

Montgomery County Community College
 CHE 152
 Principles of Chemistry II
 (For the Science Major)
 4-3-3

COURSE DESCRIPTION:

This course is a continuation of CHE 151. The topics covered are: intermolecular forces, solutions, kinetics, equilibria, electrochemistry, introductory thermodynamics, and nuclear chemistry. The laboratory includes labs in these areas with emphasis on acid-base titration. 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

- CHE 151 Principles of Chemistry I

Concurrent Course Requirements

None

| LEARNING OUTCOMES Upon successful completion of this course, the student will be able to: | LEARNING ACTIVITIES | EVALUATION METHODS |
|--|---|---|
| 1. Explain the intermolecular forces in liquids and solids, and be able to read phase diagrams. | Lectures Class Discussions Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |
| 2. Perform calculations for various physical properties of solutions; such as, colligative properties and concentrations. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |
| 3. Perform chemical kinetic calculations for rate of reaction and rate law, plot concentration vs. time equations, and understand activation energy, mechanisms and catalysis. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |

| LEARNING OUTCOMES | LEARNING ACTIVITIES | EVALUATION METHODS |
|---|---|---|
| 4. Perform calculations on weak acid and base solutions and determine pH of acid, base and salt solutions. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Lab Report | Laboratory Reports Exams ACS Final Exam |
| 5. Perform calculations for acid-base titrations, buffer solutions, common ion effect and solubility products. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |
| 6. Perform calculations for entropy, free energy, and equilibrium, and understand the three Laws of Thermodynamics. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |
| 7. Write balanced redox reactions and perform electrochemical calculations for galvanic cells, concentration cells, electrolysis, and determine spontaneity of redox reactions. | Lectures Class Discussions Emphasis on Calculations Laboratory Activities Write-Up of Laboratory Report | Laboratory Reports Exams ACS Final Exam |
| 8. Write balanced nuclear equations, and understand transmutation, fission, and fusion and the uses of isotopes. | Lectures Class Discussions Emphasis on Calculations | Exams ACS Final Exam |

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. Intermolecular Forces and Liquids and Solids
 - A. The Kinetic Molecular Theory of Liquids and Solids
 - B. Intermolecular Forces and Properties of Liquids
 - C. Crystal Structure and Types of Crystals
 - D. Amorphous Solids
 - E. Phase Changes and Phase Diagrams
- II. Physical Properties of Solutions

- A. Concentration Units
- B. Effect of Temperature and Pressure on Solubility of Solute
- C. Colligative Properties
- III. Chemical Kinetics
 - A. The Rate of Reaction
 - B. Rate Law
 - C. Concentration and Time Equations
 - D. Activation Energy and Temperature Dependence of Rate Constants
 - E. Reaction Mechanisms and Catalysis
- IV. Chemical Equilibrium
 - A. Equilibrium Constant
 - B. Factors that Affect the Equilibrium Constant
- V. Acids and Bases
 - A. Bronsted Acids and Bases
 - B. pH Calculations
 - C. Calculations of Weak Acid Ionization Constants
 - D. Calculations of Weak Base Ionization Constants
 - E. Conjugate Acids and Bases
 - F. Diprotic and Polyprotic Acids
 - G. Molecular Structure and the Strength of Acids
 - H. Acid-Base Properties of Salts, Oxides and Hydroxides
 - I. Lewis Acids and Bases
- VI. Acid-Base Equilibria and Solubility Equilibria
 - A. Homogeneous vs. Heterogeneous Equilibria
 - B. Common Ion Effect
 - C. Buffer Solutions
 - D. Acid-Base Titration
 - E. Acid-Base Indicators
 - F. Solubility Equilibrium
 - G. Common Ion Effect and Solubility
 - H. pH and Solubility
 - I. Complex Ion Equilibria
- VII. Entropy, Free Energy, and Equilibrium
 - A. Three Laws of Thermodynamics
 - B. Spontaneous Processes
 - C. Entropy
 - D. Gibbs Free Energy
 - E. Free Energy and Chemical Equilibrium
- VIII. Electrochemistry
 - A. Redox Reactions
 - B. Galvanic Cells
 - C. Standard Reduction Potentials
 - D. Spontaneity of Redox Reactions
 - E. Effect of Concentration of Cell EMF
 - F. Electrolysis

- IX. Nuclear Chemistry
- A. Nuclear Reactions
 - B. Nuclear Stability
 - C. Natural Radioactivity
 - D. Nuclear Transmutation
 - E. Nuclear Fission and Fusion
 - F. Uses of Isotopes and Biological Effects of Radiation

SEQUENCE OF EXPERIMENTS:

1. Synthesis of Aspirin
2. Distillation of Salt Water
3. Colligative Properties: Freezing Point Depression
4. Chemical Kinetics: Rate of Decomposition of Hydrogen Peroxide
5. Reaction Reversibility and Le Chatelier's Principle
6. Determination of an Equilibrium Constant Using a Spectrophotometer
7. Antacid Analysis
8. Determination of Acetic Acid in Vinegar
9. Acid-Base Equilibria: Determination of Acid Ionization Constant
10. Thermodynamics of Electrochemical Cells

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: 2/11/2009

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

Revised by: Dr. Janet A. 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

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.