Douglas College

EFFECTIVE: JANUARY 2004
CURRICULUM GUIDELINES

A. Division: Science and Technology

Effective Date: March, 2003

B. Department / Program
Area: Chemistry

Revision [X] New Course [ ]

If Revision, Section(s)
Revised: G,H

Date of Previous Revision: January 13, 2003

Date of Current Revision: March 7, 2003

C: CHEM 110 **D**: The Structure of Matter **E:** 5

Subject & Course No.	Descriptive Title	Semester Credits

F: Calendar Description:

This course offers a brief review of stoichiometry, and the treatment of experimental data, and then focuses on the modern view of atomic structure, theories of bonding and molecular structure, organic chemistry including nomenclature, conformation of alkanes, ring strain, substitution and elimination reactions, and oxidation and reduction reactions.

G: Allocation of Contact Hours to Type of Instruction / Learning Settings

Primary Methods of Instructional Delivery and/or Learning Settings:

Lecture/Laboratory

Number of Contact Hours: (per week / semester for each descriptor)

6

Number of Weeks per Semester: 15

H: Course Prerequisites:

CHEM 108 (or CHEM 105) (C or better) or Chem 12 (C+ or better) AND MATH 11 (C or better)

I: Course Corequisites:

J: Course for which this Course is a Prerequisite

CHEM 210

K: Maximum Class Size:

36

L: PLEASE INDICATE:

- [ ] Non-Credit
- [ ] College Credit Non-Transfer
- [X] College Credit Transfer:

SEE BC TRANSFER GUIDE FOR TRANSFER DETAILS (www.bccat.bc.ca)

M: Course Objectives / Learning Outcomes

Upon completion of this course, the students will:

1. Carry out measurements using the correct number of significant figures, and express the precision using absolute or relative uncertainties.
2. Given a set of experimental data, calculate the average value, the average deviation, and the standard deviation.
3. Solve stoichiometry problems of the following types: percentage composition/empirical formula, gram-gram or gram-volume (of a gas), solution stoichiometry, limiting reactant, problems involving two simultaneous or two sequential reactions.
4. Explain the Bohr theory of atomic structure.
5. Give the electronic configuration of any of the common elements in the periodic table.
6. Given a periodic table, explain the relative sizes, ionization energies, and electron affinities of the elements.
7. Explain and be able to apply the following concepts to covalent bonds: dipole moment, electronegativity, percent ionic character.
8. Draw Lewis electron dot structures for a given molecule. The molecule may exhibit resonance, or expanded valence shells.
9. Use the VSEPR theory to predict the geometry of any polyatomic molecule.
10. Given the formula of a polyatomic molecule, use the Valence Bond Theory to describe the types of bonds, the type of hybridization of the central atom, and draw a diagram showing orbital overlap and geometry.
11. Use the Molecular Orbital Theory of bonding to describe the bonding in any diatomic molecule involving atoms from the first two rows of the periodic table.
12. Given the formulas of two compounds, list the types of intermolecular forces which apply to each molecule, and predict which will have the higher boiling point, or heat of vaporization.
13. Given the formula of an organic compound, give the IUPAC name, or the common name, if one exists.
14. Given the formula of an organic compound, draw diagrams of all possible isomers, and describe each type of isomer.
15. Be able to name and identify the common functional groups.
16. Be able to draw the lowest and highest energy conformations of alkanes via Newman projections and cyclohexanes in 3D indicating axial and equatorial bonds and 1,3-diaxial interactions.
17. Given a compound with a stereogenic center, be able to identify it using the R/S system of nomenclature and for isomers with more than one stereocentre be able to draw the Fischer projection and identify if the isomer will exist as a meso compound or enantiomeric pair.
18. Be able to provide the mechanism of either an SN1 or SN2 substitution reaction indicating the structures of all transition states and intermediates including the stereochemical outcome of the reaction.
19. Be able to provide the mechanism of either E1 or E2 elimination reaction indicating the structures of all transition states and intermediates including dehydration reactions of alcohols.
20. Given the formulas of the substrates and reagents, be able to predict the major product of the reaction including competition between elimination and substitution, oxidations of alcohols and aldehydes, catalytic hydrogenation, hydration of alkenes.
21. Given a list of carbocations, be able to rank their relative stabilities including the resonance stabilized allylic and benzylic carbocations.

N: Course Content:

1. **Introduction and Review**
   Scientific measurements, significant figures, uncertainties and standard deviation; the mole, formulas, stoichiometry.
2. **Atomic Structure**
   Development of atomic structure; fundamental particles; quantum theory of radiation; the quantum mechanical model of the atom; Planck, Heisenberg, orbital shapes, sizes and energies, electronic configurations; periodic properties: ionization energy, atomic size, electron affinity.
3. **Bonding and Molecular Structure**
   Ionic bonding; covalent bonding: Lewis structures, electronegativity, polarity, resonance, shapes of

molecules; Valence Bond Theory: hybridization, orbital diagrams; Molecular Orbital Theory: shapes and energies of molecular orbitals, bond order, intermolecular forces, and hydrogen bonding.

4. **Organic Chemistry**
   Nomenclature; identification and physical properties of common functional groups, Lewis acids and bases, conformations of alkanes, Newman projections, ring strain, ring flipping, conformations of substituted cyclohexanes, R/S system of nomenclature, isomers with more than one stereocentre, meso compounds, diastereomers, cis-trans (E/Z) isomerism, SN1/SN2 and E1/E2 reactions and mechanisms, carbocation stability, competition between elimination and substitution, dehydration of alcohols, oxidation of alcohols and aldehydes and catalytic hydrogenation.

Laboratory Content
The following laboratory experiments will be selected from the following list and performed during the lab period:

1. Volumetric Techniques', A review of Titration
2. An Introduction to Statistics
3. Recycling Aluminium
4. Back Titration: Analysis of an Insoluble Base
5. Atomic Spectra
6. Gravimetric Analysis of Nickel
7. Synthesis of Aspirin
8. Separation and Identification of Drugs by Thin Layer Chromatography
9. Geometric Isomers
10. Preparation and Analysis of Potassium Hydrogen Maleate
11. Qualitative Organic Analysis
12. Stoichiometry
13. Molecular Modeling

O: Methods of Instruction

The course will be presented using lectures, problem sessions and class discussion. Films and other audio-visual aids as well as programmed material will be used where appropriate. Problems will be assigned on a regular basis, to be handed in and evaluated. The laboratory course will be used to illustrate the practical aspects of the course material. Close coordination will be maintained between laboratory and classroom work whenever possible. This will be accomplished by discussing laboratory experiments in class and, when necessary, by using the lab period for problem solving.

P: Textbooks and Materials to be Purchased by Students

Petrucci, R.H. and Harwood, W.S., *General Chemistry, Principles and Modern Applications,* 7th Edition, Maxwell Macmillan Canada, Toronto, 1997.

Douglas College, *Chemistry 110 Laboratory Manual*

Q: Means of Assessment

The final grade assigned for the course will be based upon the following components:

1. **Lecture Material (70%)**
   - Two or three in-class tests will be given during the semester (30%)
     A final exam covering the entire semester's work will be given during the final examination period (30%)
   - Any or all of the following evaluations, at the discretion of the instructor: problem assignments, quizzes, class participation [5% maximum] (10% in total)

2. **Laboratory (30%)**
   - Written reports for each experiment will be handed in and graded. These reports will either be complete reports, to be handed in in the laboratory notebook, or short reports, to be handed in on report sheets (27%). In addition, some written quizzes based on laboratory material will be evaluated.
   - Qualitative results of experiments performed on unknown samples will be graded (3%)

R: Prior Learning Assessment and Recognition: specify whether course is open for PLAR

No

Course Designer(s)

Education Council / Curriculum Committee Representative

Dean / Director

Registrar