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| CAMOSUN COLLEGE | School of Arts & Science<br>CHEMISTRY AND GEOSCIENCE DEPARTMENT<br>CHEM 213<br>Molecular Spectroscopy<br>W2017 |

# COURSE OUTLINE

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

⌖ *Please note: the College electronically stores this outline for five (5) years only.*
*It is **strongly recommended** you keep a copy of this outline with your academic records.*
*You will need this outline for any future application/s for transfer credit/s to other colleges/universities.*

## 1. Instructor Information

| | | | | |
|---|---|---|---|---|
| (a) | Instructor: | Steve McKinnon | | |
| (b) | Office Hours: | Posted on office door | | |
| (c) | Location: | F348A | | |
| (d) | Phone: | 250-370-3472 | Alternative Phone: | |
| (e) | Email: | 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

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 (5) | $^{13}$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) |

## 5. Basis of Student Assessment (Weighting)

(a) Midterm 1 (L.O. 1-7) 15%

(b) Midterm 2 (L.O. 5,7,9) 20%

(c) Final Exam (Cumulative) 40%

(d) Laboratory/tutorial 25%

Note: Students must pass the laboratory/tutorial to pass the course (>50%).

## 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. Important Dates

Feb. 13-17: Reading break
Feb. 22 (Wed): **Test I 9:30-11:20am in Lab**
Mar. 13 (Mon): Last day to Withdraw from course or Change to Audit
Mar. 29 (Wed): **Test II 9:30-11:20am in Lab**
Apr. 14 (Fri): Good Friday
Apr. 17 (Mon): Easter Monday

**Final Exam Period:** April 18-22 and 24-26

## 8. 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 the College web site in the Policy Section.

**CHEM 213 LABORATORY SCHEDULE:**
**(Subject to Change)**

| Week/date | | | Experiment |
|---|---|---|---|
| I | Jan 11 | Exp. 1 | General spectroscopy |
| II | Jan 18 | Exp. 2 | Absorption Spectra of an Acid-Base Indicator |
| III | Jan 25 | Exp. 3 | Sampling techniques in IR spectroscopy |
| IV | Feb 1 | Exp. 4 | Infrared spectroscopy part 1<br>Interpretation of IR spectra of organic compounds |
| V | Feb 8 | Exp. 5 | Infrared spectroscopy part 2<br>Gas phase IR spectra of diatomic molecules |
| VI | Feb 15 | Reading Break | |
| VII | Feb 22 | Midterm Test 1 | |
| VIII | Mar 1 | Exp. 6a | $^{1}$H NMR spectroscopy Part 1 |
| IX | Mar 8 | Exp. 6b | $^{1}$H NMR spectroscopy Part 2 |
| X | Mar 15 | Exp. 7a | $^{13}$C NMR spectroscopy Part 1 |
| XI | Mar 22 | Exp. 7b | $^{13}$C NMR spectroscopy Part 2 |
| XII | Mar 29 | Midterm Test 2 | |
| XIII | Apr 5 | Exp. 8 | Multinuclear NMR |
| XIV | Apr 12 | Exp. 9 | Structural determination<br>The use of UV / IR / NMR and MS spectra |