

CEM 141 – General Chemistry

Description: Atoms, molecules, ions; chemical calculations; reactions, energy changes, gases; periodic properties of elements; chemical bonds; states of matter, solutions; acids and bases; aqueous reactions and ionic equations.

Credit: 4 hours (3 hours of lecture and 1 hour of recitation)

Prerequisite: MTH 103 or concurrently or MTH 110 or concurrently or MTH 116 or concurrently or MTH 124 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently or LBS 117 or concurrently or LBS 118 or concurrently; OR designated score on Mathematics placement test. Not open to students with credit in CEM 152 or CEM 182H or LBS 171.

Lecture Topics:

- 1. Review of Units of Measurement; Calculations**
- 2. Atoms & Elements, Molecules & Compounds, Ions**
Matter; elements & atoms; compounds & molecules; chemical change
Atomic theory; atomic number, isotopes, atomic mass, Periodic Table
- 3. Stoichiometry & the Mole Concept**
Molecules and compounds, formulas, ionic compounds, names of compounds
The mole concept, molar mass, stoichiometry
Calculation of formulas for compounds
Stoichiometric calculations in equations; limiting reactants
More stoichiometric calculations; percent yield
Reactions in solution; acids & bases; types of reactions
Redox reactions; stoichiometry of reactions in solution; molarity
- 4. Energy & Chemical Reactions**
Energy & work; units; specific heat; 1st law of thermodynamics
Specific heat and heat capacity; changes of state; enthalpy
Hess's law; heats of formation; bond energies
- 5. Structure of Atoms & Electronic Configurations**
Electronic structure of the atom; quantization of energy; line spectra
Wave properties; electromagnetic spectrum
Heisenberg & Schrödinger; wave-like behavior of electrons; quantum numbers
The shapes and energies of atomic orbitals; electron spin
Electron configurations of atoms; Periodic Table
Periodic properties of the elements; introduction to chemical bonding
- 6. Chemical Bonding**
Valence electrons, covalent bonding; Lewis dot structures
Multiple bonds; resonance; bond energies
Valence shell electron pair repulsion theory
Polarity of molecules; valence bond theory & hybridization of atomic orbitals
Multiple bonding; s & p bonds; delocalization of p electrons

7. States of Matter

Properties of gases; pressure, volume, & temperature; the gas laws
Mixtures of gases; partial pressure
Kinetic molecular theory; diffusion; nonideal behavior
Bonding in the solid state; intermolecular bonding
Crystalline structure; metallic & ionic solids
Introduction to free energy and entropy; 2nd law of thermodynamics
Vapor pressure, phase diagrams; changes of state

8. Solutions & Their Behavior

Solutions & units of concentration; the solution process
Raoult's law; colligative properties

9. Chemical Equilibria

Introduction to chemical kinetics and chemical & physical equilibria
Equilibrium constant and reaction quotient; LeChatelier's principle
Aqueous equilibria; acids and bases
Brønsted-Lowry acid-base equilibria; pH
Hydrolysis of salts, salts of polyprotic acids
Equilibria involving weak acids, weak bases, and salts