UNIVERSITY OF CALGARY
DEPARTMENT OF CHEMISTRY
COURSE SYLLABUS
Fall 2014

1. COURSE: CHEMISTRY 203, General Chemistry: Change and Equilibrium

LEC	DAYS	TIME	ROOM	INSTRUCTOR	OFFICE	E-MAIL	OFFICE HOURS
L01	MWF	11:00-11:50	SB 103	Dr. Kal Mahadev	EEEL 237C	mahadev@ucalgary.ca	TBA
L02	MWF	12:00-12:50	SB 103	Dr. Masood Parvez	SB 331	Parvez@ucalgary.ca	TBA
L03	TR	8:00 -9:15	SB 103	Dr. Kal Mahadev	EEEL 237C	mahadev@ucalgary.ca	TBA

Course, Lab and Tutorial Coordinator : Dr. Kal Mahadev (EEEL 237C), mahadev@ucalgary.ca
Course website: https://d2l.ucalgary.ca/d2l/home

Departmental Office: SA 229, 220-5341, chem.undergrad@ucalgary.ca

Textbook references in this syllabus refer to:
J.C. Kotz, P.M. Treichel, J.R. Townsend, Chemistry and Chemical Reactivity, 8th Edition. Brooks/Cole CENGAGE Learning.

Chapter coverage in Chemistry 203:

Stoichiometry

Material from Chem 20 and/or Chem 30 that is expected background knowledge:
Found in Chapters 1-4

Gases
Chapter 11 – all sections Focus on sections: 11.5 & 11.6

Kinetics
Chapter 15 – all sections.

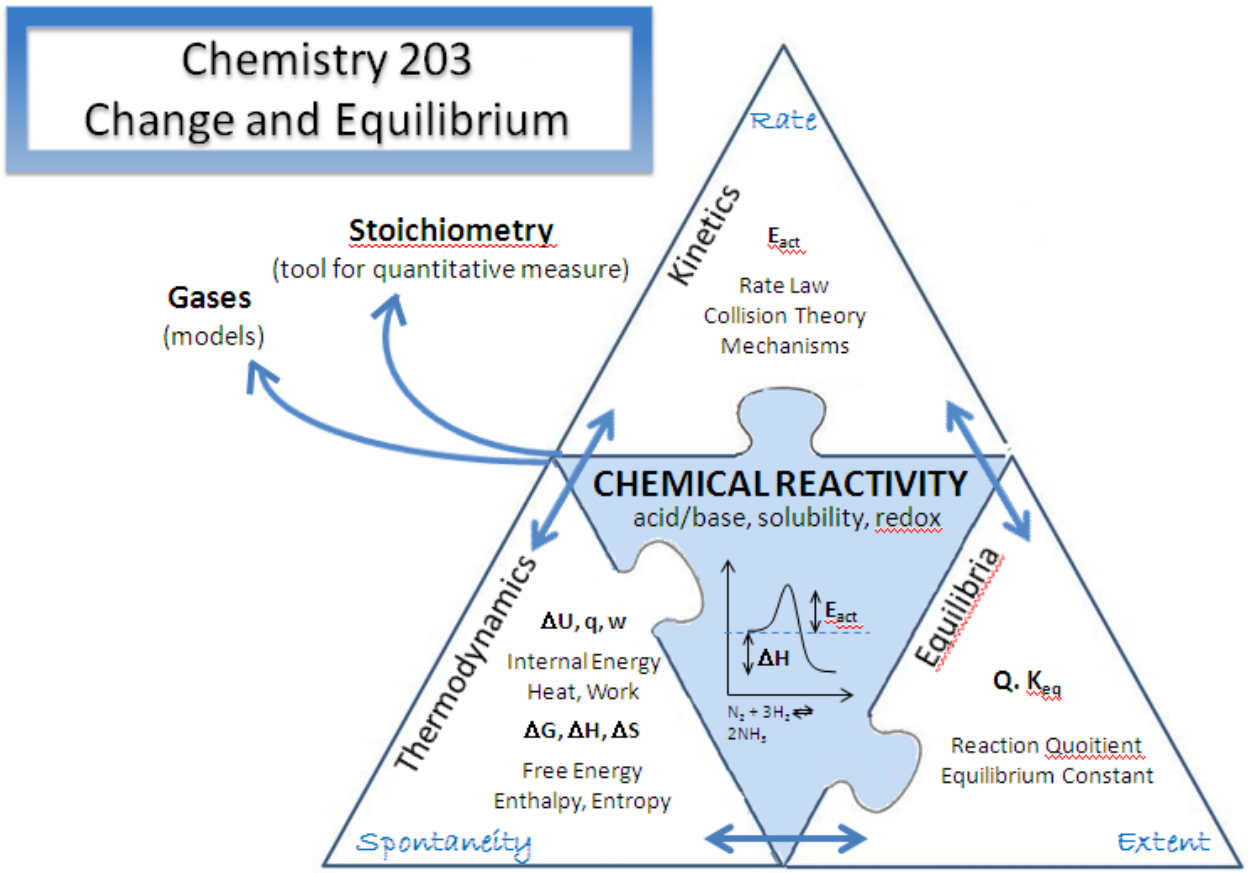
Chemical Equilibria
Chapter 16 – all sections. Background material 16.1, 16.2 & 16.6

Thermodynamics
Chapter 5 – all sections Focus on sections: 5.4, 5.5 & 5.7
Chapter 19 – all sections.

Chemical Reactivity
Acids and Bases: Chapter 17 – all sections
Solubility of Salts: Chapter 18 – all sections
Redox Reactions: Chapter 20 – all sections

Department Approval: Approved by Department Head Date: August 22, 2014

Rationale for the course: Chemical reactivity is important across a broad set of disciplines. In Chemistry 203 you will gain understandings relating to foundational concepts that are used to explain and examine chemical reactivity (Equilibria, Thermodynamics, Kinetics, Stoichiometry and Gases). Through the learning objectives for each understanding you will gain problem solving (critical thinking) and laboratory skills (teamwork and communication skills) that enable you to discuss chemical reactivity within YOUR discipline.



All pictures, unless otherwise specified, were taken with permission from Kotz, Treichel & Townsend, "Chemistry and Chemical Reactivity", 8th edition, Brooks/Cole, 2012.

LEARNING GOALS :

Enduring Understandings	Learning Objectives
Gases and Stoichiometry	
To determine what is happening quantitatively in chemical reactions one must use the principles of stoichiometry.	Interpret, predict, and write formulas for chemical species. Identify, generate and balance chemical equations. Identify limiting and excess reactant(s) and use them to determine theoretical and percent yields. Interconvert concentrations, moles and masses of chemical species in solutions.
Gases are good models for understanding the microscopic nature of chemical reactivity.	Describe the Kinetic Molecular theory of gases. Interconvert partial pressures, mole fractions of gases with and total pressure of a gaseous system. Use the ideal gas law to do stoichiometric calculations involving gases. Recognize the limitations of the ideal gas law
Equilibrium	
Most reactions attain a state of dynamic equilibrium. The reaction quotient is used to determine the progress or extent of a reaction mixture.	Qualitatively and quantitatively describe dynamic equilibria. Write K/Q expressions for an equilibrium reaction. Use K and Q values to predict the direction of a reaction for a given set of reaction conditions (concentrations, P's, T etc.).
The extent of a reaction can be altered.	Quantitatively and qualitatively describe how a system at equilibrium responds to addition of a common ion or changes in concentration, P, V and T.
Kinetics	
The rate law is used to quantitatively examine the rate of a reaction.	Calculate average and instantaneous rates of reaction using concentration versus time data. Identify the differential and/or integrated rate laws for a given reaction using experimental data. Differentiate and determine the half-life ($t_{1/2}$) of a given reaction
The rate of a reaction can be altered.	Describe and explain the factors that affect reaction rates (reactant concentrations, nature of reactants, temperature, presence of catalyst)
Microscopically rate is explained using collision theory.	Qualitatively apply the principles of collision theory to a reaction. Quantitatively use the Arrhenius equation to explain the relationship between activation energy, temperature and the rate constant.
Reactions can occur via a series of steps or a mechanism.	Explain the concept of a reaction mechanism and identify reasonable reaction mechanisms for a given reaction. Recognize the rate-determining step, intermediates and catalysts present in a given reaction mechanism and use the

	information to determine the differential rate law for a reaction..
Reaction coordinate diagrams provide an understanding of the energy changes that influence rate.	Generate and identify the important kinetic components of a reaction coordinate diagram for a chemical reaction (transition state, intermediate, activation energy). Explain how reaction coordinate diagrams vary as the mechanism of a reaction varies
Catalysts provide alternative mechanisms which alters the energy changes that occur for a reaction.	Explain the effect of a catalyst on the activation energy of a reaction.
Thermodynamics	
Chemical reactivity involves energy changes.	Explain how the terms system, surrounding and universe apply to a chemical reaction. Relate changes in the internal energy of a reaction to the work done by/on the reaction and heat released/absorbed by the reaction. Use calorimetry to determine the amount of heat produced or absorbed by a chemical reaction. Determine the pressure-volume work done by or on a system.
Reaction coordinate diagrams provide an understanding of the energy changes.	Generate and use reaction coordinate diagrams to explain the energy changes that occur in a chemical reaction. Describe what happens at the molecular level when energy changes occur.
The enthalpy, entropy and/or free energy changes of a reaction can be used to describe the spontaneity of a reaction.	Define and determine qualitatively and quantitatively the enthalpy and entropy changes for a reaction. Distinguish between standard and non-standard states. Qualitatively and quantitatively relate enthalpy and entropy to the free energy or spontaneity of a chemical reaction.
The spontaneity of chemical reactions can be varied.	Qualitatively and quantitatively examine the T at which spontaneity changes.
The spontaneity of a chemical reaction relates to the extent of the reaction.	Interconvert $\Delta_r G$, $\Delta_r G^0$, *Q and K.*
Chemical Reactivity	
The pH of an aqueous acid or base solution is determined by the extent of their reaction with water.	Differentiate between K and pK and relate it to the $[H^+]$ in solution. Quantitatively relate K, pK, pH, $[H^+]$ and $[OH^-]$. Determine the theoretical pH value for an acid or a base in aqueous solution.
The varying strength of acids and bases can be explained by examining structure.	Qualitatively relate differences in K to the variation in structure of an acid or base.
Chemists can alter the extent of reaction with water.	Qualitatively and quantitatively determine the affect of adding a

	common ion to an acidic or basic solution.
Weak acids and bases are used to prepare buffer solutions that are used to resist changes in pH.	Describe how a buffer functions and outline how to prepare a buffer with a given pH. Calculate the pH of a buffer solution before and after the addition of strong acids or bases.
Acids and Bases are studied using titration experiments.	Qualitatively and quantitatively describe how pH varies throughout a titration. Use a titration to determine the identity of an acid or base. Select an appropriate indicator for a given acid/base titration.
The solubility of salts in aqueous solution is related to their extent of dissociation in water.	Qualitatively and quantitatively relate the solubility of salts to K_{sp}. Interpret how the solubility of a salt can be affected by changing reaction conditions (concentrations, temperature, addition of acids, bases, complexing reagents etc....).
The cell potential generated by a redox reaction relates to the spontaneity and extent of that reaction.	Describe the components of an electrochemical cell. Generate or identify the electrochemical cell for a given redox reaction. Qualitatively and quantitatively differentiate between standard and non-standard cell potentials. Qualitatively and quantitatively relate the cell voltage (E^o_{cell}), free energy ($\Delta_r G^0$) and equilibrium constant (K) of a redox reaction.

Responsibilities and Expectations:

What you can expect from the course and your instructor

- Your instructor will try to help you as much as possible. Do not be afraid to contact your instructor. Your Instructor's contact information is available on the course website.
- You will have several opportunities for formal feedback on your progress throughout the term (there is one mid-term test, one final exam, five quizzes, five pre-lab assignments, five reports, five pre-tutorial assignments and five tutorial quizzes). Each activity should help inform you of your strengths and weaknesses but also help inform future course offerings.
- We recognize that unforeseeable events happen. If this results in you having problems meeting any of your assignment submission dates, accommodations are possible. Procedures for making these accommodations are found in the appropriate sections of the D2L website.

What is expected from you

- Be respectful of everyone
- Come prepared for and be willing to participate in all class activities
- Be as organized as possible so that assignments are submitted on time
- Continually assess your performance and if you are struggling please ask or email either your instructor or TA's as soon as possible. In e-mails, however, please include your name and make sure to use full sentences so that responses can be effective. Please anticipate that replies may take up to 12 hours.
- In lecture you need to make sure you understand how something is being communicated but in order to truly understand a concept YOU MUST PRACTICE and this is why suggested problems from the textbook, class homework or past examinations will be provided.

Selected exercises from the textbook – *use these exercises as a launching point when learning how to solve problems involving*

Stoichiometry
2.153, 2.157. 3.35. 3.45, 3.69. 3.73, 4.3 4.6, 4.10. 4.20, 4.37, 4.45, 4.59, 4,69, 4.91, 4.111

Gases
11.33, 11.37, 11.42, 11.61, 11.63, 11.83, 11.99

Kinetics
15.3, 15.5, 15.9, 15.11, 15.15, 15.23, 15.25, 15.31, 15.39, 15.41, 15.46, 15.55, 15.75, 15.81, 15.83, !5.85

Chemical Equilibria
16.1, 16.5, 16.9, 16.11, 16.13, 16.15, 16.21, 16.23, 16.25, 16.27, 16.43, 16.57, 16.65, 16.67, 16.70

Thermodynamics
5.1, 5.9, 5.13, 5.25, 5.29, 5.43, 5.45, 5.51, 5.57, 5.61, 5.65, 5.73(a,b,d), 5.109
19.3, 19.7, 19.13, 19.15, 19.19, 19.25, 19.27, 19.33, 19.53, 19. 57, 19. 67, 19. 77, 19.83

Chemical Reactivity
Acids and Bases: 17.3, 17.5, 17.11, 17.13, 17.15, 17.19, 17.25, 17.27, 17.31, 17.37, 17.41,17.49, 17.53, 17.59, 17.61, 17.63, 17.67, 17.91, 17.92, 17.101

Solubility of Salts: 18.3, 18.5, 18.7, 18.13, 18.17, 18.19, 18.23, 18.25, 18.31, 18.37, 18.41, 18.45, 18.51, 18.53, 18.57, 18.61,

18.69, 18.73, 18.85, 18.97, 18.101, 18.108
Redox Reactions: 20.3, 20.7, 20.9, 20.15, 20.17, 20.27, 20.29, 20.31, 20.51, 20.55, 20.63, 20.93(a-h)

Format and Procedures:

All classes are cumulative so what will be learned at the start of the course will be continually applied throughout the term.

In-class demonstrations will highlight the experiential nature of the discipline and allow for group discussion but participation in laboratory experiments allow for hands-on experience.

The use of TopHat Monocle for in-class polling is designed to help inform you about your strengths and weaknesses in knowledge or its application and inform lecturers how to pace coverage of course material.

Tutorials are opportunities to work in groups and learn how to take good notes.

In-class activities, tutorials and experiments as a whole will help you to prepare for Term Tests and Final Examinations. Examinations are a combination of multiple choice, short answer and written answer questions. Examinations are given to assess your strengths and weaknesses regarding the knowledge and application of structure/bonding concepts.

FALL 2014 – CHEM 203

SEPTEMBER 2014

SUN	MON	TUES	WED	THUR	FRI	SAT
31	Labour Day 1	2	3	4	5	6
7	Lectures Begin 8	9 **Lab 1**	10	11	12	13
14	15	16 **Tutorial 1**	17	18	19	20
21	22	23 **Lab 2**	24	25	26	27
28	29 Term Test 1	30 **Tutorial 2**				

OCTOBER 2014

SUN	MON	TUES	WED	THUR	FRI	SAT
		Tutorial 2	1	2	3	4
5	6	7 **Lab 3**	8	9	10	11
12	Thanksgiving Day 13	14 **Tutorial 3**	15	16	17	18
19	20	21 **Lab 4**	22	23	24	25
26	27 Term Test 2	28 **Tutorial 4**	29	30	31	

NOVEMBER 2014

SUN	MON	TUES	WED	THUR	FRI	SAT
						1
2	3	4 **Lab 5**	5	6	7	8
9	Reading Day 10	Remembrance Day 11	12	13	14	15
16	17	18 **Tutorial 5**	19	20	21	22
23	24	25	26	27	28	29
30						

DECEMBER 2014

SUN	MON	TUES	WED	THUR	FRI	SAT
	1	2	3	4	Lectures End 5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25 Xmas	26 Xmas	27 Xmas
28 Xmas	29 Xmas	30 Xmas	31 Xmas			