MONTGOMERY COLLEGE

DEPARTMENT OF CHEMISTRY

Common Course Outline

CHEM 135 – General Chemistry for Engineers

Course Description

Covers the nature and composition of matter, solutions, chemical reactions, equilibria, kinetics, thermodynamics, and electrochemistry with engineering applications. A one-semester general chemistry course designed for students majoring in engineering, except for bioengineering, chemical engineering, or general engineering majors. Not open to students who have completed CHEM 131 and CHEM 132.

Prerequisites: MATH 165 *or appropriate score on the Mathematics placement test. Assessment Level(s):* ENGL 101/ENGL 101A, READ 120.

Credits: 4 semester hours**,** *three hours lecture, one hour discussion, three hours lab each week.*

Course scheduling

Sections offered at Rockville campus every Fall and Spring. Sections offered at Germantown and Takoma Park campuses on rotational basis.

Broad Course Outcomes:

Upon successful course completion, a student will be able to:

- Perform mathematical operations relevant to chemical problems.
- Describe the electronic structure of atoms, ions, and molecules.
- Analyze chemical problems involving various phases such as gases and solutions.
- Solve chemical problems involving kinetics, equilibria, thermodynamics and electrochemistry.
- Collect, analyze, and report experimental laboratory results.

Specific Course Objectives:

Upon successful course completion, a student will be able to:

- Use dimensional analysis as a technique for solving problems and report the answer with the appropriate number of significant figures.
- Predict the quantitative and qualitative behavior of gases and solutions.
- Name simple compounds and write balanced molecular, ionic, and net ionic equations and predict the products of various types of reactions.
- Use the atomistic theories and VSEPR to explain and predict relative properties of elements, periodic trends, molecular geometries and physical properties of simple compounds
- Write kinetics rate expressions in terms of reactants and products; perform chemical kinetics calculations, including determination of rate laws, reaction rate constants, and application of first and second order integrated rate laws.
- Apply equilibrium concepts to calculate equilibrium constants, concentrations at equilibrium, and determine the pH effect on dynamic equilibria.

- Apply thermodynamic quantities to chemical reactions; describe and calculate dependence of chemical equilibria on ΔH, ΔS, and ΔG values.
- Recognize the differences between galvanic and electrolytic electrochemical cells; determine standard and non-standard cell potentials; calculate equilibrium constants from cell potential data.

Major Lecture Topics

Conversions; significant figures; dimensional analysis; atomic theory; nomenclature; conversions between mass/moles/number of particles; stoichiometry; percent composition; empirical and molecular formulas; limiting reagents; percent yields; precipitation reactions; acids and bases; redox; molarity; gas laws; thermochemistry; calorimetry; Hess's law; heat of reaction; electronic structure of atoms; electron configurations and orbital diagrams of atoms and ions; atomic radius; ionization energy; electron affinity; electronegativity; bonding; Lewis dot structures; polarity; molecular geometries; hybridization; intermolecular forces; phase diagrams; solubility; colligative properties; chemical kinetics; chemical equilibria; equilibria of weak acids and bases; energy; enthalpy; entropy; Gibb's free energy; electromotive force; batteries and galvanic cells.

Major Laboratory Topics

Measurements; significant figures; laboratory safety; stoichiometry; theoretical yield, actual yield, percent yield; empirical formula; activity series; titrations; percent error, percent deviation; gas laws; Hess's law; heat of reaction; colligative properties; kinetics; equilibria.

Course Requirements

Grading procedures will be determined by the individual faculty instructor of each section, but will include the following minimum criteria:

Lecture Component (75% of overall course grade):

- Minimum of three mid-semester examinations
- Homework, quizzes, other assignments or projects as assigned by the instructor
- Comprehensive lecture final exam

Laboratory Component (25% of overall course grade):

- Laboratory Safety assessment
- Pre-laboratory assignments
- Post-laboratory assignments / lab reports

Attendance in laboratory is mandatory. Unexcused absence of three or more lab meetings will result in automatic failure. Students must pass lecture and lab components separately to receive a passing final course grade.

Grading Policy

The following letter grade policy will be used to determine final course grade.

A 100 - 90% **B** 89 - 80% **C** 79 - 70% **D** 69 - 60% **F** < 60%

Required Course Materials

- Textbook – *General Chemistry: The Essential Concepts*, Raymond Chang, 7th edition
- Laboratory safety goggles
- Laboratory notebook

Textbook Chapters covered

Chapter 1 Introduction
Chapter 2 Atoms, Molecules and Ions (*optional:* section 2.8)
Chapter 3 Stoichiometry (*optional:* section 3.4)
Chapter 4 Reactions in Aqueous Solutions
Chapter 5 Gases (*optional:* section 5.6)
Chapter 6 Energy Relationships in Chemical Reactions
Chapter 7 The Electronic Structure of Atoms
Chapter 8 The Periodic Table (*optional:* section 8.6)
Chapter 9 Chemical Bonding I: The Covalent Bond (*optional:* section 9.10)
Chapter 10 chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals (*optional:* section 10.3, 10.6)
Chapter 12 Intermolecular Forces and Liquids and Solids (*optional:* section 12.4)
Chapter 13 Physical Properties of Solutions
Chapter 14 Chemical Kinetics (*optional:* section 14.5)
Chapter 15 Chemical Equilibrium
Chapter 16 Acids and Bases (*optional:* sections 16.8-11)
Chapter 18 Thermodynamics (*optional:* section 18.7)
Chapter 19 Redox Reactions and Electrochemistry (*optional:* section 19.7-9)

Optional sections and chapters may be included at the discretion of the individual faculty instructor.

Example Laboratory Experiments (subject to change)

1. Laboratory Safety
2. Measurement in the Chemical Laboratory
3. Synthesis of Alum
4. Analysis of a Hydrate
5. Acid-Base Titrations
6. Gas Laws
7. Chemical Reactivity (Electrochemistry)
8. Hess's Law
9. Heat of Fusion of Water
10. Molar Mass from Freezing Point Depression
11. Kinetics – the Iodine Clock Reaction
12. Equilibrium – K_f of $FeSCN^{2+}$
13. Preparation and Properties of Oxygen

MC Student Code of Conduct and Academic Honesty

Montgomery College Syllabus Information