CAMOSUN COLLEGE	**School of Arts & Science** **CHEMISTRY AND GEOSCIENCE DEPARTMENT** **CHEM 221-001** **Physical Chemistry** **Winter 2015**

COURSE OUTLINE

The course description is online @ http://camosun.ca/learn/calendar/current/web/chem.html

Ω *Please note: the College electronically stores this outline for five (5) years only.*
*It is **strongly recommended** you keep a copy of this outline with your academic records.*
You will need this outline for any future application/s for transfer credit/s to other colleges/universities.

1. Instructor Information

(a)	Instructor:	Neil Meanwell		
(b)	Office Hours:	Mon, Thurs: 11.30 am – 12.30 pm. Tues: 12.30 – 2.30 pm. Wed: 9.30 am – 10.30 am		
(c)	Location:	F 348B		
(d)	Phone:	370-3448	Alternative Phone:	(250)729-3838
(e)	Email:	meanwen@camosun.bc.ca or chemhelp@shaw.ca		
(f)	Website:	N/A		

Prerequisite: Chem 121 (C minimum)

Important Dates: Family Day: Monday, February 9th. Reading Break: Thursday and Friday, February 12th and 13th. Last day to withdraw without receiving a failing grade for the course: Monday, March 9th. Good Friday: Friday 3rd April. Easter Monday: Monday, 6th April.

2. Intended Learning Outcomes

At the end of this course, the student will be able to

1. Determine the quantitative and qualitative changes in the rate of a chemical reaction produced by changes in concentration, temperature and ionic strength and apply the energy of activation concept to the problems of catalysis.
2. Derive reaction mechanisms from experimental data and describe the major methods for following fast reactions and determining the presence of reaction intermediates.
3. Use the steady state approximation to explain the mechanisms for reactions in the gas phase and in solutions and apply the same procedures to competitive enzyme kinetics; and distinguish between chain reaction explosions and thermal explosions.
4. Outline the differences between heat and work, reversible and irreversible changes, state and non state functions, adiabatic and isothermal changes.
5. Apply the enthalpy concept to the net energy change in a chemical reaction and Use the principles of energy conservation and thermodynamic cycles to calculate changes in any state function.
6. Calculate the work done by a gas when it expands and use the Carnot cycle.
7. Define entropy and predict the conditions under which the reaction would be spontaneous.
8. Derive the Clausius - Clapeyron equation and apply it to the problems of volatile organic liquids and apply the concept of partial molar volumes to the problem of dissolving one liquid in another.
9. Define and use chemical potentials to explain the drive to equilibrium in both the quantitative and qualitative terms.
10. Outline the concepts of an ionic atmosphere, the ionic strength of a solution and the activity of an ion.
11. Derive and use the Nernst equation for the four major types of electrode.
12. Calculate thermodynamic data from voltage measurements at different concentrations and temperatures and describe and explain the processes of energy conversion with reference to the operation of a fuel cell and the role of hydrogen as a fuel.
13. Apply the laws of Raoult and Henry to liquid-vapour equilibria and comment on ideal and non-ideal solutions and predict their behaviour when they are distilled.
14. Construct phase diagrams and apply the lever rule at particular points to determine the proportion of a component in each phase and describe and explain the unique properties of azeotropes and eutectic mixtures.
15. Summarize the drive to equilibrium by the evaporation and condensation of volatile solvents.
16. Predict the change in vapour pressure of a volatile solvent with the addition of non-volatile solutes

and use the relationship to explain the elevation of the boiling point and the depression of the freezing point of the solvent.

17. Differentiate between the behaviour of ionic and molecular solutes in a solution and and explain the production of osmotic pressure across a membrane and the role of reverse osmosis in desalination.

3. Required Materials

(a) Text: *Physical Chemistry, Thermodynamics, Structure and Change (10th Edition) Volume 1: Thermodynamics and Kinetics,* **by Peter Atkins and Julio de Paula,** is the required text and is available in the bookstore.

(b) Chem 221 Lab Manual, In-house. Available in PDF format on D2L.

(c) Safety glasses

4. Course Content and Schedule

(a) Scheduled lectures: Mon, Tues, Thurs: 10.00 am to 10.50 am (F 200)

(b) Scheduled labs: Mon, 1.30 pm to 4.20 pm (F 356).

(c) In-class worksheets. These contain questions which we will generally use as examples as we progress through the course. Solutions will be supplied to you at timely intervals.

(d) Assignments. These will be handed out to keep pace with the course material. Include my own questions and end-of-chapter questions from the text. It is essential that you do these questions as they are typical of the questions that you will face in the exams. They are **not marked** but answers are posted periodically.

(e) Midterm on Kinetics and first part of Thermodynamics (lab period, week #8).

(f) Midterm on second part of Thermodynamics, Phase Equilibria and Mixtures (lab period, week #12)

(g) Final Exam: A three-hour written exam on **all** the lecture material presented in the course. Scheduled for the week immediately following the end of the semester.

5. Basis of Student Assessment (Weighting)

(a) Two midterm exams @ 17.5%, total 35%

(b) Laboratory work: 30%

(c) Final exam: 35%

Notes

1. You must pass (50% or more) both the lecture and laboratory portions of the course independently in order to pass overall.

2. If a student is ill and unable to take a test then the student should notify me as soon as possible and preferably before the scheduled time of the test. In order to have the test rescheduled the student must supply me with a doctor's note. If the test cannot be rescheduled then the weighting from that test will be transferred to the Final exam.

6. Grading System

Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D	Minimum level of achievement for which credit is granted; a course with a "D" grade cannot be used as a prerequisite.	1
0-49	F	Minimum level has not been achieved.	0

Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy E-1.5 at **camosun.ca** for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	*In progress*: A temporary grade assigned for courses that, due to design may require a further enrollment in the same course. No more than two IP grades will be assigned for the same course. *(For these courses a final grade will be assigned to either the 3rd course attempt or at the point of course completion.)*
CW	*Compulsory Withdrawal:* A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.

7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College calendar, at Student Services, or the College web site at camosun.ca.

STUDENT CONDUCT POLICY

There is a Student Conduct Policy **which includes plagiarism**.
It is the student's responsibility to become familiar with the content of this policy.
The policy is available in each School Administration Office, at Student Services, and the College web site in the Policy Section.

ADDITIONAL COMMENTS AS APPROPRIATE OR AS REQUIRED

Brief Summary of Course Material

A. The Properties of Gases (Chapter 1) (4 lectures)

1 A The perfect gas

1 B The kinetic model
1 C Real gases

B. Chemical Kinetics (Chapters 20 and 21) (10 lectures)

Chapter 20: Chemical Kinetics
20 A The rates of chemical reactions
20 B Integrated rate laws
20 C Reactions approaching equilibrium
20 D The Arrhenius equation
20 E Reaction mechanisms
20 F Examples of reaction mechanisms
20 H Enzyme kinetics

Chapter 21: Reaction Dynamics
21 A Collision theory
21 B Diffusion controlled reactions
21 C Transition state theory

C. Thermodynamics (9 lectures) (Chapters 2 and 3)

Chapter 2: The First Law
2 A Internal energy
2 B Enthalpy
2 C Thermochemistry
2 D State functions and exact differentials
2 E Adiabatic changes

Chapter 3: The Second and Third Laws
3 A Entropy
3 B The measurement of entropy
3 C Concentrating on the system
3 D Combining the first and second laws

D. Physical Transformations of Pure Substances (6 lectures) (Chapter 4)

4 A Phase diagrams of pure substances
4 B Thermodynamic aspects of phase transitions

E. Simple Mixtures (6 lectures) (Chapter 5)

5 A The thermodynamic description of mixtures
5 B The properties of solutions
5 C Phase diagrams of binary systems
5 E Activities
5 F The activities of ions

F. Chemical Equilibrium (6 lectures) (Chapter 6)

6 A The equilibrium constant
6 B The response of equilibria to conditions
6 C Electrochemical cells
6 D Electrode potentials

Chem 221-001 Winter 2015 Laboratory Schedule

Week # (Thursday)	Experiment # and Title
1. (5th January)	**No Lab - Lecture**

2. (12th January)	**No Lab – Lecture**
3. (19th January)	#1 The Effects of Concentration, Temperature, Catalysts and Ionic Strength on the Kinetics of the Potassium Iodide/Persulphate Clock Reaction
4. (26th January)	#2 Enzyme Kinetics and the MichaelisBMenten Mechanism
5. (2nd February)	#3 The Solubility of an Ionic Salt and the Effect of the Ionic Atmosphere
6. (9th February)	**No Lab – Family Day**
7. (16th February)	#4 The Nernst Equation and a Potentiometric Titration
8. (23rd February)	**Midterm #1 – No Lab**
9. (2nd March)	**No Lab - Lecture**
10. (9th March)	#5 Ionic Solutions: Conductivity and Conductometric Titrations **or** #6 Bomb Calorimetery and the Energy and Protein Content of Pizza **or** #7 Concentration Cells and Ion-Selective Electrodes
11. (16th March)	#5 Ionic Solutions: Conductivity and Conductometric Titrations **or** #6 Bomb Calorimetery and the Energy and Protein Content of Pizza **or** #7 Concentration Cells and Ion-Selective Electrodes
12. (23rd March)	**Midterm #2 - No Lab**
13. (30th March)	#5 Ionic Solutions: Conductivity and Conductometric Titrations **or** #6 Bomb Calorimetery and the Energy and Protein Content of Pizza **or** #7 Concentration Cells and Ion-Selective Electrodes
14. (6th April)	**No Lab – Easter Monday**

Notes: 1) Lab Reports are always due at the next laboratory session (i.e., when an experiment is being performed.

2) Late lab reports will be penalised 4 marks immediately and additional marks will be deducted from chronically late reports.