CAMOSUN COLLEGE	***School of Arts & Science*** ***CHEMISTRY AND GEOSCIENCE DEPARTMENT*** **CHEM 221-01** **Physical Chemistry** **2012W**

COURSE OUTLINE

The Approved Course Description is available on the web @ _____

Ω *Please note: this outline will be electronically stored for five (5) years only. It is strongly recommended students keep this outline for your records.*

1. Instructor Information

(a)	Instructor:	Neil Meanwell		
(b)	Office Hours:	Mon, Tues, Wed, Thurs: 11.30 am – 12.30 pm. Mon : 1.30 pm – 2.30 pm. Wed: 9.30 – 10.20 am.		
(c)	Location:	F 348 B		
(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: Reading Break: February 16th – 17th (Thursday and Friday), last day to withdraw without a failing grade: March 13th (Tuesday), Easter Friday: April 6th, Easter Monday: April 9th.

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) Texts: *The Elements of Physical Chemistry, Fifth Edition,* **by Peter Atkins and Julio de Paula,** is the recommended text. There is also a laboratory manual which all students must have. Both the text and the manual can be obtained from the bookstore. There are several physical chemistry texts kept in the library on reserve which can be signed out at the front desk.

(b) Chem 221 Lab Manual, In-house

(c) Safety glasses

4. Course Content and Schedule

(a) Scheduled lectures: Mon, Tues, Wed: 8.30 am to 9.20 am (E 344)

(b) Scheduled labs: Thurs, 2.30 pm to 5.20 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 posted outside my office.

(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 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) Review assignment on relevant first year topics. To be taken in and marked.

(h) 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) Review assignment: 5%

(b) Two midterm exams @ 15%, total 30%

(c) Laboratory work: 30%

(d) 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 on the College web site in the Policy Section.

8. Brief Summary of Course Material

A. Kinetics (12 lectures) (Chapters 10 and 11)

Topics will include:
-Factors influencing the rate
- Methods of following fast reactions
- Differential rate laws
- Methods of determining the form of the rate law
- Integrated rate laws
-Theories of reaction rates (collision theory and activated complex theory)
-Reaction mechanisms, slowest step approximation, steady state approximation
-Lindemann mechanism for unimolecular reactions
-Catalysis
-Enzyme catalysed reactions and the Michaelis-Menten mechanism
-Chain reactions and explosions.
-Photochemical reactions
-Reactions in solution

B. Thermodynamics (9 lectures) (Chapters 2, 3 and 4)

Topics will include:
-First Law
-Internal energy, work and heat
-Heat capacity (constant pressure and constant volume)
-Calorimetry
-Enthalpy concept
-Enthalpy changes for physical and chemical processes
-Variation of enthalpy with temperature
-Second Law
-Entropy and entropy changes for typical processes
-Heat engines, refrigerators, and heat pumps
-Spontaneity of chemical reactions
-Free energy
-Free energy and maximum useful work
-Gibbs energy and equilibrium
-Clausius-Clapeyron equation

C. Phase Equilibria (6 lectures) (Chapter 5)

Topics will include:
-Thermodynamics of phase transitions
-Variation of Gibbs energy with temperature and pressure
-Phase diagrams for one-component systems
-The location of phase boundaries and characteristic points
-The Gibbs phase rule

D. Solutions and Colligative Properties (6 lectures) (Chapter 6)

Topics will include:
-Partial molar quantities
-Chemical potential
-Spontaneous mixing
-Ideal and ideal dilute solutions
-Raoult's law and Henry's law
-Real solutions and activities
-Coligative properties
-Elevation of the boiling point
-Depression of the freezing point
-Osmotic pressure
-Phase diagrams of mixtures

E. Electrochemistry (6 lectures) (Chapter 9)

Topics will include:
-Arrhenius theory of dissociation
-Debye-Huckel theory, ionic strength and activity
-Ionic conductivity and Kohlrausch's law
-Electrochemical cells
-Galvanic cells and electrolytic cells
-Half-reactions and electrodes
-Varieties of electrodes
-Cell potential, Nernst equation, cell potential and equilibrium
-Junction potentials
-Concentration cells
-Ion selective electrodes, the pH electrode
-Thermodynamic functions from cell measurements

Week # (Thursday)	Experiment # and Title
1. (12th January)	**No Lab - Lecture**
2. (19th January)	#1 The Effects of Concentration, Temperature, Catalysts and Ionic Strength on the Kinetics of the Potassium Iodide/Persulphate Clock Reaction.
3. (26th January)	**No Lab - Lecture**.
4. (2nd February)	#2 Enzyme Kinetics and the MichaelisBMenten Mechanism
5. (9th February)	#3 The Solubility of an Ionic Salt and the Effect of the Ionic Atmosphere
6. (16th February)	**No Lab – Reading Break**
7. (23rd February)	#4 The Nernst Equation and a Potentiometric Titration
8. (1st March)	**Midterm #1 – No Lab**
9. (8th March)	**No Lab - Lecture**
10. (15th 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. (22nd 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. (29th March)	**Midterm #2 - No Lab**
13. (5th April)	#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. (12th April)	**No Lab - Lecture/Review**

Notes: 1) Lab Reports are always due at the next laboratory session.

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