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