

BIO 421 Independent Studies in Biology I**3-1-3**

This course is intended for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology course that would otherwise not be available during their final semester of course work. This course can only be done in close collaboration with a faculty advisor from within the Department of Biological Sciences, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.

Pre-requisite: Permission of the committee

Students with credit for BIO 371 cannot also receive credit for BIO 421.

Coordinator: Professor Chamoux

BIO 422 Independent Studies in Biology II**3-1-3**

This course represents an additional semester of independent work, either a continuation of or a separate course from BIO 421, meant for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology course that would otherwise not be available during their final semester of course work. This course can only be done in close collaboration with a faculty advisor from within the Department of Biological Sciences, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.

Pre-requisite: Permission of the committee

Students with credit for BIO 372 cannot also receive credit for BIO 422.

Coordinator: Professor Chamoux

BIO 428 Advanced Physiology**3-3-0**

This course will examine how animals adapt to environmental stresses such as extremes of temperature of altitude, hypoxia, water limitation and dietary changes. Short-term (acute), medium-term (acclimatory) and chronic (evolutionary) adaptations will be discussed.

Pre-requisite: BIO 336; Pre-or Co-requisite: BIO 337

Offered in even-numbered winters

Students with credit for BIO 328 cannot also receive credit for BIO 428.

BIO 433 Advanced Exercise Science**3-3-0**

This course examines selected topics in Exercise Physiology. Through traditional lectures, directed readings, seminars, and case studies, students will study short-term and long-term adaptations to exercise. We will also examine the scientific principles underlying sports-related topics such as optimizing exercise performance, injuries, and injury repair.

Prerequisite: BIO 336 or EXS 327

Students with credit for BIO 333 cannot also receive credit for BIO 433.

Note: See Exercise Science 433. Students may not take this course for credit if they have received credit for EXS 433.

BIO 492 Honours Research Project I**3-1-6**

An introduction to the planning, execution and reporting of biological research offered to students matching eligibility criteria. Each student is required to choose a research problem and, in consultation with a departmentally approved supervisor, draw up a formal research proposal of work to be undertaken. The final mark in this course will be based on the research proposal, preliminary research completed on the stated project, and presentation of a poster during the final week of classes. Satisfactory completion of BIO 492 with a minimum mark of 75%, with a minimal score of 70% in each graded component, is required for enrolment in BIO 493.

Prerequisite: Permission of committee

Co-requisite or prerequisite: BIO 386

Students with credit for BIO 421 cannot also receive credit for BIO 492.

BIO 493 Honours Research Project II**3-1-6**

A continuation of BIO 492 offered to students matching eligibility criteria. The student will complete all research as outlined in the research proposal. The final mark in this course will be based on the quality and amount of research completed, presentation of a departmental seminar during the final week of classes, open to the public, based on research findings, and submission of a final written honours thesis. Enrolment in BIO 493 is conditional upon completing BIO 493 with a minimum mark of 75%. Satisfactory component, is required to complete the Honours program.

Prerequisite: Permission of committee

Students with credit for BIO 422 cannot also receive credit for BIO 493.

Chemistry

Faculty

Mihai Scarlete,

Ph.D. (McGill), Ph.D. (Politehina Inst., Bucharest); Professor

Dale Wood,

B.Sc., Ph.D. (UNB); Associate Professor

Program Overview

The Chemistry Department offers three distinct programs — Chemistry Honours, Chemistry Major, and Chemistry Minor. All of our programs provide students with a balanced, rich, and practical education in all sub-disciplines of Chemistry (Analytical, Biochemical, Inorganic, Organic, and Physical) and students graduating with a Chemistry degree from Bishop's University have had an excellent record of being admitted to graduate schools and professional programs (Medicine, Dentistry, Pharmacy, Education, etc.) or in finding employment in their field.

Class sizes in chemistry courses are small, which promotes close personal interaction between members of the faculty and students. The faculty are also directly involved in all undergraduate laboratories, which enhances personal contact and results in a friendly and very productive learning in experimental chemistry.

The Chemistry Department has an excellent set of modern instruments, such as a 400 MHz NMR and a GC/MS, which are used by undergraduates in their laboratory courses and in research projects. This is in contrast to most universities where many instruments are reserved for graduate students. Hands-on, extensive training on this modern instrumentation and equipment greatly benefits our students and ensures that they are very well prepared for graduate studies or future employment.

Undergraduate Programs

It is strongly recommended that students enrolled in Department of Chemistry programs follow the order of courses outlined in the tables below. Some Chemistry courses are offered on two-year rotations, so failure to follow the suggested course sequence may result in students not being able to fulfill their degree requirements in the normal time frame.

Table 1. First year of study in the 4-year Chemistry Honours and Major programs

Fall Semester

CHM191 and CHL191
BIO196 and BIL196
PHY191 and PHL191
MAT191
ELA116

Winter Semester

CHM192 and CHL192
PHY192 and PHL192
MAT192
Humanities Option
Humanities Option

Chemistry Honours (84 credits) HONCHE

The Chemistry Honours program fulfills the academic requirements for membership in the Chemical Institute of Canada and for accreditation by l'Ordre des chimistes du Québec. (For membership in the latter, it is necessary to possess a working knowledge of the French language.) The Chemistry Honours program is a four-year program that prepares a student for graduate studies in chemistry, as well as for direct professional employment. The program requires 37 three-credit one-semester courses, one 3-credit full year course, and a full year, 6-credit research project in the final year for a total of 120 course credits. In addition, students must also complete the 15 co-requisite lab courses. The Chemistry Honours degree program is shown in Table 1.

Entrance Requirements for Honours

To be eligible to enter the third year of the Honours Chemistry program, a student must achieve a minimum average of 70% in the required second year Chemistry courses (CHM 111, CHM 211, CHM 121, CHM 131, CHM 141, CHM 341 and all co-requisite labs). To be eligible to enter the final year of the Honours Chemistry program, a student must achieve a minimum average of 70% in the third year required Chemistry courses (CHM 311, CHM 225 or CHM 245, CHM 231 or CHM 331 and all co-requisite labs).

Table 2. Honours Chemistry Program¹

	Fall Semester	Winter Semester
Year 2	CHM 111 and CHL 111 CHM 121 CHM 141 and CHL 141 BIO 201 PHY 206 and PHL 206 ²	CHM 211 and CHL 211 CHM 131 CHM 341 and CHL 341 BCH 210 Option ³
Year 3	CHM 311 CHM 231 and CHL 231 ⁴ Science option ⁵ Option ³ Option ³	Chem. Option ⁶ CHM 225 and CHL 225 ⁷ BCH 313 and BCL 313 Option ³ Option ³
Year 4	CHM 331 / CHL 331 ⁴ CHM 471 ⁸ CHM 499 ⁹ BIO 386 ¹⁰ Option ³	CHM 245 and CHL 245 ⁷ CHM 471 ⁸ CHM 499 ⁹ Option ³ Option ³

¹ All Chemistry students must take any two Humanities lecture courses in the first year. Students with a D.E.C. may be credited with these options.

² PHY 206 will be required for non-Cégep students. Cégep students already completed this course. They will replace it by a free science elective.

³ Chemistry Honours students must take one lecture course from the Humanities or the Social Sciences, one science option and one lecture course from any of the Sciences. All other options are free electives. If a course has a co-requisite lab then the lab must be taken as well.

⁴ CHM231 / CHM331 and their co-requisite labs are offered on a rotating basis, so the order in which they are taken may flip

depending on the year the student entered the program.

⁵ Students doing honours are encouraged to take a science option based on the field of their specialization:

Physical chemistry: MAT 108 or PHY 206 or MAT 206

Analytical chemistry: MAT 103 or MAT b310

Organic chemistry: BCH 311 or BIO 208

Environment: MAT 103

⁶ Students registered in the honours program will have to complete a CHM 400 level course in the field of their honours research project as an independent study.

⁷ CHM 225 and CHM 245, and their co-requisite labs are offered on a rotating basis, so the order in which they are taken may flip depending on the year the student entered the program.

⁸ CHM 471 is a full-year, 3-credit course.

⁹ CHM 499 is a full-year, 6-credit research project.

¹⁰ Honours students should register in BIO 386 – Scientific writing. Permission from the instructor is required. If denied, this course can be replaced by a free elective.

Chemistry Major (72 credits) MAJCHE

The Chemistry Major program prepares students for industrial or other employment that requires an extensive knowledge of chemistry. The program has sufficient flexibility to allow students to obtain a second major or a minor in another academic discipline. The program fulfills the academic requirements for membership in the Chemical Institute of Canada and for accreditation by l'Ordre des Chimistes du Québec. (For membership in the latter, it is necessary to possess a working knowledge of the French language.) The four-year Chemistry Major program requires 39 three-credit one-semester courses and one 3-credit full year course for a total of 120 course credits. In addition, students must complete the 18 co-requisite lab courses. The Chemistry Major degree program is shown in Table 2. Students in a minor program in another division may, with permission of the Department, reduce science options to a minimum of 9 credits.

Table 3. Chemistry Major Program¹

	Fall Semester	Winter Semester
Year 2	CHM 111 and CHL 111 CHM 121 CHM 141 and CHL 141 BIO 201 PHY 206 and PHL 206 ²	CHM 211 and CHL 211 CHM 341 and CHL 341 BCH 210 CHM 131 Option ³
Year 3	CHM 231 and CHL 231 ⁴ CHM 311 Option ³ Option ³ Option ³	CHM 225 and CHL 225 ⁵ BCH 313 and BCL 313 Option ³ Option ³ Option ³
Year 4	CHM 331 and CHL 331 ⁴ CHM 371 ⁶ Option ³ Option ³ Option ³	CHM 245 and CHL 245 ⁵ CHM 371 ⁶ Option ³ Option ³ Option ³

¹ All Chemistry students must take any two Humanities lecture courses in their first year of study. Students with a D.E.C. may be credited with these options.

² PHY 206 will be required for non-Cégep students. Cégep students already completed this course. They will replace it by a free science elective.

³ Students must take one course from either the Humanities or the Social Sciences and five lecture courses from any of the Sciences. All other options are free electives. If a course has a co-requisite lab then the lab must be taken as well.

⁴ CHM 231 and CHM 331, and their co-requisite labs are offered on a rotating basis, so the order in which they are taken may flip depending on the year the student entered the program.

⁵ CHM 225 and CHM 245, and their co-requisite labs are offered on a rotating basis, so the order in which they are taken may flip depending on the year the student entered the program.

⁶ CHM 371 is a full-year, 3-credit course.

Chemistry Minor (24 credits) MINCHE

A Chemistry Minor will be awarded for the completion of CHM 111, CHM 211, CHM 121, CHM 131, CHM 141, and their co-requisite labs, together with 3 one-semester 3-credit courses (and their co-requisite labs) chosen from CHM 311, CHM 411, CHM 231, CHM 331, CHM 341, BCH 210 or BCH 313. Students taking a Chemistry Minor have a one-lecture course (3 credits) reduction towards the credits necessary for their degree.

Recommended Electives

MAT 108 and MAT 206 are recommended electives for students pursuing a career in Physical Chemistry.

MAT 103 and MAT 310 are recommended electives for students pursuing a career in Analytical Chemistry.

BCH 311 and BIO 208 are recommended electives for students pursuing a career in Organic Chemistry.

MAT 103 is a recommended elective for students pursuing a career in Environmental Chemistry.

Accreditation by l'Ordre des Chimistes du Quebec and the Canadian Institute for Chemistry

The OCQ and CIC are professional orders that oversee and accredit Chemistry, Biochemistry, and related disciplines in Quebec and Canada respectively. In order to meet the accreditation standards of these orders, a student must meet the following criteria.

L'Ordre des Chimistes du Québec

A student must earn a minimum of 55 credits in Chemistry, of which 18 credits must be for laboratory work and 30 credits must be for lecture courses. The OCQ considers 3 credits of course or lab work to be the equivalent of 45 hours of class time and

personal work (3 course credits in Chemistry at Bishop's is 36 hours of class time) and 1 credit of laboratory work to be the equivalent of 45 hours of lab time (1 lab-credit in Chemistry at Bishop's is 40-50 hours and thus is equivalent to 3 credits for the OCQ). The chemistry credits offered at Bishop's are divided in the following manner.

1. 9 course credits and 2 lab credits of physical chemistry.
2. 9 course credits and 3 lab credits of analytical chemistry.
3. 9 course credits and 2 lab credits of organic chemistry.
4. 6 course credits and 1 lab credit of inorganic chemistry.
5. 6 course credits and 1 lab credit of biochemistry.
6. 3 course credits on scientific writing.
7. 3 course credits as advanced option in any field of chemistry.

Canadian Institute for Chemistry

The CIC expects a program to involve a total of about 1000 hours of laboratory and classroom work in chemistry, with the minimum hours of each being about 400. The laboratory hours should be distributed in such a way that every student is exposed to meaningful laboratory experience in at least four (and preferably five) of the five sub-disciplines (analytical chemistry, biochemistry, inorganic, organic and physical chemistry).

The core program beyond the first-year level shall include the equivalent of 12 chemistry courses including at least one in each of the five sub-disciplines of chemistry. In addition, there should be a selection of advanced offerings in the core disciplines and in other subjects such as for instance theoretical chemistry, solid state chemistry, natural products, polymers, advanced instrumentation, research thesis, etc. to bring the total number of hours of instruction to that described above. The program must also include at least 15 course credits in two or more of mathematics (algebra, calculus, statistics), physics, computer science and biology. In the case of pure chemistry programs, at least 6 credits in each of calculus and physics will be required. The inclusion of other cognate subjects as well as some liberal arts requirements is to be encouraged.

List of Chemistry Courses

General Chemistry

CHM 191 General Chemistry I 3-3-0

A course for students lacking Collegial Chemistry NYA or its equivalent. Atoms, molecules, and ions. Chemical formulae and equations. Thermochemistry. Electronic structure of atoms. Periodic Table and properties of elements. Chemical bonds. Physical properties and structure. Chemical kinetics

Co-requisite: CHL 191

CHL 191 Introductory Chemistry Laboratory I 1-0-4

A series of experiments in Introductory Chemistry to complement Chemistry 191 which must be taken concurrently.

Co-requisite: CHM 191

CHM 192 General Chemistry II 3-3-0

A course for students lacking Collegial Chemistry NYB or its equivalent. Solutions. Chemical equilibrium. Acids and Bases. Gases, Solids, and Liquids. Ionic equilibria.

Prerequisites: CHM 191 (or permission of instructor) or Collegial Chemistry

Co-requisite: CHL 192

CHL 192 Introductory Chemistry Laboratory II 1-0-4

A series of experiments in Introductory Chemistry to complement CHM 192 which must be taken concurrently.

Co-requisite: CHM 192