El Camino College

COURSE OUTLINE OF RECORD - Official

I. GENERAL COURSE INFORMATION

Subject and Number: Chemistry 20
Descriptive Title: Fundamentals of Chemistry

Course Disciplines: Chemistry

Division: Natural Sciences

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.*

Conditions of Enrollment:

Prerequisite

Mathematics 40 or

Mathematics 43
with a minimum grade of C in prerequisite
or

qualification by testing (El Camino College Mathematics Placement Test) and assessment

Recommended Preparation

English 84

Course Length: [X] Full Term [ ] Other (Specify number of weeks):
Hours Lecture: 4.00 hours per week [ ] TBA
Hours Laboratory: 3.00 hours per week [ ] TBA
Course Units: 5.00

Grading Method: Letter
Credit Status Associate Degree Credit

Transfer CSU: [X] Effective Date: Prior to July 1992
Transfer UC: [X] Effective Date: Spring 1994

General Education:

El Camino College:	**1 – Natural Sciences**	
	Term:	Other: Approved
CSU GE:	**B1 - Physical Science**	
	Term:	Other: Approved
	B3 - Laboratory Sciences	
	Term:	Other: Approved
IGETC:	**5A - Physical Science with Lab**	
	Term: Fall 1991	Other:
	5C - Science Laboratory	
	Term: Fall 1991	Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. On a written exercise, given the structures of reactants for a reaction, students will be able to write the correct structures of products and identify the reaction type.
2. 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.
3. 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.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Use chemical terminology to name inorganic chemical compounds, formulas and reactions and classify types of chemical reactions. Perform stoichiometric calculations involving chemical reactions.

   Objective Exams
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.

   Written homework
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.

Quizzes

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.

   Multiple Choice

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.

   Objective Exams

6. Determine oxidation numbers for compounds alone and in a chemical reaction. Identify the elements being oxidized and reduced in a redox reaction.

   Homework Problems

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.

   Objective Exams

8. Demonstrate an understanding of the concept of chirality by drawing Fischer projections of enantiomers which contain at least one chiral carbon.

   Quizzes

9. Draw structural formulas for common monosaccharides. Describe the linkage between monosaccharide units in terms of bonding. Compare common di- and polysaccharides.

   Completion

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.

    Objective Exams

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.

    Objective Exams

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.

    Laboratory reports

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	8	I	Introduction and Nomenclature 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
Lecture	8	II	Chemical Calculations 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
Lecture	4	III	Atomic Structure A. Atomic theory B. Bohr atom C. Valence electrons 1. Use of periodic table 2. Octet rule
Lecture	2	IV	Periodicity A. Periodic table B. Trends 1. Atomic size 2. Ionization energy 3. Electronegativity
Lecture	5	V	Chemical Bonding A. Ionic bonding B. Covalent bonding 1. Polar and non-polar bonds 2. Lewis Structures i. Octet rule ii. Multiple bonds
Lecture	3	VI	Molecular Geometry A. Lewis structures and shapes B. Valence Shell Electron Pair Repulsion Theory
Lecture	4	VII	States of Matter: Gases A. Properties B. Gas laws 1. Boyle, Charles, Avogadro, Gay-Lussac, Combined

			2. Partial pressures C. Kinetic Molecular Theory
Lecture	2	VIII	States of Matter: Liquids and solids A. Intermolecular forces B. Properties C. Relative energy of solids, liquids, and gases
Lecture	6	IX	Solutions A. Concentration units B. Factors affecting solubility C. Colligative properties 1. Vapor pressure 2. Boiling point 3. Freezing point 4. Osmotic pressure
Lecture	3	X	Acids and Bases A. Arrhenius theory B. Bronsted-Lowry theory
Lecture	3	XI	Reactions in aqueous solutions A. Electrolytes - Classification B. Oxidation - Reduction 1. Oxidation numbers 2. Oxidizing and reducing agents
Lecture	12	XII	Organic Chemistry 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
Lecture	12	XIII	Biochemistry A. Classification 1. Carbohydrates 2. Lipids 3. Proteins B. Structure and Properties 1. Physical properties 2. Structural formulas 3. Chemical properties
Lab	54	XIV	Laboratory Experiments - 12-14 from the following list. Starred ones are considered mandatory for all students: 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	

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. **PRIMARY METHOD OF EVALUATION:**

Problem solving demonstrations (computational or non-computational)

B. **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.

C. **COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

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.
2. A 50.0 g sample of an unknown metal requires 300.0 kcal to change its temperature from 0.0 degrees C to 100.0 degrees C. What is the specific heat of the metal in calories/gram * degree Celsius? Show all calculations in the space provided.

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Other exams
Quizzes
Written homework
Laboratory reports
Homework Problems
Multiple Choice
Completion
Matching Items
True/False

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Laboratory
Lecture
Multimedia presentations

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions

Required reading
Problem solving activities
Written work

Estimated Independent Study Hours per Week: 8

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Karen C. Timberlake. Chemistry: An Introduction to General, Organic, and Biological Chemistry. 12th ed. Pearson, 2014.
Charles Henrickson, et al. A Laboratory for General, Organic and Biochemistry. 7th ed. McGraw-Hill, 2010.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**
Scientific Calculator
Safety Goggles

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Mathematics-40 or	Computational/Communication Skills
Course Prerequisite Mathematics-43 or	Computational/Communication Skills
Non-Course Prerequisite	Computational skills are required for the class.

B. Requisite Skills

Requisite Skills
Use ratio and proportion. MATH 40 - Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. MATH 43 - Perform operations with and simplify rational and radical expressions.
Understand and be able to use in algebraic equations: constants, variables, exponents, powers. MATH 40 - Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. MATH 43 - Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables.
Use signed numbers. MATH 40 - Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. MATH 43 - Perform operations with and simplify rational and radical expressions.
Use the properties of numbers to solve equations. MATH 43 - Solve systems of two linear equations with two variables symbolically, graphically and numerically.. MATH 40 -

Set up and solve application problems using linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. MATH 43 - 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. MATH 40 - Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. MATH 43 - Solve systems of two linear equations with two variables symbolically, graphically and numerically.. MATH 43 - 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. MATH 40 - Solve linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. MATH 43 - Set up and solve application problems using quadratic equations, rational equations and systems of two linear equations with two variables.
Translate sentences into equations. MATH 40 - Use the properties of the real numbers to evaluate, simplify, and factor algebraic expressions, including expressions with fractions and radicals. MATH 40 - Set up and solve application problems using linear equations and inequalities, systems of two linear equations with two variables, and quadratic equations. MATH 43 - 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. MATH 43 - Solve quadratic equations symbolically, using a variety of algebraic methods, as well as graphically. MATH 40 - Graph linear equations and systems of linear equations by plotting points or by using intercepts and the slope. MATH 40 - Starting with a linear model in tabular, graphical or symbolic form, translate the model into the other two forms.
Interpret graphs. MATH 43 - Solve quadratic equations symbolically, using a variety of algebraic methods, as well as graphically. MATH 40 - Graph linear equations and systems of linear equations by plotting points or by using intercepts and the slope.
Find slope and intercepts on a straight line. MATH 43 - Solve systems of two linear equations with two variables symbolically, graphically and numerically.. MATH 40 - Starting with a linear model in tabular, graphical or symbolic form, translate the model into the other two forms.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification
Course Recommended Preparation English-84	

D. Recommended Skills

Recommended Skills
Read a college level text and understand directions in a laboratory manual. ENGL 84 - 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.

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Chemistry Department on 02/01/1983.

BOARD APPROVAL DATE: 11/21/2016

LAST BOARD APPROVAL DATE:

Last Reviewed and/or Revised by Thanh-Thuy Bui on 03/29/2016

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