of materials.
c. Calculate the molar concentration of a solute.
d. Describe procedures for preparing a solution of known molarity.

7. Chemical reactions and stoichiometry
    a. Classify chemical reactions and predict whether simple chemical reactions will proceed.
    b. Employ stoichiometric reasoning in evaluating reactions of gases, liquids and solids.
    c. Perform calculations that employ relationships involving masses, formula units, and the mole relationships.
    d. Determine empirical and molecular formula from appropriate data.
    e. Demonstrate the ability to balance chemical equations.
    f. Discuss solubility rules.
    g. Write net ionic equations based on solubility rules.
    h. Balance simple acid base reactions.
    i. Define oxidation and reduction.
    j. Balance simple redox reactions and determine the identity of the oxidizing and reduction agents.
    k. Determine limiting reagents from stoichiometric data; calculate the maximum product yield, and leftover reagent.
    l. Calculate theoretical yield from stoichiometric data.
8. Properties of solids, liquids, and gases
    a. Describe the origins and relative magnitudes of intermolecular forces.
    b. Relate phase behavior to nature of intermolecular forces.
    c. Compare general properties of solids, liquids and gases; including density, compressibility, heat capacity, and randomness intermolecular forces.
    d. Describe phase transitions and phase diagrams (e.g. triple point and critical point).
    e. Understand general properties of gases.
        i. Describe properties and temperatures of gasses to kinetic molecular theory.
        ii. Understand and employ ideal gas laws.
    f. Understand general properties of liquids.
    g. Understand general properties of solids.
        i. Compare and contrast properties of ionic, molecular and metallic solids.
9. Describe, define, and perform calculations involving the following basic concepts of thermodynamics:
    a. Heat capacity
    b. Calorimetry
    c. Heat/Work/Energy
    d. Enthalpy/Standard states
    e. Hess's Law
    f. Heat of formation
    g. Phase changes/Energy
    h. Use of other thermodynamic cycles in the determination of thermodynamic quantities, such as the lattice energy of an ionic solid
10. Conceptually and quantitatively relate spectroscopic observation of atoms to quantum mechanical theories.
    a. Describe the historical development of and distinction between classical and wave mechanics.
    b. Describe the radial and angular dependence of solutions to the Schrodinger equation for hydrogen-like atoms (s, p, d orbitals).
    c. Describe the behavior of photons and electrons during electronic transitions between principle quantum levels and calculate the wavelength and frequency of light involved in these transitions.

d. Using the Aufbau principle, write the electron configuration of many electron atoms and monatomic ions.
e. Relate quantum mechanical theory to the organization of the periodic table and the periodic properties of elements.

11. Molecular Bonding and Structure
    a. Describe the characteristics of ionic and covalent bonding.
    b. Draw Lewis dot structures for atoms, simple ionic and molecular compounds.
    c. Predict the shape of simple molecules and ions using Valence Shell Electron Pair Repulsion (VSEPR) theory.
    d. Explain how electronegativity differences relate to bond polarity.
    e. Identify polar and non-polar molecules.
    f. Understand valence bond descriptions of molecular structure and bonding.
    g. Understand hybridization, including sp3, sp2 and sp hybridization.
    h. Predict hybridization from Valence Shell Electron Pair Repulsion (VSEPR) structures.
    i. Determine bond orders and relate them to relative bond strength.
    j. Describe the Molecular Orbital Theory description of bonding and antibonding orbitals.
    k. Relate Molecular Orbital Theory to concepts such as the structural, energetic, spectroscopic, and magnetic properties of molecules.

Laboratory Portion

1. Work in the laboratory in accordance with good laboratory practices
    a. Dress in an appropriate manner as to promote safety in the laboratory, wearing appropriate laboratory attire and goggles when anyone is working with chemicals in the laboratory.
    b. Follow written directions accurately.
    c. Work safely and effectively, using equipment and chemical carefully and correctly.
    d. Demonstrate use of required techniques.
    e. Dispose of waste products in a proper manner.
    f. Know how to find and understand MSDS's for the chemicals used in a particular laboratory.
2. Gather and record qualitative and quantitative data accurately
    a. Acquire data using balances and volumetric glassware.
    b. Make and record visual observations.
    c. Use computers, when appropriate, as data acquisition tools.
    d. List or describe experimental assumptions made and any deviations from the written experimental procedures.
3. Handle and evaluate data in logical, productive, and meaningful ways
    a. Create notebooks and laboratory reports that are clear, understandable, and accurately represent the data collected.
    b. Display computer data in a spreadsheet or graphically, as appropriate.
    c. Correlate observations with chemical or physical processes.
    d. Carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range.
    e. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure.
4. Correlate laboratory work with principle topics in Chemistry I lecture.

Learning Assessments:

Course competencies will be assessed by exams, quizzes, homework assignments, lab work and reports, and final exam.

Instructional Materials:

Textbook: Davies, G., Foster, N., Gilbert, T. R., & Kirss, R. V. (2015). *Chemistry: The Science in Context* (4th ed.). New York, NY: W.W. Norton. ISBN: 978-0-393-91937-0

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.