



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

CHEM-213-D01
Molecular Spectroscopy
Winter 2021

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	Dr. Steve McKinnon
(b) Office hours	Online: Monday and Thursday 12:30-2:20 or by appointment
(c) Location	Fisher 348A
(d) Phone	250-370-3472
(e) E-mail	mckinnons@camosun.bc.ca
(f) Website	D2L

2. Intended Learning Outcomes

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

1. Describe and explain the production of the various types of electromagnetic radiation and derive and use the laws of absorption spectroscopy.
2. Associate a nuclear, atomic or molecular process with the absorption of radiation of a particular frequency.
3. Describe the Boltzmann distribution of energy and explain its importance in spectroscopic experiments.
4. Explain the results of the photoelectronic experiments and interpret the spectrum in terms of bonding and non-bonding molecular orbitals.
5. Describe and explain the processes of absorption and emission in organic and inorganic compounds and comment on the link between the features of a spectrum and the presence of particular structural features in the compound.
6. Describe and explain the behaviour of diatomic molecules in terms of the simple harmonic oscillator model and derive the number of modes of vibration for linear and non-linear polyatomic molecules.
7. Comment on the features of an IR spectrum in terms of the presence or absence of a particular functional group and analyze the pure rotational spectra to determine the bond length of the molecules using the rigid rotor model.
8. Describe the different ways in which the molecular mass is determined and calculate isotope splitting patterns based on the known isotopic ratios in nature.
9. Describe the absorption of radiation by the hydrogen-1, carbon-13, fluorine-19, and phosphorous-31 nuclei and deduce the chemical structures of compounds containing these nuclei using tables of chemical shifts, known reference materials and coupled and decoupled spectra.

3. Required Materials

"Chemistry 213 Laboratory Manual and Study Guide" by C.G.C. Shorthill and N. Khalifa
This is provided online (D2L). For a physical copy, contact the Camosun Bookstore.

Recommended:

"Organic Structures from Spectra", by Field, Sternhell, and Kalman

"Introduction to Spectroscopy", by Pavia, Lampman, Kriz, and Vyvyan

4. Course Content and Schedule

Topics and approximate number of lecture hours

Introduction to Spectroscopy	(3)	¹ HNMR Spectroscopy	(8)
Electronic Spectroscopy	(4)	¹³ CNMR Spectroscopy	(4)
IR and Structure	(6)	Heteronuclear NMR	(3)
Vibrational and Rotational Theory	(5)	2D NMR Spectroscopy	(3)
Nuclear Magnetic Resonance	(3)	Mass Spectrometry	(3)

Important Dates

Feb 15: Family Day

Feb 16-19: Reading Break

Feb 24 (Wed): **Test I**

Mar 31 (Wed): **Test II**

Apr 2 (Fri): Good Friday

Apr 5 (Mon): Easter Monday

Final Exam Period: April 19 - 27

See Camosun website for information on fee and drop deadlines.

<http://camosun.ca/learn/fees/#deadlines>

5. Basis of Student Assessment (Weighting)

(a) Midterm 1	(L.O. 1-7)	20%
(b) Midterm 2	(L.O. 5,7,9)	20%
(c) Final Exam	(Cumulative)	35%
(d) Laboratory/tutorial		25%

Notes

1. Student assessment is as listed above, no exceptions.
2. Students must write each test as scheduled. No one is allowed to write late and there will be no exceptions. Early exam is a privilege and not a right, at full discretion of the instructor.
3. Attendance to laboratory/tutorials is mandatory.
4. Students must complete a minimum of 70% of the laboratory/tutorial work to pass the laboratory component of Chem 213. **Students must pass the laboratory/tutorial portion (>50%) of the course in order to obtain credit for Chem 213.**

6. Grading System

- 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, Student Ancillary Fees, Academic Integrity, Grade Review & Appeals, Student Misconduct and Academic Accommodations for Students with Disabilities 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	<i>Incomplete</i> : 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	<i>In progress</i> : 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	<i>Compulsory Withdrawal</i> : 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.

**CHEM 213 LABORATORY SCHEDULE:
(Preliminary only – Dates and Marks Subject to Change)**

Week/date	Experiment	Marks
I Jan 13	Lab Orientation	
II Jan 20	Exp. 1 General spectroscopy	35
III Jan 27	Exp. 2 Absorption Spectra of an Acid-Base Indicator	15
IV Feb 3	Exp. 4 Infrared spectroscopy part 1 Interpretation of IR spectra of organic compounds	20
V Feb 10	Exp. 5 Infrared spectroscopy part 2 Gas phase IR spectra of diatomic molecules	30
VI Feb 17	Reading Break	
VII Feb 24	Midterm Test 1	
VIII Mar 3	Exp. 6a ^1H NMR spectroscopy Part 1	42
IX Mar 10	Exp. 6b ^1H NMR spectroscopy Part 2	46
X Mar 17	Exp. 7a ^{13}C NMR spectroscopy	28
XI Mar 24	Exp. 7b Organic Multinuclear NMR	50
XII Mar 31	Midterm Test 2	
XIII Apr 7	Exp. 8 Inorganic Multinuclear NMR and Mass Spec.	32
XIV Apr 14	Lab Wrap-up and Review	
		298 total