CLOUD COUNTY COMMUNITY COLLEGE

Our Mission: Cloud County Community College prepares students to lead successful lives and enhances the vitality of our communities.

**GENERAL INFORMATION**

**Course Number and Title:** SC 131 Chemistry I

**Term and Year:**Academic Year 2022-2023

**Credit Hours**: 5

**Course Description**: Chemistry I is an introductory course designed for engineering, allied health and science majors. Fundamental laws of chemistry, atomic theory and structure, chemical calculations, chemical bonding, gases and the kinetic molecular theory, chemical kinetics, acids, bases, and salts are covered in this course. This course includes three hours lecture and three hours laboratory time. Prerequisite: Intermediate Algebra with a “C” or better or appropriate ACT/ Accuplacer scores.

**Prerequisites**: None

**Division:** Mathematics, Science and Technical Programs
Department: Science

**STUDENT LEARNING OUTCOMES AND ASSESSMENT**

**Course Learning Outcomes**

For this course, students are expected to demonstrate the skills associated with the course learning goals as described by the student learning outcomes below:

***LECTURE PORTION OF CHEMISTRY***

 Content of the course will prepare students to:

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

1. 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

1. 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

1. 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

1. 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

1. 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

1. 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 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 *sp*3 , *sp*2 and *sp* hybridization

h. Predict hybridization from VSEPR structures

i. Determine bond orders and relate them to relative bond strength

j. Describe the MO theory description of bonding and antibonding orbitals

k. Relate MO theory to concepts such as the structural, energetic, spectroscopic, and magnetic properties of molecules

***LABORATORY PORTION OF THE CHEMISTRY I COURSE***

Upon completion of this course, students will be able to:

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

1. 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

1. 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

f. Correlate laboratory work with principle topics in Chemistry I lecture

The learning outcomes detailed in this syllabus meet or exceed the learning outcomes specified by the Kansas Core Outcomes Project for this course as sanctioned by the Kansas Board of Regents to ensure transfer between Kansas colleges and universities. Systemwide Transfer (SWT) Code: CHM1010

In class, students are assessed on the mastery of these outcomes using the learning management system. Student names will not be used when reporting results. Outcomes-based assessment is used to improve the instructional planning, design, and quality of student learning throughout the college

**General Education Outcomes**

For this course, students are expected to demonstrate the skills associated with the college wide learning goals as described by the general education/program outcomes below:

GESc1: Apply the scientific process to evaluate current issues and circumstances

GESc2: Demonstrate scientific literacy and knowledge about the study of matter, life and the universe.

GESc3: Critically analyze events through a scientific lens.

GESc4: Demonstrate quantitative reasoning and problem-solving.

Artifacts of student work are collected from general education courses and reviewed by a faculty committee to assess general education outcomes. Artifacts may also be reviewed by a professional outside the college. Student names will not be used when reviewing artifacts nor reporting results. Program accomplishment is partially measured through performance on program outcomes. Outcomes-based assessment is used to improve the instructional planning, design, and quality of student learning throughout the college.

**Institutional Learning Outcomes**

For this course, students are expected to demonstrate the skills associated with the college wide learning outcomes as described below.

*Sustainability*

ILO\_S1: Students will understand the importance and implementation of sustainable practices that meet the needs of today without compromising the needs of the future.

In class, students are assessed on the mastery of these outcomes. Student names will not be used when reporting results. Outcomes-based assessment of the institutional learning outcomes is used to ensure we are meeting the mission of the college, following the guiding values and enhance instructional planning, design, and quality of student learning throughout the college.