

# COURSE SYLLABUS



COURSE TITLE: CHEM-150: Engineering Chemistry

CLASS SECTION: X01A, X01B, X02A

TERM: W 2022

COURSE CREDITS: 4

DELIVERY METHOD(S): face to face, lecture and lab

Camosun College campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.

Learn more about Camosun's [Territorial Acknowledgement](#).

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For COVID-19 information please visit <https://legacy.camosun.ca/covid19/index.html>

*Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable explanation in advance, you will be removed from the course and the space offered to the next waitlisted student.*

## INSTRUCTOR DETAILS

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NAME: Daniel Dönnecke

EMAIL: [donnecked@camosun.bc.ca](mailto:donnecked@camosun.bc.ca)

OFFICE: Interurban Campus, Tec 232

HOURS: Tuesday 11:30-12:20

*As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.*

## CALENDAR DESCRIPTION

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Restricted to students in Engineering Bridge and Engineering Transfer Topics include thermochemistry, atomic and molecular structure, chemical bonding, gases, liquids and solids, solutions and phase equilibria, equilibrium, chemical thermodynamics and electrochemistry.

**PREREQUISITE(S):** Although Camosun has no high school chemistry prerequisite for CHEM 150, UVIC and UBC do. It is strongly recommended that students have Chem 11 or equivalent. We will be reviewing basic concepts in the first week or two but quickly move ahead, covering first year university material in depth. There is a CHEM 150 Review Package in the Bookstore that you can purchase. It is Camosun's in-house Chem 11 course material which students with only Science 10 background might find helpful for the review session.

**CO-REQUISITE(S):**

**EXCLUSION(S):**

## COURSE LEARNING OUTCOMES / OBJECTIVES

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Upon completion of this course students 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.

## REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

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(a) Texts: 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 are fine too).

General Chemistry, *Petrucci* (excellent book), Chemistry the Central Science, *Brown Le May* (good book but a bit weak on quantum mechanics)

(b) Other: The Lab Manual will be available online (D2L). Print it and bring it to each lab. It contains procedures for the experiments you are conducting. Come prepared. Having read and understood the procedures for the upcoming lab will greatly enhance your lab experience. The importance of the lab component cannot be overstated. I try to correlate the lab with the lecture as much as possible. You also need to bring a pair of safety glasses. You will not be allowed in the lab without safety glasses. A lab coat is recommended.

COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

The following schedule and course components are subject to change with reasonable advance notice, as deemed appropriate by the instructor.

WEEK or DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
1	<i>Lab 0</i> Safety in the Chemistry Lab	
2	<i>Lab 1</i> Densities	
3	<i>Lab 2</i> Stoichiometry Jan 27 <sup>th</sup> <b>Review test</b> (50 min, during lecture time)	
4	<i>Lab 3</i> Spectroscopic Determination of Nickel	
5	<i>Lab 6</i> Copper; corrosion and recycling of copper	
6	<i>Lab 4</i> Shape of molecules and polarity Feb 17 <sup>th</sup> <b>Term Test 1</b> (50 min, during lecture time)	
7	<b>21 February, Family Day, College closed</b> <b>Reading Break: Feb 22-25</b> <b>25 February, Conversations Day, College closed</b>	
8	<i>Lab 5</i> Distillation	
9	<i>Lab 7</i> Thermochemistry	
10	<i>Midterm week, no labs during Midterm week.</i> Mar 17 <sup>th</sup> <b>Midterm</b> (90 min during lab period)	
11	<i>Lab 8</i> Bromination of Acetone	
12	<i>Lab 9</i> Determination of Chloride	
13	<i>Lab 10</i> Atomic Absorption Spectroscopy Apr 7 <sup>th</sup> <b>Term Test 2</b> (50 min, during lecture time)	
14	<i>Lab 11</i> Review and Demos during lab period <b>15 April, Good Friday, College closed</b>	
15	<b>18 April, Easter Monday, College closed</b> 19 April, Final Exam Period starts	

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced notice is required. Deadlines can be reviewed on the [CAL exams page](http://camosun.ca/services/accessible-learning/exams.html). <http://camosun.ca/services/accessible-learning/exams.html>

**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<sup>nd</sup> law of thermodynamics, heat capacities, Hess 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 12-14:** 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.

Lectures: Section X01A and X01B  
 Mo and Tu 10:30-11:20 in Tech 173, Th 15:30-16:20 in Tec 173, Fr 13:30-14:20 in Tec 173  
 Section X02A  
 Mo 14:00-14:50 **in Tech 110**, Tu 8:30-9:20 and 12:30-13:20 in Tec 173 and Th 16:30-17:20 in Tec 173

Laboratory: Sections X01A Th 8:30 - 10:50 Tech 230  
 Sections X02A Th 13:00 - 15:20 Tech 230  
 Sections X01B Fr 15:00 - 17:20 Tech 230

## EVALUATION OF LEARNING

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DESCRIPTION	WEIGHTING
Lab	20 %
Review Test	7 %
Term Test 1	10 %
Midterm	18 %
Term Test 2	10 %
Final Exam	35 %
	<b>TOTAL</b>
	100%

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the [Grade Review and Appeals](http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf) policy for more information.

<http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf>

## COURSE GUIDELINES & EXPECTATIONS

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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 13. Topics for both tests will be announced in class. A midterm, written during week 10, will cover material from week 1 to week 9 of the course. A 3- hour final examination will cover material from week 1 to week 14.

Attendance in the lab 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 an exam.**

## SCHOOL OR DEPARTMENTAL INFORMATION

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Chair of the Chemistry Department is John Lee

## STUDENT RESPONSIBILITY

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Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

## SUPPORTS AND SERVICES FOR STUDENTS

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Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit <http://camosun.ca/students/>.

Academic Advising	<a href="http://camosun.ca/advising">http://camosun.ca/advising</a>
Accessible Learning	<a href="http://camosun.ca/accessible-learning">http://camosun.ca/accessible-learning</a>
Counselling	<a href="http://camosun.ca/counselling">http://camosun.ca/counselling</a>
Career Services	<a href="http://camosun.ca/coop">http://camosun.ca/coop</a>
Financial Aid and Awards	<a href="http://camosun.ca/financialaid">http://camosun.ca/financialaid</a>
Help Centres (Math/English/Science)	<a href="http://camosun.ca/help-centres">http://camosun.ca/help-centres</a>
Indigenous Student Support	<a href="http://camosun.ca/indigenous">http://camosun.ca/indigenous</a>
International Student Support	<a href="http://camosun.ca/international/">http://camosun.ca/international/</a>
Learning Skills	<a href="http://camosun.ca/learningskills">http://camosun.ca/learningskills</a>
Library	<a href="http://camosun.ca/services/library/">http://camosun.ca/services/library/</a>
Office of Student Support	<a href="http://camosun.ca/oss">http://camosun.ca/oss</a>
Ombudsperson	<a href="http://camosun.ca/ombuds">http://camosun.ca/ombuds</a>
Registration	<a href="http://camosun.ca/registration">http://camosun.ca/registration</a>
Technology Support	<a href="http://camosun.ca/its">http://camosun.ca/its</a>
Writing Centre	<a href="http://camosun.ca/writing-centre">http://camosun.ca/writing-centre</a>

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

## COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

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### Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the [Centre for Accessible Learning](#) (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started:

<http://camosun.ca/services/accessible-learning/>

### Academic Integrity

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf> for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

### Academic Progress

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf> for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

### Course Withdrawals Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf> for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit <http://camosun.ca/learn/fees/#deadlines>.

### Grading Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for further details about grading.

### Grade Review and Appeals

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf> for policy relating to requests for review and appeal of grades.

### Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures"

(<http://camosun.ca/learn/calendar/current/procedures.html>) and the Grading Policy at <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf>.

### Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf> to learn more about the process involved in a medical/compassionate withdrawal.

### Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf> and [camosun.ca/sexual-violence](http://camosun.ca/sexual-violence). To contact the Office of Student Support: [oss@camosun.ca](mailto:oss@camosun.ca) or by phone: 250-370-3046 or 250-3703841

### Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf> to understand the College's expectations of academic integrity and student behavioural conduct.

**Changes to this syllabus:** Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.