Course Name: General Chemistry I

Course Number: CHE* E121

Credits: 4

Catalog description: A study of the fundamental principles, theories and laws of chemistry. Topics include atomic theory and the structure of the atom, the aggregated states of matter, kinetic-molecular theory, chemical bonding, stoichiometry, periodicity, solutions and colloids. The laboratory program stresses the acquisition of skills in data gathering and in the interpretation of data. Safe manipulation of materials and the development of skill in the use of laboratory apparatus are stressed. 3 hours of lecture and 3 hours of laboratory.

Prerequisite or Parallel: ENG*101 and MAT* E172 or equivalent

General Education Competencies Satisfied:

HCC General Education Requirement Designated Competency Attribute Code(s):

☒ **SCKX** **Scientific Knowledge & Understanding**

Additional CSCU General Education Requirements for CSCU Transfer Degree Programs:

☒ **SCRX** **Scientific Reasoning**

Discipline-Specific Attribute Code(s):

☒ **SCI** **Science elective**

Course objectives:

General Education Goals and Outcomes:

☒ **Scientific Knowledge & Understanding:** Students will gain a broad base of scientific knowledge and methodologies in the natural sciences. This will enable them to develop scientific literacy, the knowledge and understanding of scientific concepts and processes essential for personal decision making and understanding scientific issues.

☒ **Scientific Reasoning (*for CSCU Transfer Degree Programs*):** Students will become familiar with science as a method of inquiry. Students will develop a habit of mind that uses quantitative skills to solve problems and make informed decisions.

Course Specific Objectives:
Lecture:

1. Demonstrate the ability to correctly use chemical nomenclature and molecular models to describe, interpret and predict physical and chemical phenomena.
2. Explain the basic principles, which underlie physical and chemical change.
3. Recognize the relationships among chemical principles and phenomena and use these to see chemistry as a unified body of knowledge rather than as a disjointed collection of facts.
4. Compare the findings of classical vs. recent experiments/observations in chemistry and how these findings were used to refine or replace existing chemical theory.
5. Apply mathematical concepts and methods in the treatment of chemical data.
6. Evaluate the results obtained from quantitative methods for accuracy and/or reasonableness.

Laboratory:

1. Use basic measuring devices such as balances, volumetric glassware, thermometers and spectrophotometers to gather data in the chemistry laboratory.
2. Perform fundamental laboratory operations such as separations, purifications and identifications.
3. Carry out chemical processes that illustrate and amplify the theoretical concepts examined in the lectures.
4. Collect, correlate and present data using linear regression analysis to confirm chemical theory and make quantitative predictions about the composition of solutions.
5. Analyze the results of a chemical laboratory experiment for accuracy and or precision
1. Correct data for instrumental and personal error both of which are inherent in the measurement of 'real' quantities.
2. Work safely in the laboratory following all instructor and professionally recommended safety guidelines, disposing of chemical waste in an environmentally responsible manner.

Course Content:

Lecture:

Introduction

1. Course operation
2. Expectations
3. Data presentation
4. Ethical questions
5. Quantitative problem solving techniques.

Matter and Its Properties

1. Basic definitions
2. Laws and theories
3. Physical vs. chemical properties
4. Physical vs. chemical changes

Measurement

1. Error
2. Precision and accuracy
3. Significant figures

Matter and Its Parts

1. Atoms
2. Protons, electrons and neutrons
3. Masses and electrical charge
4. Ions
5. Molecules
6. Chemical nomenclature

Mass Relations and Stoichiometry

1. Chemical reactions and equations
2. Equation balancing
3. Mass-mass, mole-mole and mole-mass calculations
4. Empirical formula prediction
5. Limiting reactant, theoretical yield and percent yield

Reactions in Aqueous Solutions

1. Precipitation reactions
2. Acid-base reactions
3. Introduction to oxidation-reduction reactions
4. Oxidation numbers
5. Solution concentration and solution stoichiometry
6. Limiting reactant solution stoichiometry

Gases

1. Measurement
2. Ideal and Combined Gas Laws
3. Stoichiometry of gaseous reactions
4. Ideal vs. real gases
5. Kinetic-molecular theory of gases
6. Molar Mass and Density Predictions

Thermochemistry

1. Principles of heat flow

2. Measurement of heat flow
3. Enthalpy from Calorimetry, Hess's Law and Heats of Formation
4. Calorimetry

Electronic Structure

1. Electromagnetic radiation, wavelength, frequency and Bohr energy transition calculations
2. Emission Spectra
3. Evolution of atomic theory
4. Quantum numbers
5. Energy levels and sub-levels
6. Orbitals and spin
7. Periodic trends

Covalent Bonding

1. Lewis structures, the octet rule and formal charge
2. Valence shell electron pair repulsion theory
3. Molecular geometry
4. Polarity of molecules
5. Valence bond theory
6. Hybridization
7. Evolution of bonding theory to support experimental results

Liquids and Solids

1. Introduction to intermolecular forces
2. Network, ionic and metallic solids

Solutions

1. Concentration units
2. Solubility principles and predictions
3. Dilution and titration calculations

Laboratory:

Introduction

1. Discuss safety procedures
2. Explain use of safety equipment
3. Locker assignments and check-in.

Analytical Balances

1. Operation
2. Care
3. Practice

Pipetting

1. Volumetric and measuring pipettes
2. Care and cleaning
3. Suction devices

Density Determination

1. Solids
2. Liquids
3. Use of pycnometers

Separation Techniques

1. Gravity filtration
2. Vacuum filtration
3. Paper chromatography

Formulas of Chemical Compounds

1. Composition techniques
2. Decomposition techniques

Acid/Base Chemistry

1. Acid/Base Indicators
2. Acid/Base Titration

Molar Mass Determination

1. Specific heat determination and DuLong and Petit prediction

Modeling Molecular Structures

1. Covalent compounds
2. Polyatomic ions

Oxidation/Reduction

1. Gas stoichiometry by generation of hydrogen gas

UV/VIS Spectrophotometry

1. Use of Spectrophotometer
2. Beer's Law Calibration using Linear Regression
3. Calculation and Meaning of Correlation Coefficient
4. Use of volumetric glassware
5. Quantitative Analysis of various analytes

HCC Safety Standard

Instruction covering all safety rules and guidelines will be provided by the instructor during the first laboratory session. The safety features of the individual laboratory will also be highlighted by the instructor. Students are expected to read and understand the rules of the HCC Science Laboratory Student Safety Contract. The students will then sign this contract signifying that they have been instructed and understand the requirements for safety pertaining to their course. The student and instructor will each keep a copy of this contract. Students must come to the laboratory prepared for the laboratory activity. Students must abide by the safety rules and guidelines which may include wearing personal protection equipment. Failure to do so may result in removal from the laboratory by the instructor.

Date Course Created:

Date of Last Revision: 02/27/2017