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SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

# COURSE OUTLINE

**COURSE TITLE:** PRINCIPLES OF CHEMISTRY I

**CODE NO.:** CHM 104-4 **SEMESTER:** I

**PROGRAM:** ENVIRONMENTAL, WATER RESOURCES AND PULP & PAPER ENGINEERING TECHNOLOGY

**AUTHOR:** D. TROWBRIDGE/ D. HEGGART

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**APPROVED:** _____ July 21/93.
DEAN, SCHOOL OF SCIENCES & NATURAL RESOURCES — DATE

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**TOTAL CREDIT HOURS:** 64

**PREREQUISITE(S):** CHM 099 or Grade 12 Chemistry

## I. PHILOSOPHY/GOALS:

An introductory course in Chemistry which deals with the structure of matter, electronic structure of atoms, periodic nature of the elements, bonding, Lewis Structures, nomenclature, chemical reactions, solubility and stoichiometry of reactions.

A comprehensive Workshop on lab techniques and lab safety and on report writing will be held during the early weeks of the semester.

## II. STUDENT PERFORMANCE OBJECTIVES:

Principles of Chemistry is taught to students in the Environmental Engineering, Water Resources and Pulp & Paper Technology programs in both the first and second semesters.

CHM 104 is taught in the first semester of the program and is a pre-requisite for CHM 218 which is a continuation of Principles of Chemistry theory in Semester 2. CHM 218 can be taken upon successful completion of CHM 104 or with prior approval of the instructor.

Students enrolling in CHM104 must have a high school credit in Chemistry or completed CHM099 or equivalent.

CHM 104 consists of four hours per week, two hours being devoted to theory and two hours spent on laboratory work.

Upon successful completion of this course the student will be able to:

1. Perform calculations and conversions in both the SI metric and lb, Imperial unit systems.
2. Define key terms used in chemical experiments.
3. Classify matter based on physical and chemical properties.
4. State the basic concepts of the atomic structure of matter.
5. Explain the basis of the classification of elements and the structure of the periodic table.
6. Distinguish between atomic, molecular and ionic substances.

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II. STUDENT PERFORMANCE OBJECTIVES (CONTINUED):

7. Name chemical substances by common name and IUPAC name.

8. Write and balance chemical equations and identify the different types of reactions.

9. Describe the theory of ions in solution, recognize precipitation, acid-base and gas forming reactions and write ionic and non ionic equations.

10. Explain the mole concept and quantify substances in terms of mass and moles.

11. Complete calculations to determine chemical formulas and to determine quantities of substances involved in chemical reactions.

12. Use quantum numbers to describe electrons in an atom.

13. Write and use electron configurations to predict trends in properties of the main group elements in the periodic table.

14. Define the terms and distinguish between ionic and covalent bonding.

15. Draw Lewis structures for atoms, molecules and ions.

In a laboratory setting, the student will be able to:

1. Determine the density of an unknown solid and liquid using gravimetric (weighing ) techniques.

2. Separate an unknown in nature into its components based on differences in physical properties.

3. Determine the mass percentage of water in a hydrate and calculate the formula of an unknown hydrate.

4. Conduct chemical reactions and identify the products formed from the given reactants.

5. Determine the chemical formula of a compound formed in a chemical reaction based on mass and moles.

6. Recover a mass of a substance which has been subjected to a sequence of chemical reactions.

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## III. TOPICS TO BE COVERED:

1. Chemistry and Measurement
2. Atoms, Molecules and Ions
3. Chemical Reactions
4. Calculations with Chemical Formulas and Equations
5. Atomic Structure
6. Ionic and Covalent Bonding

## IV LEARNING ACTIVITIES — REQUIRED RESOURCES

1. Chemistry and Measurement — Chapter 1 in Chemistry by Ebbing
   - 1.1 Development of Modern Chemistry
   - 1.2 Experiment and Explanation
   - 1.3 A Review of Significant Figures
   - 1.4 A Review of the International System (SI) of Units
   - 1.5 Derived Units
   - 1.6 Conversion Factors
2. Atoms, Molecules and Ions — Chapter 2
   - 2.1 Matter
   - 2.2 Atomic Energy
   - 2.3 Periodic Table of the Elements
   - 2.4 Chemical Formulas
   - 2.5 Naming Simple Compounds
     - 2.5.1 Ionic Substances
     - 2.5.2 Molecular Compounds
     - 2.5.3 Acids and Hydrates
3. Chemical Reactions — Chapter 3
   - 3.1 Chemical Reactions
   - 3.2 Types of Reactions
   - 3.3 Ions in Aqueous Solutions
     - 3.3.1 Electrolytes
     - 3.3.2 Acids and Bases
   - 3.4 Molecular and Ionic Equations
   - 3.5 Reactions in Aqueous Solutions

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**IV LEARNING ACTIVITIES (CONTINUED)** — **REQUIRED RESOURCES**

4. Calculations with Chemical Reactions — Chapter 4

   4.1 Mass and Moles of a Substance
   4.2 The Mole Concept
   4.3 Mole Calculations
   4.4 Determining Emperical Formulas
   4.5 Elemental Analysis
   4.6 Determining Molecular Formulas
   4.7 Stoichiometry
   4.8 Stoichiometry of a Chemical Equation
   4.9 Limiting Reactants: Perpetual and Percentage Yield
   4.10 Calculations Involving Solutions
   4.11 Diluting Solutions
   4.12 Stoichiometry of Solution Reactions

5. Atomic Structure — Chapter 7, 8

   5.1 Theory of the Hydrogen Atom
   5.2 Quantum Mechanics
   5.3 Quantum Numbers and Atomic Orbitals
   5.4 Electronic Spin and the Pauli Exclusion Principle
   5.5 Electronic Configurations of Atoms
   5.6 Orbital Diagrams of Atoms
   5.7 Mendelew's predictions from the Periodic Table
   5.8 Brief Descriptions of the Main-Group Elements

6. Ionic and Covanent Bonding — Chapter 9

   6.1 Describing Ionic Bonds
   6.2 Electron Configurations of Ions
   6.3 Ionic Radii
   6.4 Describing Covalent Bonding
   6.5 Polar Covalent Bonds; Electronegativity
   6.6 Lewis Electron-DOE Formulas
   6.7 Exceptions to the Octet Rule
   6.8 Delocalized Bonding and Resonance

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**V. EVALUATION METHODS:**

| | |
|---|---|
| Theory | 50% |
| Lab | 50% |
| | 100% |

A+ = 90 - 100%
A = 80 - 89%
B = 70 - 79%
C = 60 - 69%
R = Less than 60%

The theory grade is the sum of all tests and assignments.

Test 1 - 15%
Test 2 - 25%
Test 3 - 35%
Assign
Quizzes - 25%
100%

Each test will include all work up to the time of each test.

Students having 70% or more on theory termwork may be exempt from the final exam which will cover the whole course and counts 50% of the theory grade.

The laboratory grade is based on marks obtained for experimental results and for laboratory reports. Students are allowed to repeat one experiment of their own choice to improve a poor experimental result.

The minimum required to pass CHM 104 is 50% on theory work and 70% on laboratory work.

Your grade will be greatly affected by attendance at scheduled classes and labs. 85% attendance is required at all theory classes and 100% attendance is required for all laboratory sessions.

Serious illness (substantiated by a doctor's note) or personal circumstances (authorized by the instructor) are the only exceptions.

**VI. REQUIRED STUDENT RESOURCES:**

Ebbing, Darrell D., General Chemistry, 4th edition, Houghton Mifflin Co., 1993.

Lab Manual for Chemistry 104, Sault College, 1990

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**VII. SPECIAL NOTES:**

**LABORATORY**

| | |
|---|---|
| 2 wk | 1. Weighing Operations, Densities of Liquids and Solids |
| 2 wk | 2. Separation of the Components of a Mixture. |
| 2 wk | 3. Formula of Hydrate |
| 2 wk | 4. Chemical Reactions |
| 2 wks | 5. Chemical Formulas |
| 2 wks | 6. A Sequence of Chemical Reactions |
| 12 wks | |

| | |
|---|---|
| 2 wk | Lab Safety |
| 1 wk | Report Format |
| Total 15 wks | |

Students with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students.