Douglas College

EFFECTIVE: SEPTEMBER 2007
CURRICULUM GUIDELINES

A.	Division:	**Education**	Effective Date:		**September 2007**		
B.	Department / Program Area:	Science & Technology Chemistry	Revision	X	New Course		
			If Revision, Section(s) Revised:		**M, N, O, Q**		
			Date of Previous Revision:		**January 2005**		
			Date of Current Revision:		**March 2006**		
C:	CHEM 1110	**D**: The Structure of Matter			**E:** 4		

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)

Lecture: 4 hours/week
Laboratory: 2 hours/week

Number of Weeks per Semester: 15

H: Course Prerequisites:

CHEM 1108 (or CHEM 1105) (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 1210

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.bctransferguide.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, and 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 that 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 centre, 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.

Options: For classes with students enrolled in the Sport Science and Coaching Degree program:

22. Instructors will be aware that students in this class are seeking a career as teachers and therefore topics will be presented with a pedagogical perspective.
23. Students will be provided with skills enabling them to explain both quantitative and qualitative topics in the course to an audience of elementary or high school students.

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.
   Options: Organic compounds involved in human physiology and anatomy will be discussed.

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
14. Laboratory Safety
15. Preparation of Reagents and Equipment for the Laboratory

DOUGLAS COLLEGE SIGNATURE ELEMENTS

Core Competencies:

1. Oral, written and interpersonal communication
   Students will participate in class discussions and cooperate with partners in the laboratory. Written assignments will be submitted which include short answers to problems. Proper grammar is required.

2. Independent Learning and Information Literacy
   Students must work independently in the majority of laboratory and homework assignments. Preparation for tests and exams involves independent review of scientific material presented in the textbook and a variety of readings from library or internet sources.

3. Critical and Creative Thinking
   Students are encouraged to evaluate scientific data critically, both in the context of the historical development of theory and interpretation of their own data in the laboratory.

4. Computational and Information Technology Skills
   Students are required to use myDouglas to access course materials. Selected laboratory data is to be analyzed through the use of EXCEL spreadsheets. Word processing is encouraged for the submission of written assignments.

5. Team Work
   Several laboratory experiments will be performed with partners.

Academic Signature:

1. Applied Skills and Abilities:
   Applied skills will be developed through the performance of laboratory experiments.

2. Ethical Behaviour and Social Responsibility – Effective Citizenship
   The responsibility of chemists to present valid and reproducible data will be stressed. The role of synthetic versus natural chemicals in the environment will be discussed.

3. Intercultural, International and Global Perspective
   Understanding and solving global environmental issues requires a knowledge of chemical reaction mechanisms, the role of free radicals, and the impact of organic chemicals in the environment. The proper handling of chemical waste is stressed in the laboratory.

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.
Options: Students will be encouraged to view course material in the context of teaching through a combination of class presentations, cooperative learning and tutorials. Current educational technology, such as research using the Internet, molecular modeling software and data analysis with spreadsheets, will be employed.

P: Textbooks and Materials to be Purchased by Students

Petrucci, R.H. and Harwood, W.S., *General Chemistry*, *Douglas College Chemistry 110/210*. Pearson Custom Publishing, 2002.

Douglas College, *Chemistry 1110 Laboratory Manual*

Q: Means of Assessment

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

1. **Lecture Material (75%)**
   - 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], presentations, research assignments, group work (15% in total)

2. **Laboratory (25%)**
   - 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 (22%). 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