Course Acronym:	CHEM
Course Number:	20
Descriptive Title:	Fundamentals of Chemistry
Division:	Natural Sciences
Department:	Chemistry
Course Disciplines:	Chemistry
Catalog Description:	This course introduces fundamental theory and principles of chemistry applied to inorganic, organic, and biological chemistry. Atomic and molecular structure, chemical and physical changes, gases, solutions, nomenclature, equations, and calculations will be emphasized. *Note: The maximum UC credit allowed for students completing Chemistry 4 and Chemistry 20 is one course. Students will not receive UC credit for Chemistry 20 if taken after Chemistry 1A.
Prerequisite:	Beginning algebra or higher or placement by appropriate assessment
Co-requisite:	
Recommended Preparation:	Eligibility for English 1A
Enrollment Limitation:	
Hours Lecture (per week):	4
Hours Laboratory (per week):	3
Outside Study Hours:	8
Total Course Hours:	126
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:	fall 1995
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: Laboratory Activity
Term:	
Other:	
IGETC:	Area 5A - Physical Science, Area 5C - course that incorporate a laboratory
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Chemical Formulas of Reactants** On a written exercise, given the chemical formulas of reactants, students will be able to write the correct formulas of products, identify the reaction type and balance the equation. **SLO #2 Molecular Models and Drawings** 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 Safety Protocol** 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. Use chemical terminology to name inorganic chemical compounds, formulas and reactions and classify types of chemical reactions. Perform stoichiometric calculations involving chemical reactions. 2. Use atomic theories to interpret the structure of an atom. Predict and explain periodic trends based on atomic structure and the periodic table. Describe and illustrate the structure and bonding for molecules using Lewis structures, molecular geometry and polarity. 3. Use the Kinetic Molecular Theory to explain the behavior of gases and perform calculations involving gas laws. Relate intermolecular forces to observed properties of solids, liquids and gases. 4. Explain solubility qualitatively in terms of properties of both solute and solvent. Determine concentrations of solutions. Give qualitative descriptions of colligative properties as a function of solute type and concentration. Classify solute behavior in solution as strong, weak or non-electrolytes and apply to net ionic equations. 5. Compare and contrast Arrhenius and Bronsted-Lowry acid theories. Write acid-base reactions and determine the pH of aqueous solutions. Demonstrate an understanding of how a buffer works.

	6. Determine oxidation numbers for compounds alone and in a chemical reaction. Identify the elements being oxidized and reduced in a redox reaction. 7. Use common and IUPAC systems to name various classes of organic compounds, and draw structural formulas for these compounds based on their names. Write equations for selected common reactions of organic compounds. Compare and contrast structural and geometric isomers. 8. Demonstrate an understanding of the concept of chirality by drawing Fischer projections of enantiomers which contain at least one chiral carbon. 9. Draw structural formulas for common monosaccharides. Describe the linkage between monosaccharide units in terms of bonding. Compare common di- and polysaccharides. 10. Draw general structural formulas for fatty acids, triglycerides, steroids and phospholipids. Compare and contrast saturated fatty acids and unsaturated fatty acids. Explain the function of fatty acids in a membrane. 11. Determine the structure of amino acids at physiological pH and in zwitterion form. Describe the peptide linkage between amino acids in a protein in terms of geometry and resonance. Identify features of primary, secondary and tertiary structure in a protein. Explain denaturation as it applies to a biological system. 12. Demonstrate the ability to use basic laboratory skills such as taking and recording observations of chemical systems and interpreting qualitative and quantitative experimental data.
Major Topics:	**I. Introduction and Nomenclature (8 hours, lecture)** A. Intro to Chemistry B. Problem Solving 1. Units and Measurement 2. Dimensional Analysis C. Matter 1. Physical and chemical properties 2. Elements D. Nomenclature 1. Binary nonmetal compounds 2. Salts 3. Acids and bases **II. Chemical Calculations (8 hours, lecture)**

A. Mole concept
B. Chemical Equations
    1. Balancing
    2. Classifying
    3. Writing
C. Stoichiometry
D. Solutions
    1. Molarity
    2. Mass percent
    3. Solution stoichiometry including dilution and titrations

III. Atomic Structure (4 hours, lecture)

A. Atomic theory
B. Bohr atom
C. Valence electrons
    1. Use of periodic table
    2. Octet rule

IV. Periodicity (2 hours, lecture)

A. Periodic table
B. Trends
    1. Atomic size
    2. Ionization energy
    3. Electronegativity

V. Chemical Bonding (5 hours, lecture)

A. Ionic bonding
B. Covalent bonding
    1. Polar and non-polar bonds
    2. Lewis Structures
        a. Octet rule
        b. Multiple bonds

VI. Molecular Geometry (3 hours, lecture)

A. Lewis structures and shapes
B. Valence Shell Electron Pair Repulsion Theory

VII. States of Matter: Gases (4 hours, lecture)

A. Properties
B. Gas laws
    1. Boyle, Charles, Avogadro, Gay-Lussac, Combined
    2. Partial pressures
C. Kinetic Molecular Theory

VIII. States of Matter: Liquids and solids (2 hours, lecture)

A. Intermolecular forces

B. Properties
C. Relative energy of solids, liquids, and gases

IX. Solutions (6 hours, lecture)

A. Concentration units
B. Factors affecting solubility
C. Colligative properties
    1. Vapor pressure
    2. Boiling point
    3. Freezing point
    4. Osmotic pressure

X. Acids and Bases (3 hours, lecture)

A. Arrhenius theory
B. Bronsted-Lowry theory

XI. Reactions in aqueous solutions (3 hours, lecture)

A. Electrolytes - Classification
B. Oxidation - Reduction
    1. Oxidation numbers
    2. Oxidizing and reducing agents

XII. Organic Chemistry (12 hours, lecture)

A. Classification
    1. Alkanes
    2. Alkenes
    3. Alkynes
    4. Alcohols
    5. Ethers
    6. Esters
    7. Carboxylic Acids
    8. Amines
    9. Aldehydes and Ketones
    10. Haloalkanes
B. Nomenclature
    1. Common
    2. IUPAC
C. Physical Properties
D. Isomers
    1. Structural
    2. Geometric
    3. Stereoisomers
E. Reactions
    1. Substitution
    2. Addition
    3. Redox

	XIII. Biochemistry (12 hours, lecture) A. Classification 1. Carbohydrates 2. Lipids 3. Proteins B. Structure and Properties 1. Physical properties 2. Structural formulas 3. Chemical properties **XIV. Laboratory Experiments - 12-14 from the following list. Starred ones are considered mandatory for all students: (54 hours, lab)** A. Use of Bunsen Burners B. Measurement and Density* C. Titration* D. Graphing* E. Hydrocarbons* F. Charles' Law G. Molecular Models* H. Preparation of Aspirin I. Simple Chemical Reactions* J. Hydrates K. Electrolytes and Nonelectrolytes L. Combined Gas Law* M. Acid-Base Indicators N. Organic Functional Groups* O. Preparation of Soaps P. Fats, Proteins, and Carbohydrates* Q. Compounds and Mixtures
Total Lecture Hours:	72
Total Laboratory Hours:	54
Total Hours:	126
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	A certain brand of beer has a pH of 5.0. Calculate the concentration of hydrogen ions in moles per liter. Is the beer acidic or basic? Show all calculations in the space provided.
Critical Thinking Assignment 1:	A chemistry student collected a 250.0 mL sample of methane over water at 20.0 degrees Celsius. What is the partial pressure of the methane if the barometer reading is 756.2 torr? Show all calculations in the space provided.
Critical Thinking Assignment 2:	In a titration 20.60 mL of a 0.09662 M HCl solution reacts with 20.92 mL of NaOH solution. What is the concentration of the NaOH solution?
Other Evaluation Methods:	Completion, 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, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Karen C. Timberlake. Chemistry: An Introduction to General, Organic, and Biological Chemistry. 13th ed. Pearson, 2018. Charles Henrickson, et al. A Laboratory for General, Organic and Biochemistry. 7th ed. McGraw-Hill, 2010.
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Scientific Calculator Safety Goggles
Requisite:	Prerequisite
Category:	communication or computation skill
Requisite course(s): List both prerequisites and corequisites in this box.	Beginning algebra or higher or placement by appropriate assessment
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Use ratio and proportion.** Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. Perform operations with and simplify rational and radical expressions. **Understand and be able to use in algebraic equations: constants, variables, exponents, powers.** Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables. **Use signed numbers.** Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals.

	Perform operations with and simplify rational and radical expressions. **Use the properties of numbers to solve equations.** Set up and solve application problems using linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. Solve systems of two linear equations with two variables symbolically, graphically and numerically. Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables. **Write and evaluate exponential expressions.** Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. Solve systems of two linear equations with two variables symbolically, graphically and numerically. Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables. **Write and solve first degree equations in one variable.** Solve linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables. **Translate sentences into equations.** Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. Set up and solve application problems using linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables. **Graph ordered pairs on a coordinate plane.** Graph linear equations and systems of linear equations by plotting points or by using intercepts and the slope. Starting with a linear model in tabular, graphical or symbolic form, translate the model into the other two forms.

	Solve quadratic equations symbolically, using a variety of algebraic methods, as well as graphically. **Interpret graphs.** Graph linear equations and systems of linear equations by plotting points or by using intercepts and the slope. Solve quadratic equations symbolically, using a variety of algebraic methods, as well as graphically. **Find slope and intercepts on a straight line.** Starting with a linear model in tabular, graphical or symbolic form, translate the model into the other two forms. Solve systems of two linear equations with two variables symbolically, graphically and numerically.
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	**Read a college level text and understand directions in a laboratory manual.** Select and employ reading strategies to interpret the content of a college-level textbook, with special focus on constructing a thesis statement and providing valid support.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Chemistry Department
Date:	02/01/1983

Original Board Approval Date:	11/21/2016
Last Reviewed and/or Revised by:	Miguel Jimenez
Date:	05/09/2022
Last Board Approval Date:	06/20/2022