CHEM 25: FUNDAMENTALS OF CHEMISTRY

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2025
Units:	5
Hours:	4 lecture, 3 laboratory per week (84 total per quarter)
Prerequisite:	Intermediate Algebra or equivalent.
Advisory:	UC will grant transfer credit for a maximum of one course from the following: CHEM 25, 30A or 30B.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Area 5: Natural Sciences w/ Lab
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Students will be able to recognize basic patterns of chemical reactivity, express reactions in terms of balanced equations and be able to determine quantities of reactants and products in terms of moles, mass and volumes of solutions.
- The students will be able to use dimensional analysis to set up and solve numerical problems.
- The students will understand the meaning and uses of the mole and of Avogadro's number.
- The students will be able to identify physical and chemical properties and change

Description

This course includes basic chemical laboratory techniques and methods, a survey of important chemical principles with emphasis on problem solving, and a description of the elements and their compounds. The course includes active learning and student-to-student learning strategies to promote meaningful and productive work to ensure the success of all students. Intended for students who wish to meet general education requirements in physical science or need background preparation for CHEM 1A.

Course Objectives

The student will be able to:

1. Describe the scientific method and distinguish between a theory and a scientific law.
2. Report the correct number of significant figures in measured and calculated quantities.
3. Use dimensional analysis to set up and solve numerical problems.
4. Classify matter and describe the properties of matter.
5. Apply the fundamental assumptions of Dalton's atomic theory and describe the structure of the atom.
6. Use the periodic table to explain and predict the properties of elements.
7. Interpret chemical formulas and write the names and formulas for ionic compounds, molecular compounds, and acids.
8. Explain the meaning and uses of the mole and of Avogadro's number.
9. Write, balance, and classify chemical equations and recognize patterns of chemical reactivity to predict the products of a chemical reaction.
10. Perform stoichiometry calculations and understand the concept of a limiting reactant.
11. Discuss the basis of the gas laws and derive the gas laws from the ideal gas law.
12. Describe the properties of solids and liquids and understand the manifestations of intermolecular forces.
13. Describe the properties of solutions and define and use molarity in calculations.
14. Describe the properties of acids and bases and understand the basis of the pH scale.

Course Content

1. Introduction to chemistry
   a. Chemistry in the modern world
   b. Scientific method
   c. Observations, hypotheses, experiments, theories, and scientific laws
2. Measurements
   a. Mass, length, volume, and temperature
   b. SI and metric units
   c. Significant figures and scientific notation
3. Problem solving
   a. Conversion factors
   b. Density
   c. Dimensional analysis
4. Classification and properties of matter
   a. Physical states of matter
   b. Pure substances and mixtures
   c. Physical and chemical properties
   d. Physical and chemical changes
   e. Energy, heat, and specific heat capacity
5. Early atomic theory and modern atomic structure
   a. Atoms and Dalton's atomic theory
   b. Subatomic particles and atomic structure
   c. Atomic number and mass number
   d. Isotopes and average atomic mass
6. The Periodic Table
   a. Periods and groups
   b. Elemental symbols
   c. Metals, nonmetals, and metalloids
   d. Valence electrons and ion formation
7. Composition and nomenclature of inorganic compounds
   a. Law of definite proportions and law of multiple proportions
   b. Molecular compounds and molecules
   c. Ionic compounds and formula units
   d. Nomenclature of ionic and binary molecular compounds
   e. Nomenclature of common binary acids and oxyacids

8. Quantitative composition of compounds
    a. The mole and Avogadro's number
    b. Molar mass
    c. Mass percent composition
    d. Empirical formulas
9. Chemical reactions
    a. Combination, decomposition, and single- and double-displacement reactions
    b. Solubility of ionic compounds and aqueous reactions
    c. Exothermic and endothermic reactions
10. Quantities in chemical reactions
    a. The concept of stoichiometry and mole ratios
    b. Mole-mole, mole-mass, and mass-mass calculations
    c. Limiting reactants
    d. Theoretical yield and percent yield
11. Gases
    a. Kinetic molecular theory and properties of gases
    b. Boyle's law, Charles' law, and Avogadro's law
    c. The combined gas law and the ideal gas law
    d. Gas density and molar mass of a gas
    e. Gas stoichiometry
12. Liquids and solids
    a. Surface tension
    b. Evaporation and condensation
    c. Equilibrium vapor pressure and normal boiling point
    d. Heat of vaporization and heat of fusion
13. Solutions
    a. Common types of solutions
    b. Solubility and saturation
    c. Molarity
    d. Dilution calculations
    e. Solution stoichiometry
14. Acids and bases
    a. Properties of acids and bases
    b. Arrhenius theory and dissociation versus ionization
    c. Brønsted-Lowry theory and conjugate acid-base pairs
    d. Strength of acids and bases
    e. The pH scale and pH calculations
    f. Acid-base titration calculations
15. Diversity-related items
    a. Foster student belonging and scientific identity

Lab Content

1. Determining density
    a. Observe and record mass and volume data
    b. Explore whether density of a substance depends on sample size
    c. Determine the density of an unknown object and identify the composition using a provided list of substances
2. Resolving a two-component mixture
    a. Use physical separation methods including decantation, gravity filtration, evaporation, and extraction to separate and recover the components of a binary mixture
    b. Calculate the percent composition of each component in the mixture and percent recovery of the components
3. Determining the percent of water in an unknown hydrate
    a. Learn the proper use of a Bunsen burner
    b. Explore whether the percent water in a hydrate depends on sample size
    c. Calculate the theoretical percent water to evaluate the accuracy of the experimentally determined percent water
4. Determining an empirical formula
    a. Determine an empirical formula from experimental data
    b. Experimentally evaluate the law of constant composition
    c. Deduce the impact of several theoretical procedural errors on the experimentally determined empirical formula
5. Classifying some chemical reactions
    a. Effectively collaborate with a partner to perform a series of chemical reactions and detail the observed results
    b. Use qualitative observations to predict the products of several chemical reactions and classify each reaction as one of four general types
6. Introducing chemical equilibrium
    a. Evaluate the reversibility of several chemical reactions and apply the concepts of chemical equilibrium
    b. Experimentally evaluate Le Châtelier's principle
    c. Subject reversible reactions to temperature changes and use qualitative observations to classify each reaction as either exothermic or endothermic
7. Determining the molar volume of carbon dioxide
    a. Apply the simple gas laws
    b. Evaluate the accuracy of the experimentally determined molar volume relative to the accepted value for an ideal gas
    c. Deduce the impact of several theoretical procedural errors on the experimentally determined molar volume
8. Titrating the acid content of fruit juices
    a. Apply the concepts of pH and titration using a common household product
    b. Learn about the proper use of a buret

Special Facilities and/or Equipment

1. A chemistry laboratory, safety goggles or Visorgogs, a scientific calculator, and a Mastering Chemistry access code for online homework.
2. When taught as a hybrid distance learning section, students and faculty need ongoing and continuous internet and email access.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Online homework assignments
Written laboratory assignments
Lecture and laboratory quizzes
Midterm exam
Comprehensive final exam

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
Laboratory

Discussions

Representative Text(s) and Other Materials

Tro, Nivaldo J.. Introductory Chemistry Essentials, 7th ed.. 2023.

Holland, Mary. Fundamentals of Chemistry Laboratory Manual, 3rd ed.. 2018.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

1. There are 40-60 homework problems for each of the twelve chapters covered in this course, roughly half of which are completed and graded online.
2. Laboratory assignments: There are eight experiments administered in this course during the weekly two-hour laboratory session for which a pre-laboratory assignment, a data sheet, a calculations sheet, and a post-laboratory assignment are all collected and graded by the instructor.
3. Additional course work:
    a. The careful and regular reading and rereading of the text and lecture notes is essential to passing this course.
    b. There are several practice worksheets provided by the instructor that showcase more challenging problems and may be completed in-class or as additional homework.

Discipline(s)

Chemistry