SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE:	**GENERAL CHEMISTRY - WATER**		
CODE NO. :	**CHM211**	**SEMESTER:**	**II**
PROGRAM:	**ENVIRONMENTAL TECHNICIAN - WATER**		
AUTHOR:	**DAVID TROWBRIDGE**		
DATE:	**JAN 2006**	**PREVIOUS OUTLINE DATED:**	**JAN 2005**
APPROVED:			
	_____ **DEAN**		_____ **DATE**
TOTAL CREDITS:	**5**		
PREREQUISITE(S):	**ENV 103 OR EQUIVALENT**		
HOURS/WEEK:	**3 HOURS LECTURE, 2 HOURS LAB**		

I. COURSE DESCRIPTION:

General Chemistry begins with a review of the structure of matter, the electronic structure of atoms, the periodic nature of the elements, bonding, Lewis Structures, nomenclature, and chemical reactions. Main topics include chemical calculations, the mole concept, energy changes in chemical reactions, electrochemistry and oxidation-reduction equations, equilibrium in gaseous and aqueous reactions, and introduction to organic chemistry.

A comprehensive workshop on lab techniques and lab safety and on report writing will be held during the early weeks of the semester in the laboratory class

II. LEARNING OUTCOMES:

Upon successful completion of this course the student will demonstrate the ability to:

1. State the basic concepts of the atomic structure of matter.

2. Distinguish between atomic, molecular and ionic substances

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

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

5. Explain the mole concept and quantify substances in terms of mass and moles and complete calculations to determine chemical formulas and quantities of substances involved in chemical reactions.

6. Describe and calculate energy changes in chemical reactions

7. Perform calculations involving compounds in aqueous solutions.

8. Write and balance oxidation – reduction equations.

9. Use equilibrium concepts to solve for desired quantities in gaseous and aqueous reactions

10. Apply the concepts of solubility product to solve problems in solubility equilibria.

11. Apply the concepts of acid – base theory to the solution of acid base equilibrium problems.

III. ELEMENTS OF THE PERFORMANCE

Upon successful completion of this course the student will demonstrate the ability to:

1) Perform calculations involving compounds in aqueous solutions.

Potential Elements of the Performance:

- Make calculations for preparation of solutions having concentration expressed in moles per Litre or molarity (M), and ppm, and be able to convert from one concentration to another.
- Using solubility rules, decide whether two soluble ionic compounds will or will not react to form a precipitate. If they will, write the net ionic equation.
- Write the molecular equation, and then the net ionic equation for the neutralization of an acid and a base.

2) Write and balance oxidation – reduction reactions.

Potential Elements of the Performance:

- Write a skeleton equation given as balanced oxidation-reduction equation. Label the oxidizing and reducing agents, the oxidized and reduced species, and the oxidation and reduction parts of the equation. Comment on the reaction by referring to the commonly observed oxidation states.
- Given an oxidation-reduction equation (an unbalanced or a skeleton equation), complete and balance it by the half-reaction method and/or the oxidation number method.
- Make calculations for preparations of solutions having concentrations expressed in normality (N) and converting this concentration to M, ppm etc.

3) Use equilibrium concepts to solve for the desired quantities in gaseous reactions.

Potential Elements of the Performance:

- Given the starting amounts of reactants and the amount of one substance at equilibrium, find the equilibrium composition.
- Given the chemical equation, write the equilibrium-constant expression.
- Given the equilibrium composition, find Kc.
- Given the concentrations of substances in a reaction mixture, predict the direction of reaction.

- Given Kc and all concentrations of substances but one in an equilibrium mixture, calculate the concentration of this one substance.

- Given the starting composition and Kc of a reaction mixture calculate the equilibrium composition.

- Given a reaction, use Le Chatelier's principle to decide the effect of adding or removing a substance, changing the pressure, or changing the temperature.

1. Apply concepts of the solubility product to solve problems in solubility equilibria.

Potential Elements of the Performance:

- Given the concentration of hydroxide ion (or concentration of strong base), calculate the hydrogen-ion concentration.

- Given the hydrogen ion concentration (or concentration of strong acid), calculate the pH; given the pH, calculate the hydrogen-ion concentration.

- Given the relative strengths of acids (or bases), decide whether reactants or products are favored at equilibrium.

- Decide whether an aqueous solution of a given salt will be acidic, basic, or neutral.

2. Apply the concepts of acid-base theory to the solution of acid-base equilibrium problems.

Potential Elements of the Performance:

- Given the molarity and pH of a solution of a weak acid, calculate the acid ionization constant, Ka. Given Ka, calculate the hydrogen-ion concentration and pH of a solution of a weak acid of known molarity.

- Given the molarity and pH of a solution of a weak base, calculate the base ionization constant, Kb. Given Kb, calculate the hydrogen ion concentration and pH of a solution of a weak base of known molarity.

- Calculate the Ka for a cation or the Kb for an anion from the ionization constant of the conjugate base or acid.

- Given the concentrations of weak acid and strong acid in a solution, calculate the degree of ionization and concentration of the anion of the weak acid

- Given the Ka and the concentrations of weak acid and its salt in a solution, calculate the pH. Given the Kb and the concentrations of weak base and its salt in a solution, calculate the pH.

- Calculate the pH during the titration of a strong acid and strong base, given the volumes and concentrations of the acid and base.

3. Describe the characteristics of organic compounds and name simple compounds.

Potential Elements of the Performance:

- Identify the main functional groups that are common in organic compounds.
- Name simple organic compounds when given their formula and write names given their name.

IV. TOPICS

1. Atoms, Molecules and Ions

2. Chemical Reactions

3. Calculations with Chemical Formulas and Equations

4. Energy Changes in Reactions

5. Oxidation and Reduction Concepts

6. Equilibrium Concepts

7. Organic Chemistry Introduction

LABORATORY WORK

In a laboratory setting, the student will conduct experimental procedures to support the theoretical concepts and these will be selected from the following:

1. Determine the mass percentage of water in a compound and calculate the formula of an unknown compound.

2. Separate a three component mixture based on physical properties.

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

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

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

6. Titration of acids and bases, standardization and determination of an unknown acid.

7. Gravimetric determination of a chloride.

8. Volumetric determination of an unknown chloride.

9. Spectrophotometric determination of a metal in aqueous solution.

V. REQUIRED RESOURCES/TEXTS/MATERIALS:

Textbook: Introduction to General Chemistry by Blei and Odian, W.H. Freeman, 2000
Lab Materials: Lab Coat, Safety Glasses

VI. EVALUATION PROCESS/GRADING SYSTEM

The following semester grades will be assigned to students in postsecondary courses:

Grade	Definition	Grade Point Equivalent
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

The final grade is calculated by adding the theory marks (60%) and the lab marks (40%). The lab mark is the sum of all marks awarded for the analysis plus the written report for each of the

experiments. The analysis is graded on accuracy and precision. The report is graded on format, content, and neatness.
The theory mark is the sum of all tests, assignments, mid-term and final examinations.

Term Test/Quizzes/Assignments/Final Exam	60 marks
Lab Work	40 marks
	100 marks

Assignments are due on the date specified at the beginning of the class. Late assignments will not be accepted so it is critical that you submit as much of the assignment as possible on the due date. Lab reports are due one week from completion of the lab. Late labs will be downgraded 10% per day from the agreed due date. (See details below regarding missed labs)

ATTENDANCE:

Your grade will be greatly affected by attendance at scheduled classes and labs. 85% is required at all theory classes while 100% is needed for all labs. Serious illness (doctor's medical slip) is the only valid excuse.
Each laboratory activity requires a pre-lab assignment in which the student will familiarize him/herself with the procedure, equipment and safety concerns. This will include researching the hazards and precautions for each chemical used in the lab as described in the Material Safety Data Sheets (MSDS) to be found in the chemistry lab.
A pre-lab lecture will discuss the theoretical and practical aspects of the lab and identify any safety precautions. Consequently attendence at these pre-lab lectures is mandatory and any student missing this lecture must prepare a step by step procedure which also must identify all safety concerns before you will be allowed to begin the lab.
Labs missed without prior agreement of the instructor will be give a **maximum of 50%** of the lab mark once completed to the instructor's satisfaction.

VII. SPECIAL NOTES:

- Plagiarism
  Students should refer to the definition of "academic dishonesty" in the Student Rights and Responsibilities Booklet. Students who engage in "academic dishonesty" will receive an automatic zero for that submission or test and/or such other penalty, up to and including failure in the course or expulsion from the course/program, as may be decided by the professor/dean.
  In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.
  Also as part of your student responsibilities you should ensure that your course assignments and tests are not susceptible to copying. This includes taking precautions during tests that your work is not on view so as to avoid the "wandering eyes" of others as well as not engaging in these practices yourself.

- Special Needs
  If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717, 491 so that support services can be arranged for you.

- Retention of Course Outlines
  It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other post-secondary institutions.

- While every attempt will be made to accommodate all special learning needs, the college should be contacted to discuss these needs before enrolling in any program.

- Substitute Course Information is available at the Registrar's Office.

VIII. PRIOR LEARNING ASSESSMENT

Students who wish to apply for advanced credit in the course should consult the instructor. Credit for prior learning may be given if it can be established that all learning outcomes have been met.