University of South Carolina
Carolina Core

CHEMISTRY 111
GENERAL CHEMISTRY I

BULLETIN INFORMATION
CHEM 111: General Chemistry I (4 credit hours)
Course Description:
A survey of the principles that underlie all chemistry with applications illustrating these principles
Prerequisites: MATH 111 or 115
Note: Three lecture, one recitation, and two laboratory hours per week.

SAMPLE COURSE OVERVIEW
TBA

ITEMIZED LEARNING OUTCOMES
Upon successful completion of Chemistry 111, students will be able to:

1. Define and employ chemical language and symbolism
2. Summarize the important scientific discoveries that led to the development of modern chemistry
3. Demonstrate recognition that the natural world has an atomic and molecular basis which successfully explains its physical phenomena
4. Explain the fundamental principles of molecular structure and shape
5. Use dimensional analysis with proper attention to units and significant figures, and name and classify inorganic compounds
6. Balance chemical equations and use stoichiometric relationships and the mole concept to calculate product and reactant amounts
7. Identify different types of reactions (precipitation, neutralization, and oxidation-reduction) and predict the outcome of these reactions
8. Explain the first law of thermodynamics and the role of energy and enthalpy in chemical reactions and perform thermochemical calculations
9. Explain the basic concepts of quantum theory, determine the electron configurations of atoms, and use periodic trends to make predictions about atomic properties
10. Explain theories of chemical bonding and determine the molecular geometry of molecules using vsepr theory
11. Apply gas laws and kinetic molecular theory to processes involving gases.
12. Explain the intermolecular attractive forces that determine the properties of the states of matter and phase behavior
13. Explain colligative properties and their use in determining the characteristic of solutions
14. Discuss the importance of chemistry in our everyday lives and in the financial realities of a global economy

15. Discuss, through examples, the impact of chemical phenomena on the fields of medicine, pharmacy, dentistry, biology, and physics
16. Explain the fundamentals of acid-base chemistry

SAMPLE REQUIRED TEXTS/SUGGESTED READINGS/MATERIALS

1. Reger, Goode & Mercer, "Chemistry Principles & Practice", 3rd Ed.
2. *General Chemistry Laboratory Experience by Freeman and Reger (lab manual)*

SAMPLE ASSIGNMENTS AND/OR EXAMS

METHODS OF ASSESSING OUTCOMES: The expected learning outcomes will be assessed through the use of homework assignments and/or quizzes, exams, laboratory reports and the final exam.

1. 3 Hour Exams

a. EXAM I: Students will employ the terminology of the study of Chemistry and will demonstrate an understanding of matter, measurements and uncertainty, Dalton's Atomic Theory, atomic composition, masses, and structure, the periodic table, chemical nomenclature and historical experiments as related to modern day.

b. EXAM II: As an extension of the material from exam I, the students will demonstrate an understanding of chemical equations and formulas, mole and molar mass, molarity, stoichiometry and limiting reactants, enthalpy and thermochemical equations, calorimetry and Hess's Law, properties and measurements of gases, the gas laws including the ideal gas law, Dalton's law of partial pressure, the kinetic molecular theory of gases and any current societal impact discussed related to these topics.

c. EXAM III: As an extension of the material from exam I and II, the students will demonstrate an understanding of the nature of light, matter as waves, quantum numbers and energy levels for multielectron atoms, electron configurations and the periodic table trends, lewis symbols, bonding, resonance structures and bond energies.

2. Final Exam

d. FINAL EXAM: Students will demonstrate an understanding of the material from exams I, II, and III, in addition to valence-shell electron-pair repulsion theory, polarity and valence bond theory, molecular orbitals, phase changes and phase diagrams, intermolecular attractions, and the properties and structures of crystalline solids.

3. OWL Online Homework

e. OWL ONLINE HOMEWORK: Students will demonstrate critical thinking and problem solving through the OWL homework assignments (approximately 20 chemistry problems for each chapter.) The assignments are based on the text book and follow the chapter progression according to the lecture schedule.

4. Lab

f. LABORATORY REPORTS: The lab component will include 10 labs, which consist of lab reports, exercises, and discussions of research methodology as related to

Safety & Laboratory Techniques, the physical properties of substances, determination of the percent of copper in Copper Sulfate Pentahydrate, the preparation of Aspirin, determination of the Concentration of a NaOH Solution through acid-base titration, heats of formation, determination of R, Ideal gas Constant, paper chromatography, waters of hydration, vapor density, and shapes of molecules.

SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ASSIGNMENTS, EXAMS/PROJECTS

Week 1: Syllabus and introduction

Week 2: Chapter 1
- The Nature of Science and Chemistry
- Matter
- Measurements and Uncertainty
- Measurements and Units

Chapter 2
- Dalton's Atomic Theory
- Atomic Composition & Structure
- Atomic Masses
- Describing Atoms & Ions
- The Periodic Table

Week 3: Chapter 2
- Molecules and Molecular Masses
- Ionic Compounds
- Chemical Nomenclature
- Physical Properties of Ionic & Molecular Compounds

Chapter 3
- Chemical Equations
- The Mole & Molar Mass

Week 4: Chapter 3
- The Mole & Molar Mass
- Chemical Formulas
- Mass Relationships in Chemical Equations

Week 5: Chapter 3
- Limiting Reagents

EXAM I-class-11: Chapters 1- 3

Chapter 4
- Ionic Compounds in Aqueous Solution
- Molarity

Week 6: Chapter 4
- Molarity
- Stoichiometry Calculations for Reactions in Solution
- Chemical Analysis

Chapter 5

Energy, Heat, & Work
Enthalpy & Thermochemical Equations

Week 7: Chapter 5
Calorimetry
Hess's Law
Standard Enthalpy of Formation
Chapter 6
Properties & Measurements of Gases
Gas Laws

Week 8: Chapter 6
The Ideal Gas Law
Stoichiometry Calculations Involving Gases
Dalton's Law of Partial Pressure
Kinetic Molecular Theory of Gases
Chapter 6
Diffusion & Effusion
Deviations from Ideal Behaviour

Week 9: Exam II Review
EXAM II-class-23: Chapters 4-6

Week 10: Chapter 7
The Nature of Light
Line Spectra and the Bohr Atom
Matter as Waves
Quantum Numbers in the Hydrogen Atom
Energy Levels for Multielectron Atoms
Electrons for Multielectron Atoms
Electron Configurations of Heavier Atoms

Week 11: Chapter 8
Electronic Structure and the Periodic Table
Electron Configurations of Ions
Sizes of Atoms and Ions
Ionization Energy
Electron Affinity
Trends in the Chemistry of Elements in Group 1A, 2A, and 7A

Week 12: Chapter 9
Lewis Symbols
Ionic Bonding
Covalent Bonding
Electronegativity
Formal Charge

Week 13: Chapter 9
Resonance in lewis Structures
Molecules that do not satisfy the octet rule
Bond Energies

EXAM III-Class-35: Chapters 7-9

Week 14: Chapter 10

Valence-Shell Electron-Pair Repulsion Model
Polarity of Molecules
Valence Bond Theory
Multiple Bonds
Molecular Orbitals: Homonuclear Diatomic Molecules
Heteronuclear Diatomic Molecules & Delocalized Molecular Orbitals

Week 15: Chapter 11

Kinetic Molecular Theory
Phase Changes
Phase Diagrams
Intermolecular Attractions
Properties of Liquids and Intermolecular Attractions
Properties of Solids and Intermolecular Attractions

Week 16: Chapter 11

Structures of Crystalline Solids

FINAL EXAMS According to University exam schedule

LABORATORY SCHEDULE

Experiments will be performed on the dates indicated. Bring your laboratory manual, text, calculator and a pen to the lab. (Keep this sheet in your laboratory manual for ready reference).

Week 2: Safety & Laboratory Techniques

Week 3: The Physical Properties of Substances:

Chapter 1

The Nature of Science and Chemistry, Measurements and Uncertainty, Measurements and Units

Chapter 2

Atomic Composition & Structure, Atomic Masses, Describing Atoms & Ions , The Periodic Table, Physical Properties of Ionic & Molecular Compounds

Week 4: Percent of Copper in Copper Sulfate Pentahydrate:

Chapter 3

Chemical Equations, The Mole & Molar Mass, Chemical Formulas, Mass Relationships in

Week 5: Preparation of Aspirin

Chemical Equations, Limiting Reagents

Chapter 4

Ionic Compounds in Aqueous Solution, Molarity

Week 6: Acid-Base Titration: Determination of the Concentration of a NaOH Solution*5r*

Stoichiometry Calculations for Reactions in Solution
Chemical Analysis

Week 7: Heats of Formation

Chapter 5

Energy, Heat, & Work
Enthalpy & Thermochemical Equations Hess's Law, Standard Enthalpy of Formation

Week 8: Determination of R, Ideal gas Constant

Chapter 6

Properties & Measurements of Gases
Gas Laws
The Ideal Gas Law
Stoichiometry Calculations Involving Gases

Week 9: Paper Chromatography

Chapter 8

Electronic Structure and the Periodic Table
Electron Configurations of Ions
Sizes of Atoms and Ions, Electron Affinity

Week 10: Waters of Hydration

Chapter 11

Properties of Liquids and Intermolecular Attractions, Properties of Solids and Intermolecular Attractions, Structures of Crystalline Solids

Week 11: Make-up Lab – Molar mass – Vapor Density

Chapter 6

Dalton's Law of Partial Pressure
Kinetic Molecular Theory of Gases, Diffusion & Effusion, Deviations from Ideal Behavior

Week 12: Shapes of Molecules and Lab Clean-up

Chapter 10

Valence-Shell Electron-Pair Repulsion Model, Polarity of Molecules, Valence Bond Theory, Multiple Bonds, Molecular Orbitals: Homonuclear Diatomic Molecules Heteronuclear Diatomic Molecules & Delocalized Molecular Orbitals