

COURSE OUTLINE

Chemistry 101 (C-ID Number: CHEM 110) General Chemistry (C-ID Title: General Chemistry for Science Majors I with Lab)

I. Catalog Statement

Chemistry 101 is the first course in a two-semester sequence which covers important chemistry concepts including physical properties of matter, chemical reactions, stoichiometry, electronic structure of atoms, quantum mechanics, chemical bonding, and the three phases of matter. Lecture and laboratory activities are integrated into one cohesive lecture-lab section. The latter part of the course covers solution chemistry with emphasis on chemical kinetics, thermodynamics, and electrochemistry. Laboratory activities supports the above-mentioned topics, including both qualitative and quantitative analysis of data and propagation of errors.

Total Lecture Units: 3.0

Total Laboratory Units: 2.0

Total Course Units: 5.0

Total Lecture Hours: 48.0

Total Laboratory Hours: 96.0

Total Laboratory Hours To Be Arranged: 0.0

Total Faculty Contact Hours: 144.0

Prerequisites: 1) Eligibility for English 120 or ESL 151. 2) Math 101 OR Math 120 OR Math 220B OR 1.5 years of high school algebra with a grade of "C" or better. 3) Chemistry 110 OR 1 year of laboratory-based high school chemistry with a grade of "C" or better and a satisfactory composite score on the Mathematics and Chemistry Placement Exams.

II. Course Entry Expectations

Prior to enrolling in the course, the student should be able to:

- evaluate current atomic theories;
- analyze experimental data;
- predict chemical properties;
- demonstrate proper use of laboratory equipment and chemicals.

III. Course Exit Standards

Upon successful completion of the required coursework, the student will be able to:

- describe the scientific method and apply it to the development of the science of chemistry;
- evaluate past and present atomic theories with respect to experimental observations;
- describe chemical processes in terms of chemical equations and be able to use the equations to answer quantitative questions concerning the process described;
- describe the relationship between matter and energy and the inter-conversion of the two;
- analyze modern theories of atomic motion, especially as they apply to gasses;
- use quantum theory to predict electronic structures of the atom;
- analyze the properties of the elements and develop algorithms for the classification of the elements into logical groups;
- utilize bonding theories to describe the chemical nature of ions and molecules;
- demonstrate an understanding of intermolecular forces and apply those forces to the nature of solids and liquids;
- demonstrate the proper use of laboratory equipment and the ability to handle chemicals safely.

IV. Course Content

Total Faculty Contact Hours = 144.0

- A. Fundamental Definitions and Conversions of Units (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
1. Matter and energy
 2. Mass and weight
 3. Properties of substances
 4. Elements and compounds
 5. SI and derived units
 6. Temperature scales
 7. Significant figures
 8. Scientific notation
 9. Factor-label method (or dimensional analysis) for problem solving
- B. Atomic Structure (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
1. Structure of the atom
 2. Atomic mass, atomic number, isotopes
 3. The mole
 4. Chemical formulas
 5. Empirical and molecular formulas
 6. The laws of chemical combination
 7. Properties of waves and light
- C. Periodic Table (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
1. Development
 2. Relationship to electron configuration
 3. Relationship to periodic properties
 4. Relationship to chemical properties
- D. Nomenclature (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
1. Assigning oxidation numbers
 2. Binary compounds

3. Acids
- E. Stoichiometry (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
 1. Writing equations
 2. Types of reactions
 3. Stoichiometric calculations
 4. Limiting reactants
 5. Molarity
 6. Acid/base titrations
- F. Thermochemistry (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
 1. Definitions
 2. Calorimetry
 3. Energy changes in chemical reactions
 4. Hess' Law
 5. Enthalpies of solution
- G. Gases (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
 1. Pressure
 2. Boyle's, Charles', and Avogadro's Laws
 3. The Kinetic Molecular Theory
 4. The ideal gas law
 5. Stoichiometry involving gasses
 6. Dalton's Law
 7. Diffusion, effusion, and Graham's Law
 8. Deviation from ideal behavior
- H. Chemical Bonding (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
 1. Ionic compounds, Born-Haber Cycle, lattice energy
 2. Lewis structures, the octet rule, formal charge
 3. The covalent bond
 4. Resonance
 5. Bond energies
 6. Molecular geometry: VSPER, VP and MO theories
 7. Dipole moments
- I. Liquids and Solids (**Lecture: 5.3 hr. Lab: 10.7 hr.**)
 1. The hydrogen bond
 2. Bonding in metals
 3. Weak intermolecular forces
 4. The liquid state
 5. Crystal structure
 6. Phase changes and phase diagrams

V. **Methods of Instruction**

The following methods of instruction may be used in the course:

- traditional white board and lecture format;
- laboratory demonstrations.

VI. Out of Class Assignments

The following out of class assignments may be used in the course:

- laboratory reports;
- supplementary readings from handouts;
- library research.

VII. Methods of Evaluation

The following methods of evaluation may be used in the course:

- four to six one-hour exams;
- quizzes;
- laboratory reports;
- final exam with essay questions.

VIII. Textbook(s)

Postma, James M., et al. *Chemistry in the Laboratory*. 7th edition. New York: W.H.

Freeman, 2009. Print.

13th Grade Textbook Reading Level, ISBN 1429219548

Brown, T.E. and H. E. LeMay. *Chemistry The Central Science*. 11th edition. Prentice

Hall/ Pearson, 2009. Print.

13th Grade Textbook Reading Level, ISBN 0-13-600617-5

IX. Student Learning Outcomes

Upon successful completion of the required coursework, the student will be able to:

- design, construct, and interpret graphs accurately;
- solve quantitative chemistry problems including problems in stoichiometry, molarity, gas laws, and thermodynamics;
- demonstrate reasoning in solving chemistry problems;
- integrate multiple ideas in the problem solving process;
- check results to make sure they are physically reasonable;
- write balanced general-chemical and net-ionic equations, and classify their types;
- perform laboratory experiments while correctly using appropriate techniques and safety procedures;
- analyze experimental results, evaluate sources of error, and express results in clearly written laboratory reports;
- apply knowledge of the electronic structure of atoms to bonding, shape, and polarity;

- apply microscopic properties of matter to macroscopic processes;
- use quantum theory to explain electronic structure of atoms;
- use electronic properties to predict qualitative concepts and trends in the periodic table.