CAMOSUN COLLEGE
School of Arts & Science
Department of Chemistry & Geoscience

CHEM-221-001
Physical Chemistry
Winter 2020

COURSE OUTLINE

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

Ω *Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.*

1. Instructor Information

(a) Instructor	Neil Meanwell			
(b) Office hours	Mon: 12:30-2.30 pm, Tues:12.30 – 1.30 pm; Wed: 2.30-3.30 pm; Thurs: 12.30 pm-1:30 pm			
(c) Location	F 348B			
(d) Phone	250-370-3448	**Alternative:**	250-729-3838	
(e) E-mail	meanwen@camosun.bc.ca or chemhelp@shaw.ca			
(f) Website	Not available			

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: ***PHYSICAL CHEMISTRY Thermodynamics, Structure and Change (Eleventh Edition, Volume 1: Thermodynamics and Kinetics)****,* by Peter Atkins and Julio de Paula (paperback, **ISBN: 9780198817895**)**,** is the recommended text. 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. Available on D2L.

(c) Safety glasses and laboratory coat (compulsory).

4. Course Content and Schedule

(a) Scheduled lectures: Mon, Wed and Thurs: 3.30 - 4.20 pm (F 208)

(b) Scheduled labs: Tues, 1.30 pm - 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 on D2L.

(d) End-of chapter questions. Most worksheets will have and end-of-chapter questions chosen from the textbook. It is very important that you do these. Your answers are not taken in for marking. Solutions are posted periodically on D2L.

(e) Five assignments handed out periodically during the semester. These are taken in for marking.

(f) Term tests: You will take the following term tests:

Term Test #1 Week 6 - 120 minutes duration. Written test on the lecture material presented from Week 1 to Week 5 of the course. Scheduled for the lab period of Week 6.

Term Test #2 Week 12 - 120 minutes duration. Written test on the lecture material presented from Week 6 to Week 11 of the course. Scheduled for the lab period of 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.

Important Dates: Family Day: Monday,17th February; Reading Break: Tuesday-Friday, 18th – 21st February; Final Examination Schedule Posted: Friday, 21st February; Last Day to Withdraw Without an Academic Penalty: Monday, 9th March.

Brief Summary of Course Material

A. The Properties of Gases (Focus1) (4 lectures)

1 A The perfect gas
1 B The kinetic model
1 C Real gases

B. Chemical Kinetics

Focus 17: Chemical Kinetics (6 lectures)

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

Focus 18: Reaction Dynamics (4 lectures)

18 A Collision theory
18 B Diffusion controlled reactions
18 C Transition state theory

C. Thermodynamics

Focus 2: The First Law (4 lectures)

2 A Internal energy
2 B Enthalpy
2 C Thermochemistry
2 D State functions and exact differentials
2 E Adiabatic changes

Focus 3: The Second and Third Laws (5 lectures)

3 A Entropy
3 B The measurement of entropy
3 C Concentrating on the system
3 D Combining the first and second laws

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

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

E. Focus 5: Simple Mixtures (6 lectures)

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. Focus 6: Chemical Equilibrium (6 lectures)

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 2020 Laboratory Schedule

Week # (Tuesday)	Experiment # and Title
1. (7th January)	**No Lab – Safety Talk/Lecture**
2. (14th January)	#1 The Effects of Concentration, Temperature, Catalysts and Ionic Strength on the Kinetics of the Potassium Iodide/Persulphate Clock Reaction (21st January)
3. (21st January)	**No Lab - Lecture**
4. (28th January)	#2 Enzyme Kinetics and the Michaelis-Menten Mechanism (4th February)
5. (4th February)	#3 The Solubility of an Ionic Salt and the Effect of the Ionic Atmosphere (13th February)
6. (11th February)	**Midterm #1 – No Lab**
7. (18th February)	**No Lab – Reading Break**
8. (25th February)	#4 The Nernst Equation and a Potentiometric Titration (3rd March)
9. (3rd March)	#7 Concentration Cells and Ion-Selective Electrodes (10th March – at lecture)
10. (10th March)	**No Lab - Lecture**
11. (17th March)	#6 Bomb Calorimetery and the Energy and Protein Content of Pizza and #5 Ionic Solutions: Conductivity and Conductometric Titrations (31st March – at lecture)
12. (24th March)	**Midterm #2 - No Lab**
13. (31st March)	#6 Bomb Calorimetery and the Energy and Protein Content of Pizza and #5 Ionic Solutions: Conductivity and Conductometric Titrations (7th April – at lecture)
14. (7th April)	**No Lab - Lecture/Review**

Notes: 1) The deadline for handing in a lab report is given in parentheses after the title of the experiment.
2) Late lab reports will be penalised 4 marks immediately and additional marks will be deducted from chronically late reports.

5. Basis of Student Assessment (Weighting)

(a) Five assignments: 10%

(b) Two midterm exams (@ 15%): 30%

(c) Final exam: 30%

(d) Laboratory work: 30%

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

[X] Standard Grading System (GPA)

[ ] Competency Based Grading System

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

The Camosun Student Success Centre offers many support services including online Learning Skills Guides, Learning Circles, and one-one-one appointments. Students are encouraged to explore what is available here: http://camosun.ca/services/writing-centre/learning-skills.html

8. College Supports, Services and Policies

Immediate, Urgent, or Emergency Support
If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @ http://camosun.ca/about/mental-health/emergency.html or http://camosun.ca/services/sexual-violence/get-support.html#urgent

College Services
Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at http://camosun.ca/

College Policies
Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at http://camosun.ca/about/policies/. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. GRADING SYSTEMS *http://camosun.ca/about/policies/index.html*

The following two grading systems are used at Camosun College:

1. 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		1
0-49	F	Minimum level has not been achieved.	0

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

B. 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 at http://camosun.ca/about/policies/index.html 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 are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
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.