Course Acronym:	CHEM
Course Number:	1A
Descriptive Title:	General Chemistry I
Division:	Natural Sciences
Department:	Chemistry
Course Disciplines:	Chemistry
Catalog Description:	This course details fundamental theory and principles of atomic and molecular structure, physical states and chemical reactions. Included is the study of elements, compounds, periodic relationships, bonding, acids and bases, oxidation-reduction, energy, solutions, electrolytes and chemical equations. Descriptive chemistry of water and selected nonmetals including hydrogen, oxygen and carbon is presented.
Prerequisite:	(1) CHEM 4 with a minimum grade of C or CHEM 4H or 1 year of high school chemistry and qualification by testing (El Camino College Chemistry Placement Test) and assessment (2) eligibility for MATH 170 or qualification by testing (El Camino College Mathematics Placement Test) and assessment
Co-requisite:	
Recommended Preparation:	Eligibility for English 1A
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	6
Outside Study Hours:	6
Total Course Hours:	162
Course Units:	5
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992

Transfer UC:	Yes
Effective Date:	prior to 1992
General Education: ECC	Area 1 - Natural Sciences
Term:	
Other:	
CSU GE:	Area B1 - Physical Universe and its Life Forms: Physical Science, Area B3 - Physical Universe and its Life Forms: Laborator Activity
Term:	
Other:	
IGETC:	Area 5A - Physical Science, Area 5C - course that incorporate a laboratory
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Equation Writing** On a written exercise, given the names of chemical compounds, students will be able to write the correct reactant formulas, states of matter (when required), identify reaction type, predict the product formulas and balance the chemical equation. **SLO #2 Structural Representations of Compounds** Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will contain appropriate bonds, lone pairs, and geometry. **SLO #3 Lab Safety** Students will adhere to safety protocol in the laboratory regarding eye protection. Students will follow the proper procedure regarding wearing goggles in the laboratory, and keeping them on to protect their eyes.
Course Objectives:	1. **The student will be more proficient in** a. the use of scientific terminology. b. the naming and writing of chemical formulas for inorganic compounds: binary nonmetal compounds, salts, acids and bases. c. writing and classifying chemical equations for elementary chemical reactions. d. performing stoichiometric calculations involving chemical reactions. 2. **Structure: The student will** a. provide a historical picture of the development of atomic theory. b. be able to state the fundamentals of quantum theory; assign quantum numbers and construct orbital diagrams. c. predict and explain periodic trends of elements in terms of electronic configurations. d. describe and illustrate the structure and bonding of molecules by constructing Lewis structures, sketching and labeling the molecular geometries of a molecule, describing the hybridization of the atoms involved, and determining polarity.

e. predict and explain properties of molecules in terms of structure and bonding.
f. predict and explain properties of conductors, semiconductors and insulators in terms of structure and bonding.

3. **States of Matter: The student will**
    a. use the Kinetic Molecular Theory to explain the behavior of gases.
    b. compare and contrast various gas laws.
    c. perform gas law calculations.
    d. relate intermolecular forces to observed properties of solids, liquids and gases.
    e. interpret phase diagrams.
    f. describe basic crystal systems.

4. **Aqueous solutions: The student will**
    a. explain solubility in terms of properties of both solute and solvent.
    b. determine concentrations of solutions quantitatively and experimentally.
    c. give qualitative and quantitative descriptions of solution properties as a function of solute type and solute concentration.
    d. classify solutes as strong, weak, or nonelectrolytes.
    e. write net ionic equations for chemical reactions.

5. **Acids and bases: The student will**
    a. define and identify acids and bases.
    b. write and classify acid-base reactions.

6. **Oxidation-Reduction: The student will**
    a. determine oxidation numbers.
    b. balance oxidation-reduction equations.
    c. identify oxidizing and reducing agents.

7. **Energy: The student will**
    a. apply the First Law of Thermodynamics.
    b. relate ΔU to ΔH.
    c. calculate ΔH through calorimetry, Hess' Law, enthalpy of formation, and bond energies.

8. **Nonmetals: The student will**
    a. compare and contrast properties and reactions within a family of compounds.
    b. describe the role of nonmetals and nonmetal compounds in pollution.
    c. draw Lewis structures and name simple organic compounds.
    d. identify the classes of organic compounds.

9. **Laboratory: The student will**

	a. learn fundamental chemistry techniques such as gravimetric analysis, spectral analysis, titration. b. become proficient in the use of the following laboratory equipment: analytical balance, spectrophotometer, burets, pipets, volumetric flasks. c. illustrate basic principles of gases, solutions, acids and bases, and oxidizing and reducing agents through experimental setups.
Major Topics:	**I. Introduction and Nomenclature (5 hours, lecture)** A. Introduction to chemistry B. Problem solving 1. Units and measurements 2. Dimensional analysis 3. Significant figures C. Matter 1. Physical and chemical properties 2. Mixtures 3. Elements 4. Historical development through Rutherford D. Nomenclature 1. Binary nonmetal compounds 2. Salts 3. Acids and bases 4. Organic compounds: simple alkanes, alcohols and carboxylic acid **II. Chemical Calculations (5 hours, lecture)** A. Mole concept, empirical and molecular formulas B. Chemical equations 1. Balancing 2. Classifying 3. Writing C. Stoichiometry 1. Percent yield 2. Limiting reagents 3. Analysis of mixtures D. Solutions 1. Molarity 2. Solution stoichiometry including titrations **III. Thermochemistry (6 hours, lecture)** A. First Law of Thermodynamics B. ΔU, q and w C. Calorimetry D. Enthalpy changes, ΔH 1. Standard molar enthalpy of formation 2. Heat of reaction E. Hess' Law **IV. Atomic Structure (6 hours, lecture)**

A. Nature of light
B. Atomic spectra
    1. Rydberg equation
    2. Bohr atom
C. Quantum mechanics
    1. DeBroglie equation
    2. Heisenberg uncertainty principle
    3. Schroedinger equation
    4. Quantum numbers
    5. Atomic Orbitals
        a. cross-section and boundary diagrams
        b. radial probability distributions
D. Electronic configurations
    1. Use of periodic table
    2. Explanation of trends

V. Periodicity (3 hours, lecture)

A. Periodic table
B. Trends
    1. Atomic radius
    2. Ionization energy
    3. Electron affinity
    4. Electronegativity

VI. Chemical Bonding (6 hours, lecture)

A. Ionic Bonding
    1. Ionic radii
    2. Born-Haber cycle
B. Covalent Bonding
    1. Polar and nonpolar bonds
    2. Dipole moment and percent ionic character
    3. Bond energies and their use to estimate ΔH
    4. Lewis structure
        a. Octet rule
        b. Formal charge
        c. Multiple bonds
        d. Resonance
        e. Exceptions to the octet rule
        f. Structural isomers

VII. Bonding Theories and Molecular Geometry (5 hours, lecture)

A. Valence Shell Electron Pair Repulsion model
B. Valence Bond Theory
    1. Hybrid orbitals
    2. Multiple bonding
C. Molecular orbital theory and energy diagrams
D. Band theory and metallic bonding

VIII. Gases (4 hours, lecture)

A. Properties
B. Gas Laws: Boyle, Charles, Avogadro, Gay- Lussac, Combined and ideal
    1. Partial pressures
    2. Gas Stoichiometry
C. Kinetic Molecular Theory
D. Real Gases
E. Air Pollution

IX. Liquids and Solids (6 hours, lecture)

A. Properties
B. Intermolecular forces
C. Dynamic equilibrium
D. Types of crystalline solids
E. Energy and Phase Changes
F. Crystal types and properties
G. Base crystal systems of metals and binary salts

X. Solutions (2 hours, lecture)

A. Concentration units
B. Factors affecting solubility
    1. Energy
    2. Temperature and pressure
    3. Henry's Law
C. Colligative properties
    1. Raoult's Law of vapor pressure, non-volatile solutes and two-component systems
    2. Freezing and boiling points
    3. Osmotic pressure
    4. Effect of electrolytes including Van't Hoff factor

XI. Acids and Bases (1 hours, lecture)

A. Arrhenius theory
    1. Definitions
    2. Solution properties
B. Bronsted-Lowry theory
    1. Definitions
    2. Bronsted-Lowry reactions

XII. Reactions in Aqueous Solutions (5 hours, lecture)

A. Electrolytes
B. Net Ionic Equations
    1. Precipitation
    2. Acid-base
    3. Dissolving
C. Oxidation-Reduction
    1. Oxidation numbers

	2. Balancing redox equations by half-reaction method 3. Oxidizing and reducing agents **XIV. Laboratory Experiments. Starred Experiments are Mandatory. (Number of Lab Periods needed) (108 hours, lab)** A. Gravimetric and Volumetric Equipment* B. Computer Graphing using Excel C. Molecular Modeling D. Gravimetric Determination of Sulfate Ion* E. Calorimetry: Hess' Law* F. Atomic Spectra and Energy Levels G. Determination of Solution Concentration by Spectrophotometry* H. Analysis of KCIO3/KCI Mixture by Thermal Decomposition to Measurable Volume of Oxygen* A. Determination of the Molar Mass of Gaseous Carbon Dioxide J. Lewis Structures* K. Model Making: Geometry* XX. Model Making: Carbon Compounds LLLLLLLLL. Metallic and Ionic Crystal Lattices* N. Acid/Base Titrations* O. Part I: Standardization of sodium Hydroxide Solution P. Part II: Determination of the Molar Mass of an Acid Q. Ions in Solution* R. Oxidation-Reduction* S. Uncertainty in Measurement and Propagation of Error* T. Nomenclature Worksheet* U. Significant Figures Worksheet E. Calorimetry Worksheet W. Net Ionic Equation Worksheet
Total Lecture Hours:	54
Total Laboratory Hours:	108
Total Hours:	162
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Use the heat of vaporization of water and the normal boiling point to calculate the vapor pressure of water at 25 °C.
Critical Thinking Assignment 1:	The electrolyte in a lead storage battery must be between 4.8 M and 5.3 M sulfuric acid if the battery is to be most effective. If a 5.00 mL sample of battery acid requires 49.74 mL of 0.935 M NaOH for its complete neutralization, determine if the concentration of the acid falls within the desired range. Show your work in the space provided.

Critical Thinking Assignment 2:	Below is schematic of an experiment which contributed to our current understanding of atomic structure. Describe how this setup was important to modern atomic theory**.** Your description should include the name of the scientist, his observations and conclusions, and how his work supported and/or changed what was understood at the time about atomic structure.
Other Evaluation Methods:	Completion, Essay Exams, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Other Exams, Quizzes, True/False, Written Homework
Instructional Methods:	Demonstration, Discussion, Lab, Lecture, Multimedia presentations
If other:	
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Skill practice, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Texts:	Lab Manual: Scroggins, ECC Faculty. Chemistry 1A Supplement. ECC Reproduction Center, 2012. (Discipline Standard) Main Text: Petrucci, et al. General Chemistry: Principles and Modern Applications. 11 ed. Pearson, 2016. (Discipline Standard)
Alternative Texts:	
Required Supplementary Readings:	
Other Required Materials:	Scientific Calculator Department-Approved Safety Goggles
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Chemistry-4 or Chemistry- 4H or
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**The Chem 1A curriculum demands that the entering student has a solid foundation in introductory chemistry. Upon starting the course, the student is expected to be able to use the periodic table and the symbols of the elements; solve introductory chemistry problems including equation writing and quantitative analysis; express answers with the correct number of significant figures; identify types of chemical reactions; identify different types of chemical bonds; and be able to determine electron configurations and draw Lewis structures.** **Incoming Chem 1A students are required to solve basic math and algebra problems.** **Write symbols for chemical elements given the names, and vice versa.** CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4H - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

Introductory knowledge of problem solving and dimensional analysis.

CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties.

CHEM 4 - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, [H+], and [OH-].

Basic knowledge of inorganic chemical nomenclature.

CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

CHEM 4 - Given one or the other, generate names or formulas for elements, ions, and compounds.

Fundamentals knowlege of basic types of chemical reactions.

CHEM 4 - Differentiate between five reaction types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products.

Identify the oxidation number of an atom in a simple compound or ion.

CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

CHEM 4 - Given one or the other, generate names or formulas for elements, ions, and compounds

Basic knowledge of groups, periods, and areas of the periodic table.

CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

Basic knowledge of equation writing and reaction stoichiometry.

CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.

CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties.

	CHEM 4 - Differentiate between five reaction types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products. **Experience writing simple electron configurations.** CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. **Basic understanding of states of matter and their transitions.** CHEM 4 - Compare and contrast physical properties, physical changes, chemical properties, and chemical changes. **Write simple Lewis structures and deduce simple molecular geometries.** CHEM 4 - Compare and contrast ionic and covalent compounds. Evaluate bonding based on the chemical formula, and then correlate compound properties with the structure and types of bonding present. **Use the Ideal Gas Law in simple calculations.** CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties. **Knowlege of significant figures and relative error.** CHEM 4 - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, [H+], and [OH-]. CHEM 4 - Evaluate volumetric laboratory glassware for the correct significant place to be read and record volumes correctly. Evaluate quantitative experimental data, and infer the presence or absence of specific ions in an unknown mixture. **Construct simple lab set-ups and a basic understanding of lab operations and safety.** CHEM 4 - Demonstrate basic laboratory skills, including making, recording, and evaluating observations of chemical systems. CHEM 4 - Evaluate volumetric laboratory glassware for the correct significant place to be read and record volumes correctly. Evaluate quantitative experimental data, and infer the presence or absence of specific ions in an unknown mixture.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	

Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	Eligibility for English 1A
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	**In order to succeed in the course, students must be able to read a college level textbook and answer essay questions explaining chemistry concepts and principles.** **Answer essay questions explaining chemical concepts and principles**. Read and apply critical thinking skills to college-level expository prose for the purposes of writing and discussion.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Warren Ford
Date:	02/01/1965
Original Board Approval Date:	Prior to 1992
Last Reviewed and/or Revised by:	Miguel Jimenez
Date:	09/13/2023
Last Board Approval Date:	12/18/2023
Effective Term:	FALL 2024