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**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**
2. 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.
3. 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.
4. 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.
5. **Final Exam**
6. 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.
7. **OWL Online Homework**
8. 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.
9. **Lab**
10. 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