DEPARTMENT OF ACADEMIC UPGRADING

COURSE OUTLINE – FALL 2016

CH0130 (A2/B2): Chemistry Grade 12 Equivalent – 5(5 - 0 - 1.5) 95 Hours over 15 Weeks

Instructor	Les Rawluk	**Phone**	780 539 2738
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Office Hours	Monday/Tuesday/Wednesday/Thursday 1:15 – 2:15pm		

CALENDAR DESCRIPTION: Course concepts include: thermochemical changes; electrochemical changes; chemical equilibrium focusing on acid-base systems; and chemical reactions of select classes of organic compounds. Energy changes and safety are emphasized.

PREQUISITES/COREQUISITE(S): CH0120 (Chemistry 20), and MA0122 (Math 20-2), or MA0120 (Math 20-1) or MA0130 placement

REQUIRED TEXT/RESOURCE MATERIAL:

General Chemistry by Ebbing 11th Edition
Lab coat + Safety glasses
Scientific calculator (Note: this is the only electronic device allowed during tests or exams)

DELIVERY MODE(S): Lectures will introduce new Chemistry topics. Practice questions will be a regular part of each class. Lecture material is supplemented with laboratory experiments.

COURSE OBJECTIVES:

Students will encounter the following topics:

Thermochemical Changes:

1. The First Law of Thermodynamics; distinguishing between the system and its surroundings.

2. Enthalpy; endothermic and exothermic reactions.
3. Heat capacity and calorimetry. Heats of formation, reaction, combustion, and neutralization.
4. Hess's law.
5. Collision theory, activated complex, activation energy, and the reaction coordinate.
6. Potential energy diagrams for exothermic and endothermic reactions.
7. Factors affecting rates of reaction – temperature, concentration, catalyst, molecular details.

Chemical Equilibrium Focusing on Acid-Base Systems:

Students will encounter the following topics:

1. Reversible reactions and the meaning of equilibrium.
2. Conditions affecting equilibrium.
3. The equilibrium constant (K_c) with numerical problems.
4. Le Chatelier's principle, and predicting changes to systems at equilibrium.
5. Arrhenius acids and bases.
6. Brønsted – Lowry concept of acids and bases and conjugate acid-base pairs.
7. Neutralization reactions.
8. Strength of acids and bases; strong acids and bases; weak acids and bases.
9. Lewis acids and bases.
10. Definition of K_w, pH, pOH and acid-base solution related problems.
11. Expressions for the ionization constants, K_a and K_b, for acids and bases.
12. Acid-base indicators.
13. Buffers and their relationship to living systems.

Electrochemistry:

Students will encounter the following topics:

1. Oxidation, reduction, oxidizing agent, and reducing agent.
2. Determination of oxidation numbers.
3. Oxidation and reduction skeletal half reactions; balancing redox reactions using half reactions.
4. Balance redox reactions using the oxidation number method.
5. Spontaneous and non-spontaneous redox reactions.

6. Construction of a Voltaic (or Galvanic) electrochemical cell having a spontaneous redox reaction.
7. Definition of reduction potential, E and standard reduction potential, E^0.
8. Calculation of the standard cell potential E^0.
9. Construction and electrode reactions of common batteries.
10. Definition and explanation of electrolysis and electrolytic cells. Electrode reactions for the electrolysis of select molten and aqueous solutions. Electroplating.
11. Faraday's laws of electrolysis, and discuss quantitative aspects of electrolysis relating charge, Q, to the current and time.
12. Corrosion, and methods to prevent corrosion.

Organic Chemistry:

Students will encounter the following topics:

1. A definition of organic chemistry.
2. Functional groups including saturated and unsaturated aliphatic and aromatic hydrocarbons, alcohols, aldehydes, ketones, carboxylic acids and esters.
3. Names for common organic compounds using the IUPAC system. Formulas plus structural, condensed structural, and line diagrams of common compounds.
4. Definition of isomers.
5. Names for saturated and unsaturated aliphatic (including cyclic) and aromatic compounds containing up to ten carbon atoms in the parent chain.
6. Carbohydrates.
7. Polymerization.
8. Lipids, proteins, biochemical reactions and enzymes.

LEARNING OUTCOMES:

Thermochemical Changes:

Students should be able to:

1. Determine and interpret energy changes in chemical reactions
   - recall the application of $Q = mc\Delta T$ to the analysis of heat transfer
   - explain, in a general way, how stored energy in the chemical bonds of hydrocarbons originated from the sun

- define enthalpy and molar enthalpy for chemical reactions
- write balanced equations for chemical reactions that include energy changes
- use and interpret ΔH notation to communicate and calculate energy changes in chemical reactions
- predict the enthalpy change for chemical equations using standard enthalpies of formation
- explain and use Hess's law to calculate energy changes for a net reaction from a series of reactions
- use calorimetry data to determine the enthalpy changes in chemical reactions
- classify chemical reactions as endothermic or exothermic (including those for the processes of photosynthesis, cellular respiration and hydrocarbon combustion)

2. Explain and communicate energy changes in chemical reactions
   - define activation energy as the energy barrier that must be overcome for a chemical reaction to occur
   - explain the energy changes that occur during chemical reactions, referring to bonds
   - breaking and forming bonds and changes in potential and kinetic energy
   - analyze and label energy diagrams of a chemical reaction, including reactants, products, and enthalpy change and activation energy
   - explain that catalysts increase reaction rates by providing alternate pathways for changes, without affecting the net amount of energy involved; e.g., enzymes in living systems

Chemical Equilibrium Focusing on Acid-Base Systems:

Students should be able to:

1. Explain that there is a balance of opposing reactions in chemical equilibrium systems
   - define equilibrium and state the criteria that apply to a chemical system in equilibrium; i.e., closed system, constancy of properties, equal rates of forward and reverse reactions
   - identify, write and interpret chemical equations for systems at equilibrium
   - predict, qualitatively, using Le Chatelier's principle, shifts in equilibrium caused by changes in temperature, pressure, volume, concentration or the addition of a catalyst and describe how these changes affect the equilibrium constant
   - define K_c to predict the extent of the reaction and write equilibrium-law expressions for given chemical equations, using lowest whole-number coefficients

• describe Brønsted–Lowry acids as proton donors and bases as proton acceptors

• write Brønsted–Lowry equations, including indicators, and predict whether reactants or products are favoured for acid-base equilibrium reactions for monoprotic and acids and bases

• identify conjugate pairs and amphiprotic substances

• define a buffer as relatively large amounts of a weak acid or base and its conjugate in equilibrium that maintain a relatively constant pH when small amounts of acid or base are added.

2. Determine quantitative relationships in simple equilibrium systems

   • recall the concepts of pH and hydronium ion concentration and pOH and hydroxide ion concentration, in relation to acids and bases

   • define K_w, K_a, K_b and use these to determine pH, pOH, $[H_3O^+]$ and $[OH^-]$ of acidic and basic solutions

   • calculate equilibrium constants and concentrations for homogeneous systems and Brønsted–Lowry acids and bases (excluding buffers) when

      - concentrations at equilibrium are known
      - initial concentrations and one equilibrium concentration are known (ICE table)
      - the equilibrium constant and one equilibrium concentration are known.

Electrochemistry:

Students should be able to:

1. Explain the nature of oxidation-reduction reactions

   • define oxidation and reduction operationally and theoretically

   • define oxidizing agent, reducing agent, oxidation number, half-reaction, and disproportionation

   • differentiate between redox reactions and other reactions, using half-reactions and/or oxidation numbers

   • identify electron transfer, oxidizing agents and reducing agents in redox reactions that occur in everyday life, in both living systems (e.g., cellular respiration, photosynthesis) and nonliving systems; i.e., corrosion

   • compare the relative strengths of oxidizing and reducing agents, using empirical data

   • predict the spontaneity of a redox reaction, based on standard reduction potentials, and compare their predictions to experimental results

• write and balance equations for redox reactions in acidic and neutral solutions by - using half-reaction equations obtained from a standard reduction potential table - developing simple half-reaction equations from information provided about redox changes -assigning oxidation numbers, where appropriate, to the species undergoing chemical change

• perform calculations to determine quantities of substances involved in redox titrations

2. Apply the principles of oxidation-reduction to electrochemical cells.

   • define anode, cathode, anion, cation, salt bridge/porous cup, electrolyte, external circuit, power supply, voltaic cell and electrolytic cell

   • predict and write the half-reaction equation that occurs at each electrode in an electrochemical cell

   • explain that the values of standard reduction potential are all relative to 0 volts, as set for the hydrogen electrode at standard conditions

   • calculate the standard cell potential for electrochemical cells

   • predict the spontaneity or nonspontaneity of redox reactions, based on standard cell potential, and the relative positions of half-reaction equations on a standard reduction potential table

   • calculate mass, amounts, current and time in single voltaic and electrolytic cells by applying Faraday's law and stoichiometry.

Organic Chemistry

Students should be able to:

1. Explore organic compounds as a common form of matter

   • identify and describe significant organic compounds in daily life, demonstrating generalized knowledge of their origins and applications; e.g., methane, methanol, ethane, ethanol, ethanoic acid, propane, benzene, octane, glucose, polyethylene

   • name and draw structural, condensed structural and line diagrams and formulas, using International Union of Pure and Applied Chemistry (IUPAC) nomenclature guidelines, for saturated and unsaturated aliphatic (including cyclic) and aromatic carbon compounds - containing up to 10 carbon atoms in the parent chain (e.g., pentane; 3-ethyl-2,4-dimethylpentane) or cyclic structure (e.g., cyclopentane) - containing only one type of a functional group (with multiple bonds categorized as a functional group; e.g., pent-2-ene), including simple halogenated hydrocarbons (e.g., 2- chloropentane), alcohols (e.g., pentan-2-ol), carboxylic acids (e.g., pentanoic acid) and esters (e.g., methyl pentanoate), and with multiple occurrences of the functional group limited to halogens (e.g., 2-bromo-1-chloropentane) and alcohols (e.g., pentane-2,3- diol)

• identify types of compounds from the hydroxyl, carboxyl, ester linkage and halogen functional groups, given the structural formula

• define structural isomerism as compounds having the same empirical formulas, but with different structural formulas, and relate the structures to variations in the properties of the isomers

• compare, both within a homologous series and among compounds with different functional groups, the boiling points and solubility of examples of aliphatics, aromatics, alcohols and carboxylic acids (general trends only)

2. Describe chemical reactions of organic compounds.

   • define and identify simple addition, elimination, substitution, esterification and combustion reactions

   • define, illustrate and provide examples of monomers (e.g., ethylene), polymers (e.g., polyethylene) and polymerization in living systems (e.g., carbohydrates, proteins) and nonliving systems (e.g., nylon, polyester, plastics) (addition and condensation polymers)

   • relate the reactions described above to major reactions that produce thermal energy and economically important compounds from fossil fuels.

TRANSFERABILITY: Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability

EVALUATIONS:

Unit exams (four at 12% each)	48%
Lab Reports (seven at 2% each)	14%
Final Exam	38%

GRADING CRITERIA:

Alpha Grade	4-point Equivalent	Percentage Guidelines		Alpha Grade	4-point Equivalent	Percentage Guidelines
A+	4.0	90-100		C+	2.3	67-69
A	4.0	85-89		C	2.0	63-66
A-	3.7	80-84		C-	1.7	60-62
B+	3.3	77-79		D+	1.3	55-59
B	3.0	73-76		D	1.0	50-54
B-	2.7	70-72		F	0.0	00-49

Course Schedule/Timeline:

Days	Topics	Required Reading Ebbing 11th edition
Thermochemical Changes		
4	Thermodynamics: heat, enthalpy, and temperature; first law of thermodynamics; heat capacity, specific heat; problems.	183 – 202
4	Molar enthalpy, heat of formation, Hess's law	202 – 210
Reaction Kinetics		
4	Transition state theory, activated complex, activation energy, and reaction coordinate. Diagrams for endothermic and exothermic reactions. Rates of reaction: Collision theory, factors affecting rates of reactions	462 – 466
Chemical Equilibrium		
2	Chemical equilibrium: Irreversible and reversible reactions, equilibrium, equilibrium constant, factors affecting equilibrium.	487 – 501
2	Solving for equilibrium; LeChatelier's Principle	501 – 517

1	Solubility and K_{sp}	583 – 588
Acids and Bases		
.5	Electrolytes	103 – 107
.5	Arrhenius acids	521 – 522
2	Brønsted–Lowry acids and bases, conjugate acid-base pairs	522 – 526
3	pH and pOH, calculations of pH and pOH.	537 – 540
3	Ionization of acids and bases in water, K_a, K_b. Indicators	534 – 536 544 – 558
2	Buffers	563 – 573
1	Titration curves	573 – 579
Electrochemistry		
2	Spectator ions, net ionic equations	108 – 111
2	Redox, oxidation numbers (O.N.)	122 – 131
4	Balancing redox reactions in acidic and basic solutions	637 – 641
3	Electrochemical cells	642 – 656
Organic Chemistry		
4	Hydrocarbons: alkanes, alkenes, alkynes, aromatic hydrocarbons, nomenclature, isomers	812 – 833
4	Functional groups: Alcohols, ethers, aldehydes, ketones, carboxylic acids, amines, amides and nomenclature and reactions.	834 – 839
2	Polymers, monomers, biochemistry	842 – 847 849 – 861

STUDENT RESPONSIBILITIES:

Regular attendance is expected of all students, and is crucial to passing this course. As per Department Policy, if you miss 10 or more classes per semester in any course, you may be debarred from the final exam for that course.

Unexcused absences result in a mark of zero for course evaluation components. If a student has an excused absence, the marks for the missed component will be deferred to the final exam. **However, you will receive a grade of F if you miss the final exam.** The possession of any kind of electronic device such as a cell phone, tablet, laptop etc., is not allowed in the room during tests or the final exam.

Laboratory attendance to each specific experiment is compulsory; a passing grade in the laboratory component is required to pass the course. There are **NO** 'make up' labs in this course. Being absent from an experiment will result in a grade of **ZERO** for that experiment.

Submit lab reports in the drop box attached to the wall outside of J116. Lab reports are due by 2:30pm on the Monday four days after the lab is completed. The late penalty is 20% per every 24 hours after the lab is due.

STATEMENT ON PLAGIARISM AND CHEATING:

Cheating and plagiarism will not be tolerated and there will be penalties. For a more precise definition of plagiarism and its consequences, refer to the Student Conduct section of the College Admission Guide at http://www.gprc.ab.ca/programs/calendar/ or the College Policy on Student Misconduct: Plagiarism and Cheating at http://www.gprc.ab.ca/about/administration/policies/

**Note: all Academic and Administrative policies are available on the same page.