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

***CHEM-150-X01AB***
***Engineering Chemistry***
***F 2020***

# COURSE OUTLINE

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**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.*

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## 1. Instructor Information

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|---|---|---|---|
| **(a) Instructor** | Daniel Dönnecke | | |
| **(b) Office hours** | **Friday 13:00-13:50** | | |
| **(c) Location** | Tec 232 (online) | | |
| **(d) Phone** | 250 370 4447 | **Alternative:** | |
| **(e) E-mail** | donnecked@camosun.bc.ca (please use this email address only, not the d2l email) | | |
| **(f) Website** | | | |

## 2. Intended Learning Outcomes

*(If any changes are made to this part, then the Approved Course Description must also be changed and sent through the approval process.)*

Upon completion of this course the student will be able to:

1. Calculate outcomes of chemical reactions based on stoichiometric quantities in general and in aqueous solutions in particular.
2. Describe the electronic configuration of atoms and explain why some atoms have unusual configurations.
3. Determine the shape and symmetry of molecules based on atomic, molecular, and hybrid orbitals.
4. Explain the impacts of bond polarity on molecular interactions on the physical states (phases) of molecules.
5. Determine the properties of polymers, ceramics and other engineering materials based on bonding and molecular interactions.
6. Calculate the properties of ideal gases. Describe the differences between ideal and non-ideal gases.
7. Calculate physical properties of solutions.
8. Determine rate constants, order of reaction and activation energy for simple chemical reactions.
9. Determine concentrations of participating molecules in chemical equilibria, in particular, aqueous equilibria. Determine the pH of dilute aqueous solutions of acids and bases.
10. Explain the importance of total energy, enthalpy, entropy and free energy in chemical processes.
11. Balance redox reactions. Determine the voltages of simple electrochemical cells. Describe the role of electrochemistry in corrosion and corrosion control.
12. Use orbital theory to describe the properties of metals and semiconductors.

## 3. Required Materials

**(a) Text:** No text is required, but it is strongly recommended that you have a first-year university chemistry text, either used or from the library. The following are suitable chemistry books (older editions available on Amazon fairly cheaply are fine too).
General Chemistry, *Petrucci* (excellent book), Chemistry the Central Science, *Brown Le May* (good book but not strong on quantum mechanics).

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(b) **Online access**: During these unprecedented times of a global pandemic the course is delivered online. You need access to the internet to attend classes via *Blackboard Collaborate Ultra* and to access course materials like handouts, lecture slides and assignments via *d2l*. A link to these sessions will be provided by your instructor. You need speakers or headphones (or headset) to get audio and you will need a microphone to be able to participate in discussions. Most laptops and phones have these built in. It will be advantageous to have access to a printer and a scanner/camera so you can print out an assignment, write down the answers and scan/photograph your work and e-mail it back to your instructor. Respect the privacy of your fellow students and your instructor. Do not share the link to the lectures/labs, recordings or screenshots with people outside your class. You need permission to do that.

(c) **Other:** The lab Manual will be available online (D2L). **We will meet online via collaborate during our scheduled lab time and do each lab online**. Come prepared to these sessions. Having read and understood the lab manual will enable you to ask relevant questions and focus on key points of the experiments.

## 4. Course Content and Schedule

(Can include: Class hours, Lab hours, Out of Class Requirements and/or Dates for quizzes, exams, lecture, labs, seminars, practicums, etc.)

**We will meet online via collaborate during our scheduled lecture and lab time.**

| | |
|---|---|
| Lecture: | Section X01A and X01B |
| | Mo 14:00-14:50 online, Th 14:00-15:20 online, Fr 14:00-15:20 online |
| | Section X02A and X02B |
| | Mo 16:00-17:20 online, Th 12:30-13:20 online, Fr 8:30-9:50 online |
| Laboratory: | Sections X01A Mo 8:30 - 10:50 online |
| | Sections X01B Th 8:30 - 10:50 online |
| | Sections X02A Tu 8:30 - 10:50 online |
| | Sections X02B Tu 13:00 - 15:20 online |

**Detailed outline**

| Week | Activity |
|---|---|
| 1 | *Lab 0* Safety in the Chemistry Lab |
| 2 | *Lab 1* Densities |
| 3 | *Lab 2* Stoichiometry<br>**Review test** (50 min, during lecture time) |
| 4 | *Lab 3* Spectroscopic Determination of Nickel |
| 5 | *Lab 6* Copper; corrosion and recycling of copper |
| 6 | **12 October, Thanksgiving Day, College closed**<br>**Term Test 1** (50 min, during lecture time) |
| 7 | *Lab 4* Shape of Molecules and Polarity |
| 8 | *Lab 5* Distillation |
| 9 | **Midterm week, no labs during Midterm week** |
| 10 | *Lab 7* Thermochemistry |
| 11 | *Lab 8* Bromination of Acetone |
| 12 | *Lab 9* Determination of Chloride<br>**Term Test 2** (50 min, during lecture time) |
| 13 | *Lab 10* Atomic Absorption Spectroscopy |
| 14 | *Lab 11* Review and Demos during lab period |

**Detailed Lecture Outline (approximate):**

**Week 1-2** Review: Foundations of chemistry including Matter, Daltons atomic theory, fundamental particles, isotopes, atomic weights, ionic bonding, ionization energy, Electron Affinity, Metals, Non-metals, Octet rule, covalent bonding, Lewis structures of simple molecules and ions. Nomenclature of ionic and molecular compounds including acids. Stoichiometry and solution stoichiometry.
**Week 2-3**: The shape of molecules, Lewis structures of molecules and ions part (II), Resonance Hybrids, formal charges, Valence Shell Electron Pair Repulsion Theory, exception to the octet rule, Odd electron species, electron deficient compounds, expanded valence shell, coordinate covalent bond.
**Week 4-5**: Electronegativity, polar covalent bonds, polarity and shape of molecules, resultant Dipole moment, Intermolecular forces, dipole-dipole, London dispersion forces, induced dipole-induced dipole, polarizability and shape of molecules, hydrogen bonding, boiling point, melting point, surface tension, viscosity, vapour pressure, phase diagram,
**Week 6-7**: Colligative Properties (Raoult's Law, Osmosis and Osmotic pressure) Gases: Units of pressure, Boyle's law, Charles's law, Avogadro's law, ideal gas law, Daltons law of partial pressure, gas stoichiometry, Kinetic molecular gas theory, effusion, diffusion, real gasses, Van der Waals equation, Joule-Thomson effect.
**Week 7-8**: Thermochemistry, work and heat, systems and surroundings, first law of thermodynamics, Internal energy, state functions, enthalpy of reaction, $2^{nd}$ law of thermodynamics, heat capacities, Hess's law, enthalpies of formation, entropy, spontaneous processes, irreversible processes, third law of thermodynamics. Gibbs free energy.
**Week 8-9**: Electrolytes, Dissociation and Ionization, pH of strong and weak acids and bases, pH of salt solutions, buffers, molecular structure and acid-base behaviour.
**Week 10**: Electrochemistry: Voltaic cells, electromotive force, standard cell potential, standard hydrogen electrode, electrochemical series, Nernst equation, concentration cell, pH-meter, lead acid battery, dry cell, fuel cell, corrosion, anodizing, electroplating, sacrificial anode.
**Week 11**: Introductory Quantum Mechanics: electromagnetic radiation, photoelectric effect, Planks equation, Dual nature of light, De Broglie relationship, Heisenberg's uncertainty principle, Wave mechanics, wave functions and standing waves, Schrodinger equation, Particle in a box, quantization of energy, probability and electron charge density, wave functions for the hydrogen atom, atomic orbitals, quantum numbers, multi electron atoms, electron configuration and the periodic table, Pauli exclusion principle, Hund's rule, para and diamagnetism.
**Week 12-13**: Advanced bonding models: Valence-bond method: $sp^3$, $sp^2$ and sp hybrid orbitals. Strengths and limits of VB method. MO theory: constructive and destructive interference of wave functions, Bonding and anti-bonding molecular orbitals, MO-diagrams' for homonuclear diatomic species of the first and second period up to Z =10, Paramagnetism of dioxygen. Band theory, conductors, insulators and semiconductors, band gap of group 14 elements, doping, LED and photo voltaic cells, thermal properties of semiconductors.
**Week 14**: Important polymers, composite material

## 5. Basis of Student Assessment (Weighting)

*(Should be directly linked to learning outcomes.)*

**Evaluation** **Grading as in Camosun College Calendar**

| | | | |
|---|---|---|---|
| **Review test** | **7 %** | **Term Tests (two)** | **10 % each** |
| **Midterm** | **18 %** | **Lab** | **20 %** |
| **Final** | **35 %** | | |

Problem sets which will prepare you for exams will be provided on D2L (approximately biweekly). These problem sets are not graded but answer keys will be posted on D2L. A 50 min review test covering basic topics of chemistry such as atomic structure, chemical nomenclature and stoichiometry (which will be reviewed during the first week) will be written during lecture time of week three. Two 50 min Term Tests, worth 10 % each, will be written during lecture time of week 6 and week 12. Topics for both tests will be

announced in class. A midterm, written during week 9, will cover material from week 1 to week 8 of the course. A 3-hour final examination will cover material from week 1 to week 14.
Attendance (online presence) during lab periods is mandatory. If you miss more than two labs unexcused you have failed the lab. You must pass both the lab and the lecture component separately to pass the course. You must also pass the final exam to pass the course. A lab that is missed, an exam that is not written or a lab report that is not handed in, within the beginning of the following lab period, counts as zero towards your course grade. Exceptions can be made if a valid excuse is produced in writing to the instructor (such as a note from a medical doctor) as soon as possible. It is important to let me know what is happening. **Send me an e-mail if you cannot attend a lab or write an exam**.

## 6. Grading System

*(If any changes are made to this part, then the Approved Course description must also be changed and sent through the approval process.)*
*(Mark with "X" in box below to show appropriate approved grading system – see last page of this template.)*

[x] Standard Grading System (GPA)

[ ] Competency Based Grading System

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

## 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. |