

Montgomery County Community College
CHE 151
Principles of Chemistry I
(For the Science Major)
4-3-3

COURSE DESCRIPTION:

This course is a study of the fundamentals of general chemistry for the science major. An emphasis is placed on atomic structure, molecular structure, bonding, periodic law, reactions and weight relations, gases, thermochemistry and an introduction to organic chemistry. The laboratory includes experiments from topics discussed in lecture. This course is subject to a course fee. Refer to <http://mc3.edu/adm-fin-aid/paying/tuition/course-fees> for current rates.

REQUISITES:*Previous Course Requirements*

- High school Chemistry within the last 5 years **OR** CHE 121 General Chemistry - Inorganic

Previous or Concurrent Course Requirements

- MAT 161 Precalculus I, **OR** MAT 170 College Algebra and Trigonometry

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Use Dimensional Analysis in all calculations.	Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
2. Discuss molecular and ionic compounds.	Lectures Class Discussions Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
3. Perform all forms of stoichiometric calculations: mass-to-mass, limiting reagent and % yield.	Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
4. Identify acid-base, redox, and precipitation aqueous solutions.	Lectures Class Discussions Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
5. Perform calculations using gas laws for ideal and real gases, gas mixtures and gas stoichiometry.	Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
6. Perform thermochemical and thermodynamic calculations.	Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
7. Explain electronic structure of an atom by using quantum numbers and electron configuration.	Lectures Class Discussions Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
8. Explain periodic variation in physical and chemical properties.	Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams ACS Final Exam
9. Understand ionic and covalent bonding theories and should know how to draw Lewis structures.	Lectures Class Discussions	Exams ACS Final Exam
10. Assign molecular geometry and hybridization.	Lectures Class Discussions	Exams ACS Final Exam
11. Name simple aliphatic and aromatic hydrocarbons, and identify different functional groups.	Lectures Class Discussions	Exams

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
12. Develop laboratory reports reflecting use of the scientific method for experiments performed in the laboratory.	Laboratory Activities Write-Up of Laboratory Report	Laboratory Report
13. Discuss the impact and use of chemistry in relation to contemporary issues.	Lectures Class Discussions Laboratory Activities Write-Up of Laboratory Report	Laboratory Report Exams

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria.*

SEQUENCE OF TOPICS:

- I. Chemistry: The Study of Change
 - A. The Scientific Method
 - B. Classification of Matter
 - C. The Three States of Matter
 - D. Physical and Chemical Properties of Matter
 - E. Measurement
 - F. Dimensional Analysis in Solving Problems
- II. Atoms, Molecules and Ions
 - A. The Atomic Theory
 - B. The Structure of the Atom
 - C. Atomic Number, Mass Number, and Isotopes
 - D. The Periodic Table
 - E. Molecules and Ions
 - F. Chemical Formulas
 - G. Nomenclature
- III. Mass Relationships in Chemical Reactions
 - A. Atomic Mass
 - B. Avogadro's Number and Molar Mass of an Element
 - C. Molecular Mass
 - D. The Mass Spectrometer
 - E. % Composition of Compounds
 - F. Determination of Empirical Formula
 - G. Mass to Mass Calculations
 - H. Limiting Reagent Calculations
 - I. % Yield Calculations

- IV. Reactions in Aqueous Solutions
 - A. Precipitation Reactions and Gravimetric Analysis Calculations
 - B. Acid-Base Reactions and Titration Calculations
 - C. Oxidation-Reduction Reactions and Titration Calculations
 - D. Molarity of Solution Calculations
- V. Gases
 - A. Pressure of Gases
 - B. Gas Laws
 - C. Ideal Gas Equation
 - D. Gas Stoichiometry
 - E. Dalton's Law of Partial Pressure
 - F. The Kinetic Molecular Theory of Gases
 - G. Real Gases van der Waals Equation
- VI. Thermochemistry
 - A. Types of Energy
 - B. Energy Changes in Chemical Reactions
 - C. Calorimetry: Bomb and Coffee Cup
 - D. Standard Enthalpy of Formation and Reaction
 - E. Heats of Solution and Dilution
 - F. Hess's Law
- VII. Quantum Theory and the Electronic Structure of Atoms
 - A. Classical Physics to Quantum Theory
 - B. Photoelectric Effect
 - C. Bohr's Theory of the H atom
 - D. Dual Nature of Electrons and the De Broglie's Equation
 - E. Quantum Mechanics
 - F. Quantum Numbers
 - G. Atomic Orbitals
 - H. Electron Configuration and the Aufbau Principle
- VIII. Periodic Relationships Among the Elements
 - A. Development of the Periodic Table
 - B. Periodic Classification of the Elements
 - C. Periodic Variation in Physical Properties
 - D. Ionization Energy and Electron Affinity
 - E. Variation in Chemical Properties of the Representative Elements
- IX. Chemical Bonding: Basic Concepts
 - A. The Ionic Bond and Lattice Energy of Ionic Compounds
 - B. Covalent Bond
 - C. Electronegativity
 - D. Lewis Dot Structures and Formal Charge and Resonance
 - E. Expanded Octet, Reduced Octet and Free Radicals
- X. Chemical Bonding: Molecular Geometry and Hybridization of Atomic Orbitals
 - A. Molecular Geometry and Dipole Moment
 - B. Valence Bond Theory
 - C. Hybridization of Atomic Orbitals
 - D. Hybridization of Molecules Containing Double and Triple Bonds
 - E. Delocalized Molecular Orbitals

- XI. Organic Chemistry
- A. Classes of Organic Compounds
 - B. Aliphatic Hydrocarbons
 - C. Aromatic Hydrocarbons
 - D. Chemistry of Functional Groups

SEQUENCE OF EXPERIMENTS:

1. Laboratory Techniques and Glass Bending and Fire Polishing
2. Nomenclature and Reaction Stoichiometry
3. Determination of a Chemical Formula
4. Chemical Reactions
5. The Molar Volume of Gases
6. Thermochemistry
7. Reaction Enthalpies and Hess's Law
8. Atomic Spectroscopy
9. Oxidation of Vitamin C
10. Recycling Aluminum

LEARNING MATERIALS:

Chang, R. and Goldsby, K. (2013). *Chemistry* (11th ed.). McGraw-Hill Publishers.

Chang, R. and Goldsby, K. (2013). *Student Solution Manual* (11th ed.). McGraw-Hill Publishers.

Van Koppen. (2008). *General Chemistry Laboratory Manual* (Special Edition). McGraw-Hill Publishers.

Scientific calculator (logarithms, exponential, powers, roots, etc.)

Tutoring Services (College Hall 180, South Hall 159)

Computer-based Plotting

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: Dr. E. Martins, Assistant Professor of Chemistry Date: 10/5/2004

Revised by: Dr. E. Martins, Assistant Professor of Chemistry Date: 2/10/2009

VPAA/Provost Compliance Verification: Dr. John C. Flynn, Jr. Date: 9/11/2009

Revised by: Dr. E. Martins, Assistant Professor of Chemistry Date: 6/2012

VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D. Date: 6/19/2012

Revised by: Dr. Janet Graden Date: 12/19/2012
Assistant Professor of Chemistry

VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D. Date: 2/13/2013

Revised by: Debbie Dalrymple Date: 6/27/2016

VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D. Date: 6/27/2016

Revised by: Evon Martins
VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D.

Date: 5/11/2017

Date: 5/11/2017

Revised by: Debbie Dalrymple
VPAA/Provost or designee Compliance Verification:

Date: 1/9/2018

Date: 1/10/2018



This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.