Faculty of Science

I. Summary of Programs

Through its six Departments of Biological Sciences, Chemistry, Computer Science, Geology and Geophysics, Mathematics and Statistics, and Physics and Astronomy, the Faculty of Science offers the programs listed below.

All BSc and BA programs within the Faculty normally require four years to complete, with the exception of the Combined Degree programs and the Co-operative Education/Internship programs that require five years or more.

Students starting their first year of university may enter any Science Major programs designated for first-year students. Students who are undecided about which program to choose should register in the Natural Sciences program in first year. While registered in this program, they should register in the first-year courses that are appropriate to the future program of their choice.

Admission to some programs is based on selection criteria as described in Section V (Program Details).

1. Undergraduate Programs

Details on undergraduate programs are given in Section V (Program Details).

Degree Programs Within the Faculty of Science

- BSc Major Programs
- BSc Honours Programs
- Co-operative/Internship BSc Major Programs
- Co-operative/Internship BSc Honours Programs
- BSc Double Major Programs
- BSc Double Honours Programs
- BSc/BSc Combined Degree Programs within the Faculty of Science
- Second Degree Programs following an appropriate first degree: BSc Major or BSc Honours Programs.

BA degrees may be conferred in programs in the Departments of Computer Science and Mathematics and Statistics if the program is part of a Double Major or Double Honours program with the second program in another Faculty that only awards BA degrees.

Collaborative Degree Programs

Single degree programs administered jointly by the Faculty of Science and the Faculty of Social Sciences:

- BSc Earth Science
- BSc Environmental Science.

Combined Degree Programs with Other Faculties

- BComm and BSc, administered jointly with the Haskayne School of Business.
- BSc and BA, administered jointly with the Faculty of Humanities.
- BA or BSc (General Mathematics in Education) or BSc (Natural Sciences) and BEd (Master of Teaching Program), administered jointly with the Faculty of Education.
- BSc or BA (Science) and BSc or BA (Social Sciences), administered jointly with the Faculty of Social Sciences.

Minor Programs

Science Minors are available in the following subjects:

Actuarial Science, Applied and Environmental Geology, Applied Mathematics, Astrophysics, Biological Sciences, Chemistry, Computer Science, Earth Science, Geology, Geophysics, Physics, Pure Mathematics, Statistics.

Pre-Professional Preparation for Degree Programs at this and Other Institutions

The Faculty of Science admits students only to its degree programs. However, students who wish to transfer to a professional program are advised to choose a Faculty of Science program that best fits their professional aspirations and which at the same time permits them to work toward completing the chosen Science program, i.e., it is important to simultaneously satisfy both

Degrees Offered

	Natural Sciences	Biological Sciences	Chemistry	Computer Science	Geology & Geophysics	Mathematics & Statistics	Physics & Astronomy
UNDERGRADUATE				BA		BA	
				BA Honours		BA Honours	
	BSc	BSc	BSc	BSc	BSc	BSc	BSc
	BSc Honours	BSc Honours	BSc Honours	BSc Honours	BSc Honours	BSc Honours	BSc Honours
						BA co-op	
						BA Honours co-op	
		BSc co-op	BSc co-op	BSc INTE		BSc co-op	
		BSc Honours co-op	BSc Honours co-op	BSc Honours INTE		BSc Honours co-op	
				BComm/BSc*		BComm/BSc*	
	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**
	BSc/BEd***					BSc or BA/BEd***	
GRADUATE		MSc	MSc	MSc	MSc	MSc	MSc
		PhD	PhD	PhD	PhD	PhD	PhD

* Combined Degree with the Haskayne School of Business
** Combined Degree with the Faculty of Humanities or Social Sciences
*** Combined Degree with the Faculty of Education

Faculty of Science program requirements as well as pre-professional requirements.

- Dentistry – the University of Alberta, Edmonton.
- Medicine – various institutions.
- Optometry – the University of Waterloo, Ontario.
- Veterinary Medicine – Western College of Veterinary Medicine, Saskatoon, Saskatchewan.

For more information, see the end of Section V (Program Details).

2. Graduate Programs

All Departments of the Faculty of Science offer graduate programs leading to Masters and Doctoral degrees. These programs are under the jurisdiction of the Faculty of Graduate Studies.

The normal preparation for graduate studies will be an Honours degree in the chosen subject.

Details on graduate programs are given in the calendar of the Faculty of Graduate Studies.

II. Faculty Student Affairs

All programs offered by the Faculty of Science are administered by the Undergraduate Programs Office, in collaboration with the six Departments within the Faculty and the Directors of the Natural Sciences, Earth Science, and Environmental Science programs. Advice on these programs is available in the Undergraduate Programs Office, in the Departments or from the Directors.

General inquiries related to the Faculty Regulations described in Section III below should be directed to the Undergraduate Programs Office. Specific inquiries related to course requirements, as described in Section V below, can be directed to the Undergraduate Programs Office, but often the Student Advisor in the Department concerned may be in a better position to answer these. Information on Departmental Student Advisors is given in Section V.

Undergraduate Programs Office

Location: Social Sciences 209

Phone: (403) 220-5881

E-mail address: upo@ucalgary.ca

Undergraduate Programs Office Web page: http://www.upo.ucalgary.ca

Faculty of Science Web page: http://www.science.ucalgary.ca/

III. Faculty Regulations

Students in the Faculty of Science are governed by the regulations in this section of the Calendar as well as by the general University regulations in the section titled Academic Regulations. For the precise interpretation of any statement or regulation, students should feel free to contact the Associate Dean (Student Affairs) of Science, hereafter referred to as the Associate Dean, in the Undergraduate Programs Office, Room 209 of the Social Sciences Building; Telephone 220-6769. The Associate Dean is responsible for all undergraduate student affairs in the Faculty.

1. Terminology

Please refer to the glossary at the back of this Calendar.

2. Admission

Admission to the Faculty involves at the same time admission to one of its Major or Honours programs.

All programs offered by the Faculty of Science have a fixed number of places for students. For any given program, whenever demand exceeds capacity enrollment will be limited and students will be admitted on the basis of descending ranked academic performance until that capacity is met. Specified selection criteria are described in Section V (Program Details) under the appropriate Department.

Direct entry is possible to most Science Major programs. Entry to a Science Honours program is possible only after successful completion of at least five full-course equivalents. Repeated courses may only be counted once but are used in the calculation of the admission grade point average.

For additional admission requirements, refer to the departmental sections.

Students may transfer from one program to any other for which they are eligible.

Continuing University of Calgary students may request a change of program using the Infonet. Changes in program include transfer to a program in the Faculty of Science, either from another faculty or from within the Faculty of Science, including transfer from a Major to an Honours program, and designation of a Minor. If an application is unsuccessful, a new application must be submitted in the following year.

To be eligible for admission, a student must meet the following requirements.

Major Programs

High school matriculation or equivalent. All applicants must have English 30 and Pure Mathematics 30 or Mathematics 30 and three additional 30-level subjects. Incoming students should complete the appropriate high school 30/31 courses that support their expected first-year course registrations and that are listed in the Admission Requirements in the Academic Regulations section at the front of this Calendar.

Students who have completed some university-level course work should consult Admission Requirements in the Academic Regulations section at the front of this Calendar for details.

Honours Programs

Admission to an Honours Program requires successful completion of at least five FCE. At the time of admission, students must present (i) a GPA of at least 3.30 calculated over the most recent course work to a maximum of 10 FCE, and (ii) a GPA of at least 3.30 calculated for all science courses included in (i) above (University of Calgary courses and/or transferable courses taken at other institutions).

***Note**: For continuation in an Honours program, students are subject to an annual review. Students may apply for Honours after the first, second or third year of their program, but need to plan their program at an early stage in order to be able to meet all Honours Program Requirements. See Subsection 4 (Program Requirements) below.*

***Note**: Students who wish to change from a Major to an Honours program, must meet the deadline for submission of their application.*

3. Enrollment Limitations

Enrollment limitations may be in effect for some courses in the Faculty of Science.

Any of the junior (200-level) courses offered by the Faculty of Science may be so limited. Students should consult the current Master Timetable for information about registration priorities in such courses.

At the senior level (courses numbered 300 or above), many courses in several departments may have limited enrollment, with selection based on academic merit when demand exceeds available space. Selection criteria are described in Section V (Program Details) under the appropriate Department.

4. Program Requirements

The following general requirements apply to all programs in the Faculty of Science. In addition, there are the course requirements for the individual programs. These are listed in Section V (Program Details).

A. Major Degree Programs

A student must present an approved list of courses completed with passing grades. This list will be referred to as the program. The program must satisfy the following conditions.

(a) The program must contain at least 20 FCE with at least 11 FCE numbered 300 or above.

(b) The program must contain at least seven FCE in a Science field. The field chosen for a program will be referred to as the "major field." The Science fields are listed in Section V (Program Details). Only one FCE in the major field may be a "D" or "D+."

(c) The GPA calculated over the program must be at least 2.00, and the GPA for courses in the major field must also be at least 2.00. The program may not contain more than three 3 FCE with a "D" or "D+" grades.

(d) The program must contain at least 10 FCE from outside the major field, of which at least four must be non-science courses from other faculties including at least one from each of the Faculties of Humanities and Social Sciences.

The four FCE from other faculties may **not** be chosen from among the courses listed in Table I. Table I lists science-content courses from other Faculties. The requirement to include four FCE in non-science areas is intended to extend the student's perspective beyond science.

Science 311 may be counted among the four FCE from other faculties.

(e) The program must include certain specified courses. The specified courses required for individual programs are listed in Section V (Program Details).

(f) No more than 10 FCE taken at other institutions and acceptable for transfer credit may be included in the program. At least four FCE in the major field must be taken at the University of Calgary.

(g) Credit will not be granted toward Science degrees for Physical Activity courses (i.e., Dance Education Activity/ Theory, Outdoor Pursuits Activity/ Theory, and Physical Education Activity/ Theory).

***Note**: These requirements may change with every Calendar issue. A given Calendar issue applies to the academic year beginning on July 1 and ending on the following June 30. The time of entry into a program in the Faculty of Science is defined as the first session after admission to the program during which a student successfully completes any courses applicable to the program. A student's program is subject to the course requirements which are in the Calendar current at the time of entry into the program, and a student is allowed five years counted from the time of entry into the program to graduate under these requirements.*

Students who exceed this five-year limit must consult with the Head of the Department concerned who will decide on an acceptable set of course requirements for the proposed date of graduation. The Head of the Department will communicate the decision to the Associate Dean in writing.

***Note**: Course work that either forms part of the requirements from a student's major field as listed in Section V (Program Details) or is in the student's major field and which is more than six years old at the time of graduation may be included in the program only with written permission of the Head (or designate) of the Department concerned.*

***Note**: Courses taken in the Faculty of Medicine may be counted towards a BSc degree in the Faculty of Science if at least 15 FCE have been taken in a Science program, and if the Science course requirements for a Science Major are met by those 15 or more FCE. Honours degrees and degrees with distinction will not be granted in this manner. Not all Major programs can be completed in this way in three years.*

B. Degrees with Distinction

The notation "With Distinction" will be entered in the permanent record and on the graduation parchment of a student successfully completing a Major program with a grade point average of at least 3.60 over the last 15 FCE taken for the degree. In cases in which the "last 15" must include some but not all of a group of courses taken concurrently, the selection will be made in the manner most advantageous to the student.

A student who has taken part of his/her course work at another university or who has transferred into the Faculty at a relatively late stage may be granted a degree "With Distinction" at the discretion of the Faculty.

C. Honours Degree Programs

Degrees with Honours are awarded in two classes: Honours and First Class Honours.

The requirements are the same as for the Major Programs, except for the following additions or changes.

Honours Requirements

- A minimum GPA of 3.30 over the last 15 FCE.
- At the time of each annual review, a GPA of 3.30 or better over
  - (i) all Science courses taken since the previous review,
  - (ii) all courses taken since the previous review.
- The program must contain at least eight FCE in the major field.
- The program must contain at least eight FCE outside the major field.
- Candidates for Honours have five years in which they are registered in courses to complete the required program.
- Candidates for Honours Co-operative Education or Internship programs have six years in which they are registered in courses to complete the required program.

***Note**: A student who fails to maintain the necessary performance standards or who decides not to continue in an Honours program may transfer to a Major program.*

First Class Honours Requirements

In addition to the Honours requirements, successful completion of a Department-approved program equivalent to 20 FCE with a GPA of at least 3.60 over the last 15 FCE. A student who has taken part of his/her course work at another university may be granted a degree with First Class Honours at the discretion of the Faculty.

Table I

The following courses may form part of a student's degree program in Science, but may not be used to satisfy the requirement of four FCE from outside the Faculty.

- Anthropology 307, 351, 353, 435, 451, 457
- Applied Psychology 301, 303
- Archaeology 203, 493
- Chemical Engineering 427, 501, 535, 537, 541
- Civil Engineering 461
- Electrical Engineering 315, 327, 353, 415, 463, 465, 475, 495, 511, 515, 555, 563,565, 575, 579 (if a student takes both Electrical Engineering 463 and 465, he or she may count one of these as from outside Science)
- Engineering 201, 205, 213, 233, 311, 317, 319, 325, 349, 407
- Environmental Design 631, 659
- Environmental Science 401, 501, 502, 504, 505
- Geography 201, 305, 307, 415, 417, 511
- Kinesiology 261, 263, 363, 463
- Management Information Systems 321, 331
- Mechanical Engineering 479, 485, 587
- Medical Science (all courses in this category)
- Political Science 399
- Psychology 312, 407, 409, 476
- Sociology 311, 315

D. Co-operative Education/ Internship Degree Programs

The Faculty of Science has three Co-operative Education programs and one Internship program. All are offered as Major and Honours programs. For general information on Co-operative Education and Internship programs refer to the Co-operative Education/Internship section of this Calendar. For specific program details, see Section V (Program Details) in the Faculty of Science section of the Calendar.

Cooperative Education and Internship programs in the Faculty of Science are five years in length and include four or five four-month terms of supervised work experience in various industrial and government establishments. Apart from this work experience, the

degree requirements are the same as for the regular Major and Honours programs.

Students who wish to enter a Co-operative Education or Internship program are urged to discuss their pre-admission course selection with the Undergraduate Officer of the Department offering the program as early as possible.

The general deadline for admission to a Co-operative Education or Internship program in the Faculty of Science is December 1. However, for some Co-operative Education programs, as for Internship programs, additional admission deadlines may be available. If so, these are listed in the Calendar section of the Department offering the program. Applications for admission to a Co-operative Education or an Internship program must be submitted to the Career Services Office on forms available from that Office.

For continuation in Co-operative Education/ Internship programs, students are required to maintain a minimum GPA of 2.30 (Major) or 3.30 (Honours). Note: Department requirements that exceed the Faculty minimum supersede these Faculty standards. Furthermore, students who receive a grade of "F" in a Co-operative Education/ Internship course will be withdrawn from the Co-operative Education/Internship program and will not receive Co-operative Education/ Internship designation.

E. Double Major and Double Honours Degree Programs

These are single degree programs. A student in a Major program whose program also meets the requirements for a second Major in a different field, in either the Faculty of Science or another faculty, may declare a second Major in this field. The same is true for Honours programs. It is not possible for one of the two programs to be an Honours program and for the other one to be a Major program.

Declaration of the second Major or Honours may be made no later than at the time of the last registration. Special restrictions apply to certain double Major or Honours combinations. Consult the relevant Department in Section V (Programs Details). All such double Major or Honours combinations must be able to be accommodated under the same rubric (either BSc or BA).

F. Combined Degree Programs Within the Faculty of Science

Students may pursue a combined program of at least 25 FCE that leads to two degrees from the Faculty of Science. The two degrees will be awarded simultaneously. Interested students should consult with the Associate Dean.

The two programs may not be from the same Department, except for combinations of Geophysics with one of Geology, Applied and Environmental Geology, or Environmental Science.

G. Second Degree Programs

Major Degree Requirements

Students who have obtained an approved degree (BSc, BEd, etc.) may enroll in a "second" bachelor's degree program. The degree requirements for a second degree are the same as those for a first degree except for the following:

(a) Up to 12 FCE counted towards any previous degrees may be counted towards the second degree, if approved by the Associate Dean.

(b) Courses extra to the first degree(s) completed before enrolling in the second degree program may be counted towards the second degree with the permission of the Associate Dean.

(c) Of all courses additional to those approved under (a), at least five FCE must be University of Calgary courses including four numbered 300 or higher in the Faculty of Science and including at least half of those required in the major field.

(d) The second bachelor's degree may not be in the same field as the first degree(s). Students with a degree in the Natural Sciences should consult the Undergraduate Programs Office to find out whether they would be permitted to enroll in a program that covers the same subject matter as their Concentration One.

Formal application for admission to a second degree program should be made to the Admissions Office. Upon receipt of application, the Faculty will provide a detailed assessment listing previous courses which can be applied to the degree and establishing the remaining requirements in each individual case.

The second degree may be awarded "With Distinction" at the discretion of the Faculty if a GPA of at least 3.60 in all the additional courses required is combined with an appropriately high performance standard in the first degree program.

Note: *Departments are under no obligation to compress their course offerings in such a way as to minimize the time spent on a second degree.*

Honours Degree Requirements

Students who have obtained an approved degree may proceed to a second bachelor's Honours degree, subject to the requirements for Honours degrees specified above, with the following modifications:

(a) The student must obtain approval of the Department concerned.

(b) The GPA over all previous courses applied to the second degree must be at least 3.30. A maximum of 10 FCE from the first degree may be allowed for credit toward the second Bachelor's degree.

(c) The permissible duration of the second-degree program will be determined by the Associate Dean at the start of the program in conformity with the spirit that governs the duration of a first-degree honours program, taking into account what courses remain to be taken in the second degree.

(d) The degree may be awarded as First Class Honours at the discretion of the Faculty if a GPA of at least 3.60 in all the additional courses is combined with an appropriately high performance standard in the first degree program.

H. Collaborative Degree Programs

The two collaborative programs available, in Earth Science and in Environmental Science, are single BSc degree programs administered jointly by the Faculty of Science and the Faculty of Social Sciences.

These multi-disciplinary programs with restricted entry require careful course selection to satisfy the requirements of both Faculties. Students considering one of these programs should contact the appropriate Program Director, as early as possible for advice regarding their program. Program details are listed in the Collaborative Programs section of this Calendar.

I. Combined Degree Programs with Other Faculties

Students may pursue a combined program of at least 25 FCE that leads to two degrees, one from the Faculty of Science and one from another Faculty. The two degrees will be awarded simultaneously.

Students must meet the admission requirements of both Faculties involved, as described in the Faculties' sections of this Calendar.

These programs require careful selection of courses to complete the requirements of both faculties. Interested students are urged to contact the Student Affairs Offices of both faculties for advice in choosing their courses, beginning in first year, and should see the Associate or Assistant Deans of the two Faculties involved.

BComm and BSc (Actuarial Science) Program

For program details, please see the Haskayne School of Business section of this Calendar.

BComm and BSc (Computer Science) Program

For program details, please see the Haskayne School of Business section of this Calendar.

BSc (Science) and BA (Humanities) Program

For program details, please see the Faculty of Humanities section of this Calendar.

BA or BSc (General Mathematics in Education) and BEd (Master of Teaching Program)

For program details, please see the Department of Mathematics and Statistics section in Section V (Program Details).

BSc (Natural Sciences) and BEd (Master of Teaching Program)

For program details, please see the Natural Sciences section in Section V (Program Details).

BSc or BA (Science) and BSc or BA (Social Sciences) Program

Students intending to pursue this program may enter either the Faculty of Science or the Faculty of Social Sciences. At the time of admission to either Faculty, students must apply for the combined degree program and declare two major fields as described in each Faculty's section of this Calendar.

Degree Requirements for the BSc or BA (Science) and BSc or BA (Social Sciences) Program

(i) The Faculty of Social Sciences requires the successful completion of 10 FCE offered by the Faculty of Social Sciences of which at least seven and not more than 10 FCE are in the Major Field. Faculty and Departmental requirements for graduation in a program with a Major Field must be met.

(ii) The Faculty of Science requires successful completion of all courses required for graduation in a program with a Major Field as listed in this Calendar.

(iii) Courses taken to satisfy the major field requirements for one of the two degrees may be counted towards the four FCE from another faculty required for the other degree.

(iv) The number of junior courses taken must not exceed 10 FCE in total. Of these, not more than eight may be included in the Social Sciences degree program and not more than nine in the Science degree program.

(v) At least half of the 25 FCE must be taken at the University of Calgary. Of these a maximum of 10 full-course equivalents may be transferred to any one of the Faculties. Note that half the courses counting towards the Social Sciences Major and at least four FCE in the Major Field in Science must be taken at the University of Calgary.

J. Minor Programs

The course requirements for the Minor Programs are listed in Section V (Program Details) under the appropriate Department. Students are cautioned to check the Calendar descriptions of the courses required for the Minor and to include the necessary prerequisites for these courses in their programs.

For a Minor, passing grades must be obtained in at least five FCE in the minor field of which at least three FCE must be numbered 300 or above. For certain major/minor combinations there will be considerable overlap between fields. The degree of permissible overlap must be discussed with the Associate Dean before proceeding. The GPA over all courses counting towards the Minor must be at least 2.00 and only one FCE "D" grade will be allowed.

5. Course Selection and Registration

A. Accuracy of Registration

Students are responsible for ensuring that their annual course selections are in accord with all Calendar requirements, including the completion of prerequisite courses with a satisfactory grade and registration in corequisite courses as appropriate. If registration in any course(s) is contrary to regulations, the Faculty may cancel such registration anytime after the beginning of the session. Registration at all times must be appropriate to the degree program being followed. Students with wholly inappropriate course selections in their registration may have their registration cancelled by the Associate Dean. Students should seek advice from the Associate Dean, or the staff of the Undergraduate Programs Office, or from the Department concerned.

Students are responsible for ensuring that they meet degree and program requirements. While the Undergraduate Programs Office endeavours to assist all students as they proceed in the various programs, a final and thorough check is not done until application for graduation. Any departure from standard requirements must receive prior authorization in writing from the Associate Dean. It is strongly recommended that students consult with the Associate Dean before submitting their final registration.

First-year students in the Faculty of Science who wish to register in senior courses should be aware that in addition to stated prerequisites, senior courses offered by other faculties often require completion of three full courses at the junior level.

Students must be admitted to a program before they will be allowed to register in more than six FCE from the Department offering that program or in any group of courses required for that program.

First-year students should obtain a copy of the Course Registration and Planning Guide from the Office of the Registrar.

B. Introductory Courses for Science Degree Programs

All programs have introductory course requirements. Since these courses are often the prerequisites for more advanced courses, students are advised to take the introductory courses in the manner depicted in Section V. Program Details "Suggested Program Sequences." By so doing, students make it possible to complete their programs in a timely fashion.

C. Prerequisites

A student may not register in a course unless a grade of at least "C-" has been obtained in each prerequisite course, except with a letter of permission from the Head of Department (or designate). It is the responsibility of students to ensure that they meet all prerequisite requirements. Students who do not meet the exact prerequisites/corequisites and do not have Departmental permission to waive those requirements will have their registrations cancelled automatically by the Faculty after the deadline for student change of registration.

A student who has received credit for a course without having the normal prerequisite course(s) may not subsequently register in the prerequisite course(s) for program credit. Taking or repeating a course that is prerequisite for a higher level course after having completed the higher level course with a grade of "C-" or better will only be allowed with the permission of both the faculty in which the student is registered and the department offering the course.

D. Withdrawal from Courses

Students will not be permitted to withdraw more than once from a particular course.

Students will be required to withdraw from the Faculty of Science if they have accumulated a total of more than five full-course equivalent withdrawals while in attendance at the University of Calgary.

A student who wishes to withdraw from a course must do so before the deadline specified in the Academic Schedule.

E. Repetition of Courses

A student will be permitted to repeat a particular course only once. This regulation applies not only to individual courses, but also to sets of courses where it is stated that credit for more than one of the sets is not allowed. For example, a student may not take Mathematics 353 twice and then attempt Mathematics 331. A withdrawal counts as an attempt. Repetition of courses is limited to those courses that have not already been used to satisfy the prerequisite requirements for another course (see " Prerequisites" above).

F. Course Load

Five courses taken concurrently represent a full load. Students who have completed a full load through the previous Fall and Winter Sessions with a GPA of at least 3.20 may be permitted to register in six courses concurrently at the risk of damage to overall

performance. Undergraduates may register in 600-level courses only with the permission of the Department offering the course.

G. Opportunities to Take Courses at Another Institution for Transfer of Credit

Students may be authorized to take some program course work at another university if registration as a visiting student is acceptable to that university. Students with poor academic performance will not be allowed such privileges.

Applications for such authorization must be made as early as possible in writing to the Associate Dean and must be accompanied by full details of the proposed courses and the total hours of instruction (machine copies of actual calendar descriptions are preferred). The student will be advised officially by letter of the acceptability of the proposed courses for transfer credit in the program and an appropriate letter will be sent to the Registrar of the other university.

It will be the responsibility of the student to ensure that an official transcript of grades is forwarded directly to the Registrar of this University in order that appropriate credit may be officially recorded.

H. Credit in Courses by "Special Assessment"

Students who feel that they know the material covered in a course without having received formal University credit for that course may apply for "special assessment" in such a course. Students should obtain the form headed "Permission to Take Courses by Special Assessment" from the Office of the Registrar and submit their application to the Department offering the course. A course in which the student was previously registered may not be taken subsequently by special assessment, nor may any course be attempted more than once in this way.

The Faculty will not allow more than five full-course equivalents completed by special assessment to count towards a degree.

See also the general University regulations concerning special assessment.

6. Assessment

A. Missed Components of Term Work

Any student who is absent from a test or fails to complete a laboratory assignment or similar work for legitimate reasons must discuss an alternative course of action with the instructor. The regulations covering such circumstances are outlined in the sections titled "Attendance" and "Deferral of Term Work" in the Academic Regulations section of this Calendar. Notification of such eventualities must be given to the instructor within 48 hours.

B. Deferral of Final Examinations

See the general University regulations governing the deferral of final examinations.

In order to apply for a deferral of a final examination in a course taught by the Faculty of Science, students must pick up an application form in the Office of the Registrar or download it from the Registrar's Website at http://www.ucalgary.ca/UofC/departments/REGISTRAR/exam and submit the completed form to the Associate Dean in the Undergraduate Programs Office. Students seeking a deferment of a final examination for medical reasons must submit a University of Calgary Medical Statement form, which they can obtain from the Office of the Registrar or download from the Registrar's Website. A medical certificate stating only that a student was seen by a physician is insufficient. Students are warned that trivial medical excuses are also insufficient and that their record of applications for previous medical deferrals will be checked when deferred privileges are applied for. Late medical documentation or medical documentation that does not coincide precisely with the examination(s) missed will not be accepted.

Misreading the examination timetable is not a valid reason for requesting a deferred final examination.

In the event of foreseeable absence from a final examination, an application for a deferral must be made prior to the examination. In the event of an unforeseen need to be absent from such an examination, the Associate Dean should be notified as soon as possible and application made within 48 hours of the examination. Applications made after the deadlines printed in the Calendar will not be considered.

7. Student Standing

A. Performance Review, Probationary Status and Dismissal

The academic standing of each student registered in the Faculty will be reviewed annually following the Winter Session.

Students who have taken three or more FCE since approval of satisfactory standing at the previous review and have achieved a GPA of at least 2.00 on those courses will retain their satisfactory standing. If this GPA is less than 2.00 but not less than 1.70, the student will be placed on probationary status or may be required to withdraw if his/her overall record is considered unsatisfactory (e.g., if there is a history of marginal performance evidenced by earlier probationary status). If this GPA is less than 1.70, the student will be required to withdraw from the Faculty.

Students who were on probation in the period before the review and have taken three or more full-course equivalents since being placed on probation will have their probation cleared if their GPA over these courses is at least 2.00. Students will be required to withdraw from the Faculty if this GPA is less than 2.00.

Students who have not completed three FCE since the previous review will retain their existing status until the next subsequent review. Students placed on probation or required to withdraw will be so advised in writing.

Students will be permitted a maximum of one probationary period while registered as undergraduate students at the University of Calgary. Students will be required to withdraw rather than be placed on probation for a second time. Students placed on probation as a criterion of admission will not have this period counted in the total permitted. Probationary periods that have occurred in excess of five years previous will not be counted.

Notwithstanding the specific regulations above, students' academic standing may be reviewed at any time and those with generally poor academic records may be placed or continued on academic probation or required to withdraw at the discretion of the Dean or Associate Dean.

B. Readmission

- Students who have been required to withdraw for unsatisfactory academic performance may be considered for readmission after 12 or more months have elapsed since the date of dismissal.
- Applicants must apply by the deadlines stated in the current Calendar and meet the current admission requirements of the program to which they are seeking admission.
- Applicants must attach a letter to their application which (a) offers an explanation for their previously poor record, (b) outlines their academic plans and (c) explains why they are now likely to be successful.
- Readmission is not guaranteed.

Students so readmitted must maintain a grade point average of at least 2.00 on all courses taken after readmission. Failure to do so will result in permanent dismissal from the Faculty of Science. Students who have twice been required to withdraw from one or more Faculties at this or any other institution will not normally be considered for admission at any time.

C. Dean's List

The Dean's List recognizes the outstanding academic achievement of students in the Faculty of Science. To be included, a student must achieve a grade point average of at least 3.50 over all courses taken in the preceding Fall and Winter Sessions, with a minimum of four and one-half FCE to be counted. A statement of inclusion on the Dean's List will be recorded on the student's transcript.

Students completing a required Co-operative Education Work Term in either a Fall or Winter Session will be eligible for inclusion on the Dean's List provided they have completed two and one-half FCE with a GPA of at least 3.50 over all courses in the complementary Fall or Winter Session, and have passed the Work Term.

IV. Administration

Faculty Administrative Officers

Dean

P.M. Boorman

Associate Dean (Research & Academic Affairs)

J.S. Murphree

Associate Dean (Student Affairs)

H.I. Rosenberg

Associate Dean (Science Education)

G.B. Bourne

Director of the Natural Sciences Program

J.W. Nicholls

V. Program Details

Natural Sciences

Degrees Offered

UNDERGRADUATE

- BSc
- BSc Honours
- BSc/BEd*
- BSc/BA**

* Combined Degree with the Faculty of Education
** Combined Degree with the Faculty of Humanities or Social Sciences

Regulations

1. Programs Offered in Natural Sciences

- BSc in Natural Sciences
- BSc Honours in Natural Sciences
- BSc (Natural Sciences) and BEd (Master of Teaching Program)

2. Program vs. Faculty Regulations

Regulations governing programs in Natural Sciences are a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to read Section III (Faculty Regulations) first.

Students are advised to check the Degree Navigator periodically to ensure that all requirements are being met.

3. Program Information

Director: J.W. Nicholls
Program Student Office: SS 236
Student enquiries: (403) 220-6769
FAX: (403) 282-9154
Web Site: http://www.science.ucalgary.ca

4. Enrollment Limitations

The program requires students to choose two concentrations (after completion of four FCE), which must be from different Science Departments. Concentrations can be chosen from any Science Department, subject to enrollment limitations that may be in effect. Students should refer to Subsection 3 on Enrollment Limitations under Section III (Faculty Regulations), and the sections on enrollment limitations under the regulations of the Department offering the courses in which the student is interested. Students who declare a concentration in an area with enrollment limitations will be subject to the same selection criteria as students intending to major or minor in that area.

5. Students Intending to Transfer to Other Science Programs

Students who enter the Natural Sciences program with the intention of transferring to another program offered by the Faculty of Science are advised to follow the requirements and sequence of their intended program. Particularly in the first two years, the flexibility of the Natural Sciences program makes it relatively easy for students who decide not to transfer to another Science program to remain in and complete a Natural Sciences degree.

6. Programs in Natural Sciences

Admission

See also Section III (Faculty Regulations), Subsection 2 (Admission).

Declaration of Concentrations

The program requires students to choose two concentrations, denoted Concentration One (C1) and Concentration Two (C2), respectively. A concentration consists of courses selected from one of the existing Science major fields. Except for Co-operative Education programs and Internships, any major field from the Departments of Chemistry, Computer Science, Geology and Geophysics*, Mathematics and Statistics, Physics and Astronomy, and the major field of Biological Sciences from the Department of Biological Sciences may be chosen for a concentration, subject to enrollment limitations. (See Subsection 4 on Enrollment Limitations above.) The two concentrations must be from different departments. The major fields available in the six Departments are detailed in Departmental program sections.

Students cannot declare their concentrations until they have completed at least four FCE and must do so no later than upon registering for the final year.

** For either C1 or C2 in the Department of Geology and Geophysics, students will enter a departmental concentration made up of the combined major fields offered by the department, rather than selecting concentrations from any specific major field. See the Geology and Geophysics program section of this Calendar for details.*

Courses Constituting the Major Field of Natural Sciences

The major field of an individual's Natural Sciences program is defined as:

- the total of all courses that constitute the major fields in which the two concentrations are taken.
- Science 502.

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsection 4A (Program Requirements – Major Programs) and Subsection 5B (Course Selection – Introductory Courses).

1. Major Field Courses (Concentrations One and Two)

The program must contain two concentrations as described under Declaration of Concentrations above.

The courses in the two concentrations must be selected as follows:

5.0 FCE – Minimum number of courses in C1
3.0 FCE – Minimum number of courses in C2
6.0 FCE – Maximum number of courses in either C1 or in C2.
10.0 FCE – Maximum number of courses in C1 plus C2.
0.5 FCE – Minimum number of courses in C1 that must be at the 400 level or higher.

2. Capstone Courses

0.5 FCE – Science 501 (Project Course)
0.5 FCE – Science 503 (Interdisciplinary Seminar)

3. Other Courses outside the Major Field

4.0 FCE – Non-science options as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

4. Science Breadth

The program must include the following:

- 1 FCE in Mathematics*, selected from Mathematics 211 or 221, Mathematics 249 or 251 or Applied Mathematics 217, Mathematics 253 or 263 or Applied Mathematics 219
- 0.5 FCE in Computer Science*
- At least 1.0 FCE from each of four different Science Departments*
- 1.0 FCE of course work accompanied by a laboratory component* (taken from any of the Departments of Biological Sciences, Chemistry, Geology and Geophysics, and Physics and Astronomy.)

**Apply these courses to either (1) Major Field courses or (3) Other Courses outside the Major Field as appropriate.*

Required Courses – Honours Program

Same as for Major Program except that:

1.0 FCE – Minimum number of courses in C1 that must be at the 400 level or higher.
1.0 FCE – Science 502 (Research Project)

Recommendation for both the Major and Honours Programs

Writing Component

It is strongly recommended that a course emphasizing writing skills be included in the program, e.g., a junior English course or Communications Studies 363 or Science 311.

International Component

This suggestion may be satisfied in various ways, e.g., by completing 1.0 FCE from the list of courses in item 4 of the section "Make Your Degree More International," under "About the University" in the back of the Calendar, or by following one of the other suggestions listed there. If non-science course work is used to satisfy this recommendation, this course work could be part of the required 4.0 FCE from outside of Science.

Suggested Program Sequences

First Year	
Fall	**Winter**
Mathematics	Mathematics
Science concentration 1	Science concentration 1
Science concentration 2	Science concentration 2
Computer Science or option	Option
Non-science option	Non-science option
Second Year	
Science concentration 1	Science concentration 1
Science concentration 1	Option
Science concentration 2	Science concentration 2
Computer Science or option	Science breadth
Non-science option	Non-science option
Third Year	
Science concentration 1	Science concentration 1
Science concentration 2	Science concentration 1
Option	Science concentration 2
Option	Option
Non-science option	Non-science option
Fourth Year	
Science 501	Science 503
Science concentration 1 (400 level or higher)	Science concentration 1 (400 level or higher)*
Science 502*	Science 502*
Option	Option
Non-science option	Non-science option

**Required for Honours, replaced by options in the Major program*

Combined Degree in Natural Sciences and BEd (Master of Teaching Program)

Admission

To be eligible for admission, a student must meet the following requirements:

- A minimum of four FCE of university-level course work, including one FCE in Mathematics as required for the Natural Sciences program, with a GPA over all courses taken of at least 2.50 and a GPA over all Science courses taken of at least 2.50 (University of Calgary courses and/or transferable courses taken at other institutions).
- Declaration of two Science concentrations as required in the Natural Sciences program.
- All students must satisfy the Effective Writing Requirement.
- A Faculty of Education "Statement in Support of Application" which includes names of three referees.

***Note**: A maximum of 15 students will be accepted in the program in any one year. Admission to the program is competitive and meeting the minimum requirements does not guarantee admission. Students interested in this combined degree program should consult the Director of the Natural Sciences program at the earliest possible opportunity.*

Continuation

- Students must have completed the 15.0 FCE required for the initial Science portion of the program (see below under Program Structure) with a minimum GPA of 3.00 over the last 5 FCE taken.
- Students must notify the Faculty of Education no later than March 1 of the year that they intend to begin the Faculty of Education portion of the program.

Program Structure

The program is divided into a Science portion, which consists of 15.0 FCE and is completed in the first three years of the program, and an Education portion, which consists of 10.0 FCE and is completed in the last two years of the program. In the Education portion of the program in Year 5, a project course is required amalgamating Science and Education. This course replaces both the 500-level Science project course (Science 501) and the 500-level Interdisciplinary Seminar course (Science 503) required in the regular Natural Sciences program.

Science Portion (15.0 FCE)

The requirements are the same as for the Natural Sciences Major program as specified under Item 6 above except that the 1.0 FCE capstone courses, the 4.0 FCE non-science options, and the 5.0 FCE options from outside of the major field are replaced by:

0.5 FCE - Junior English
0.5 FCE - Option from the Faculty of Humanities
1.0 FCE - Options from the Faculty of Social Sciences
3.0 FCE - Options from anywhere
5.0 FCE - Half of the Education portion of the program (to be completed in the Education portion of the program)

The options in the preceding list must be chosen to include 0.5 FCE from a list of courses in the Science, Technology and Society area. (Consult the Director of the Natural Sciences program for the list.)

Education Portion (10.0 FCE)

For details see the Fourth and Fifth Years under Suggested Course Sequence

Suggested Course Sequence

First Year	
Fall	**Winter**
Computer Science 001*	
Two courses chosen from Applied Mathematics 217, 219, Mathematics 211 or 221, 249 or 251, 253 or 263	

Science concentration 1	Science concentration 1
Science concentration 2	Science concentration 2
Option	Computer Science 203 or 215 or 231
Junior English	Non-science option
Second Year	
Science concentration 1	Science concentration 1
Science concentration 1	Science concentration 1
Science concentration 2	Science concentration 2
Option	Option
Non-science option	Non-science option
Third Year	
Science concentration 1	Science concentration 1
Science concentration 1	Science concentration 1
Science concentration 2	Science concentration2
Option	Option
Option	Option
Fourth Year	
Studies in • Learners and learning/Teachers and teaching; School and Community/ Workplace placements. • Curriculum Studies (areas of specialization and interdisciplinarity); Curriculum Contexts; School placements.	
Fifth Year	
• Praxis (Case Tutorial, School Placement) • Integration (Case Tutorial, Special Topics Seminar) • Inquiry project focusing on some aspect of teaching and learning science. ***Note:*** *The Special Topics Seminar and Inquiry Project in the final session of the program will also serve as the Capstone courses (i.e., replacing Science 501 and 503) in the Natural Sciences portion of the combined degree program.*	

**Computer Science 001 is a non-credit course taught during block week before the beginning of the session. It is strongly recommended as preparation for Computer Science 215 or 231. If the course is offered at the beginning of the Winter Session, it can be taken then.*

Notes:

1. *This schedule will be adjusted to accommodate individual programs. The options will include any courses that are prerequisite to the concentration courses, but are from another field, and will include the Science Breadth requirements.*
2. *If the Mathematics courses or the Computer Science courses are part of C1 or C2, the number of C1 and C2 slots in this schedule can be reduced accordingly as per degree requirements.*

Degrees Offered in Biological Sciences

	Biochemistry	Biological Sciences	Botany	Cellular, Molecular & Microbial Biology	Ecology	Zoology
UNDERGRADUATE	BSc	BSc	BSc	BSc	BSc	BSc
	BSc Honours	BSc Honours	BSc Honours	BSc Honours	BSc Honours	BSc Honours
					BSc co-op	
					BSc Honours co-op	
		BSc/BSc*				
	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA*
GRADUATE	MSc	MSc	MSc	MSc	MSc	MSc
	PhD	PhD	PhD	PhD	PhD	PhD

* Combined Degree with the Department of Computer Science
** Combined Degree with the Faculty of Humanities or Social Sciences

Biological Sciences Regulations

1. Programs Offered In Biological Sciences

BSc and BSc Honours in Biochemistry; Biological Sciences; Botany; Cellular, Molecular and Microbial Biology; Ecology; Zoology

BSc and BSc Honours in Ecology Co-operative Education

Minor in Biological Sciences

2. Department vs. Faculty Regulations

Programs in the Department of Biological Sciences are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below.

It is **essential** for students to be familiar with **both** sets of regulations. It is helpful to read the general Faculty regulations first (Faculty of Science section of this Calendar, Section III). Students should consult the Degree Navigator periodically to ensure that requirements are being met and that regulations are adhered to.

3. Department Information

Department Head: D.M. Reid
Department Student Office: BI 188
Student enquiries: (403) 220-3140
Department General Office: BI 186
Other enquiries: (403) 220-5261
Fax: (403) 289-9311
Web Site: http://www.bio.ucalgary.ca/

4. Enrollment Limitations

Enrollment Limitations in Programs

The number of spaces in Biological Sciences is limited. Students may be directly admitted into the Biological Sciences Major program and, once admitted, a place in this program is assured for students advancing through the second and subsequent years with satisfactory performance. Admission will be granted for Fall Session only and will be based upon academic merit. At the end of the second year, students may continue in this program or appropriately qualified students may seek entrance to one of the other Majors offered by the Department. Due to limited enrollment capacity in many senior courses, it will not always be possible to accommodate every student's choice of a Major in the third and subsequent years.

Students admitted into a Major program, other than the Biological Sciences Major program, will have to meet additional criteria to those listed above in "Faculty Regulations – Admissions." These criteria are:

- Completion of the Biocore, including Biology 231, 233, 311, 313, and 331 with a grade of "C-" or better in each course.
- In the event that the number of students choosing one of these other programs exceeds the number that can be accommodated by available resources, students will be admitted to that program in descending rank order of academic performance until the enrollment limit is reached.
- Academic performance will be measured on the basis of the grade point average calculated over the most recent five FCE (University of Calgary courses and/or transferable courses taken at other institutions). (New admissions to the University are always subject to the "Admission Requirements" as stated in the Academic Regulations section of this Calendar.)

Students will be notified of the results of their application by mail (results will not be provided by telephone).

Strictly as space permits, the Department will admit students who transfer from other programs and institutions. Students requesting admission at this level are subject to "Admission Requirements" as stated in the Academic Regulations section of this Calendar and must meet additional criteria:

- Completion of Biology 231 and 233, Chemistry 201 and 203, one of Mathematics 249 or 251 and one of Mathematics 211, 221 or 253 with a grade of "C-" or better in each course.
- In the event that the number of transfer applicants exceeds the number that can be accommodated by available resources, students will be admitted to the Department in descending rank order of academic performance until the enrollment limit is reached.
- Academic performance will be measured on the basis of the grade point average calculated over the most recent five FCE (University of Calgary courses and/or transferable courses taken at other institutions). (New admissions to the University are always subject to the "Admission Requirements" as stated in the Academic Regulations section of this Calendar.)
- If successful transfer students wish a program other than the Biological Sciences program, additionally, such students will be subjected to the same criteria (listed above) for students at the end of their second year.

Enrollment Limitations in Courses

Enrollment in many courses offered by the Department of Biological Sciences is limited by available laboratory space. The following courses are available in the first instance only to those students in good standing who meet the prerequisite(s) and have been admitted into a major program that requires the course(s):

- Biochemistry 443, 541
- Biology 315
- Botany 303, 321, 327, 503, 543
- Cellular, Molecular and Microbial Biology 403, 421, 443, 451, 527
- Ecology 413, 417, 419, 425, 429, 439
- Zoology 269, 361, 363, 461, 463, 477.01, 477.02, 567, 577

Consult the Master Timetable for details regarding enrollment in these courses.

5. Block Transfers between Alberta Universities and Colleges

The Departments of Biological Sciences at the Universities of Alberta and Calgary and the Department of Biology at the University of Lethbridge have a block transfer agreement in effect. Under this agreement, students who have completed successfully two full years of a biological sciences program offered by any of the Universities normally will be able to transfer elsewhere without loss of credit. The same applies to students at the Colleges that follow university credit programs of one of these three Universities.

Note: *The Universities of Calgary and Alberta are members of the Western Canadian Universities Marine Sciences Society (WCUMSS). The other member universities are Simon Fraser University, the University of British Columbia and the University of Victoria. Students from any member university of WCUMSS may transfer into the Department of Biological Sciences under the above provisions. Thus, any student from a member university whose program* ***required*** *a half course in Mathematics and a half course in Statistics may present the Statistics course in lieu of a second Mathematics course for transfer purposes. Such students must meet all other transfer requirements. Once accepted into a Biological Sciences program, these students must complete the missing mathematics course as a program requirement.*

6. Ethics in the Biological Sciences

Studies in the Biological Sciences involve the use of living and dead organisms. Students taking laboratory-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

7. Common First and Second Years

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Required Courses

2.5 FCE – Biology 231, 233, 311, 313, 331 (Biocore)

1.0 FCE – Chemistry 201, 203

1.0 FCE – Mathematics 249 or 251 and one of 211, 221, 253 or 263 (see **Recommendations** below)

1.0 FCE – Computer Science 231 and 233, or 235 and Computer Science option

or

Geology 201 and 203

or

Physics 211 or 221, and 223 (see **Recommendations** below)

0.5 FCE – Biochemistry 393

1.0 FCE – Major options and/or options combination (see **Second Year** in the **Program Sequence Table** below)

1.0 FCE – Chemistry 351 and 353 (or Chemistry 351 and option, check details of programs below to see where this is allowed)

2.0 FCE – Non-science options.

Note: *1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*

Recommendations

- Biology 231, 233, 311, 313, 331 constitute the Biocore and must be taken in the sequence described below if students wish to pursue any of the degree programs offered by the Department of Biological Sciences.
- Students planning a Biochemistry or Zoology major must take Physics 211 or 221, and 223.
- Students planning an Ecology or Zoology major are advised to take a course in linear methods (i.e., Mathematics 211 or 221).
- Prior to registering in the second year, students should consider which program they wish to pursue in the third and subsequent years so that an appropriate choice of major access courses may be made (see **Second Year** in the **Program Sequence Table** below.)
- On entry into the second year of the Department of Biological Sciences, students should register in Biology 007. This non-credit, non-fee course is offered in Fall Session Block Week.
- Chemistry 354 is an acceptable substitute for Chemistry 351 and 353. Chemistry 355 is an acceptable substitute for Chemistry 353 ; students planning Biochemistry Honours are invited to complete Chemistry 353.

Common First and Second Years Program Sequence

First Year for All Programs	
Fall	**Winter**
Biology 231 or 233	Biology 233 or 231
Chemistry 201	Chemistry 203
Mathematics 249 or 251	Mathematics 211, 221, 253 or 263
Choose **either** Computer Science 231 or 235 **or** Geology 201 **or** Physics 211 or 221*	Continue Computer Science with Computer Science 233 or Computer Science option if 235 is chosen **or** continue Geology with Geology 203 **or** continue Physics with Physics 223
Non-science option	Non-science option
Second Year for All Programs	
Fall	**Winter**
Biology 007** (Block Week)	
Biology 311	Biochemistry 393
Biology 313	Biology 331
Chemistry 351	Chemistry 353 or option*
Non-science option	Non-science option
Choose one of the following pairs to prepare for the third and fourth years of the intended major.	
Biochemistry:	
Chemistry 311	Chemistry 315
Biological Sciences:	
Option	Option
Botany:	
Option	Botany 327
Cellular, Molecular and Microbial Biology:	
Option	Cellular, Molecular and Microbial Biology 343
Ecology:	
Option	Biology 315
Zoology:	
Zoology 375	Zoology 377

**Check program details to see where allowed.*
*** Students should register in the non-credit, non-fee Block Week course Biology 007.*

8. Programs in Biochemistry

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Biochemistry

All courses labelled Biochemistry except Biochemistry 341

Biology 231, 233, 311, 313, 331 and Cellular, Molecular and Microbial Biology 411

Certain Medical Science courses*

** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Program Requirements), in particular, the regulations on the number of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties (Table I).

10.0 FCE – Common first and second years including Physics 211 or 221, and 223 (from First Year) and Chemistry 311, 315, 351 and 353 (from Second Year)

2.0 FCE – Biochemistry 431, 443, 471, 541

2.5 FCE – chosen from Biochemistry 537, 543, 547, 551, 555, 561, 577 or Cellular, Molecular and Microbial Biology 411

2.0 FCE – chosen from Biochemistry 507, 528, 553, 555, 561, 577; Botany 501, 503, 543; Chemistry 331, 333, 453, 515, 555; Cellular, Molecular and Microbial Biology 343, 411, 421, 427, 443, 511, 519, 523, 531, 549; Computer Science 215, 231, 233, 313, 331, 333, 335, 355, 491; Statistics 211 or 213; Zoology 461 and 463

2.0 FCE – Non-science options.

***Note:** 1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*

1.5 FCE – Options

Required Courses – Honours Program*

Same as in Major Program except:

1.0 FCE – Options are replaced by Biochemistry 530.

**Honours students normally do not register in Biochemistry 507 or 528.*

Recommendations

- **Biochemistry Program Options**

  The following sequences of courses are possible for students interested in the indicated areas of Biochemistry, although any sequences that fulfill the program requirements may be taken:

  Cellular and Microbial Biochemistry

  Cellular, Molecular and Microbial Biology 343, 421, 443, 519

  Biochemical Genetics

  Cellular, Molecular and Microbial Biology 411, 427, 549

  Plant Biochemistry

  Botany 303, 501, 403 or 503, 543

  Animal Biochemistry

  Zoology 461, 463, 471; Cellular, Molecular and Microbial Biology 411

  Biotechnology

  Biochemistry 561 and Botany 501

  Structural Biology

  Biochemistry 543, 551, 555, 577

  Biocomputing

  Biochemistry 543, 551, 577

- Students who wish to enter the Faculty of Medicine should take Zoology 461, 463.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion of Biochemistry 393, and the Biocore program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Biochemistry 443	Biochemistry 431
Biochemistry 471	Option from the Field*
Option from the Field*	Option
Option	Option
Non-science option	Non-science option
Fourth Year	
Fall	**Winter**
Biochemistry 530 (for Honours), option (for majors)	Biochemistry 530 (for Honours), option (for majors)
Biochemistry 541	Option from the Field*
Option from the Field*	Option
Option from the Field*	Option
Non-science option	Non-science option

**Choose from either Biochemistry 537, 543, 547, 551, 555, 561, 577 or Cellular, Molecular and Microbial Biology 411*

9. Programs in Biological Sciences

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Biological Sciences:

- All courses labelled Biochemistry, except Biochemistry 341*
- All courses labelled Biology*, except Biology 205, 305, 307
- All courses labelled Botany*, except Botany 309
- All courses labelled Cellular, Molecular and Microbial Biology*

- All courses labelled Ecology*
- All courses labelled Zoology* except Zoology 269
- Most courses labelled Marine Science** including 420, 430, 440, 450, 451, 500, 507, 511, 515, 525, 537, 540, 544, 546, 572, 574, 582
- Certain Medical Science courses***

** Certain courses with restricted enrollments are available in the first instance to those Divisional Honours, Majors and Biological Sciences Honours who have met all prerequisites and whose programs require such courses. After a specific registration period for those students, other students who have met all prerequisites may be accommodated. See Limitation of Enrollment for courses that may apply.*
*** Applicability to the field depends upon the actual course content. Additional approvals will be granted on a course by course basis. Check the list published by the Department each February.*
**** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Degree Requirements), in particular, the regulations on the number of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties (Table I).

10.0 FCE – Common first and second years*
3.0 FCE – Options from the Field.
1.0 FCE - Options from the Field chosen from 400- or 500-level offerings
2.0 FCE – Non-science options. ***Note:*** *1FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*
4.0 FCE – Options

** Students have the option of completing Chemistry 353 or substituting 353 with an option.*

Required Courses – Honours Program

10.0 FCE – Common first and second years including Chemistry 353 (from Second Year).
6.0 FCE – Two FCE chosen from each of three of the areas that constitute the field. ***Note:*** *These courses must be different from the Biology core program and Biochemistry 393.*
1.0 FCE – Chosen from one of Biochemistry 530 or Botany 530 or Cellular, Molecular and Microbial Biology 530 or Ecology 530 or Zoology 530.
2.0 FCE – Non-science options. ***Note:*** *1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*
1.0 FCE – Options

Recommendations

- Major options should be selected to satisfy the requirements for entry into another chosen major program or to satisfy the requirements for the Biological Sciences program. (See Required Courses - Major Program and Required Courses – Honours Program.)
- Courses in Marine Science may be taken for credit during the summer and/or students may elect to spend the fall of either the third or fourth year attending the **Bamfield Fall Program**. Refer to the **Marine Science course listings** for details.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion of the Biocore program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Option	Option
Option	Option
Option	Option
Option	Option
Non-science option	Non-science option
Fourth Year	
Fall	**Winter**
One of Biochemistry 530, Botany 530, Cellular, Molecular and Microbial Biology 530, Ecology 530, Zoology 530 (for Honours), option (for Majors)	One of Biochemistry 530, Botany 530, Cellular, Molecular and Microbial Biology 530, Ecology 530, Zoology 530 (for Honours), option (for Majors)
Option	Option
Option	Option
Option	Option
Non-science option	**Non-science option**

10. Programs in Botany

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Botany

- Biology 231, 233, 311, 313, 331, 335, 451, 619
- Biochemistry 443
- All courses labelled Botany except Botany 309
- Ecology 419
- Marine Science 420, 500*, 501*, 502*, 507*, 525
- Certain Medical Science courses**

**Applicability to the field depends upon the actual course content. Approval will have to be granted on an individual basis. Check the list published by the Department each February.*
*** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Degree Requirements), in particular, the regulations on the distribution of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties.

10.0 FCE – Common first and second years, including Botany 327, and Chemistry 353 (from Second Year)
2.5 FCE – Botany 303, 321, 501, 503, 543
0.5 FCE – Choose one from Biology 335, 451, Botany 441, 633, or 645,
1.0 FCE – Options from the Field.
2.0 FCE – Non-science options. ***Note:*** *1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*
4.0 FCE – Options

Required Courses – Honours Program

Same as in Major Program except:

1.0 FCE – Options are replaced by Botany 530.

Recommendations

- Courses in Marine Science may be taken for credit during the summer and/or students may elect to spend the fall of either the third or fourth year attending the **Bamfield Fall Program**. Refer to the **Marine Science course listings** for details.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion of the Biological Sciences core program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Botany 303	Botany 503 or 543
Botany 321	Option
Option	Option
Option	Option
Non-science option	Non-science option

Fourth Year	
Fall	**Winter**
Botany 530 (for Honours), option from Field (for Majors)	Botany 530 continued (for Honours), option from Field (for Majors)
Botany 501	Botany 503 or 543
One of: Biology 335, 451, Botany 441, or option	One of: Botany 633, 645 or option
Option	Option
Non-science option	Non-science option

11. Programs in Cellular, Molecular and Microbial Biology

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Cellular, Molecular and Microbial Biology

- Biochemistry 537, 547, 555, 561
- Biology 231, 233, 311, 313, 315, 331, 335
- Botany 501, 543
- All courses labelled Cellular, Molecular and Microbial Biology
- Marine Science 500*, 501*, 502*, 507*
- Medical Science 612, 613 and certain other Medical Science courses**
- Zoology 373, 471, 531

**Applicability to the field depends upon the actual course content. Approval will have to be granted on an individual basis. Check the list published by the Department each February.*

*** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Degree Requirements), in particular, the regulations on the number of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties (Table I).

10.0 FCE – Common first and second years including Biochemistry 393, Cellular, Molecular and Microbial Biology 343, and Chemistry 353 (from Second Year)

0.5 FCE – Biochemistry 443

1.0 FCE – Cellular, Molecular and Microbial Biology 411, 527

2.0 FCE – Chosen from **either** (for Molecular Cell Biology) Cellular, Molecular and Microbial Biology 403 and three of 413, 505, 511, 519, 523, 451, 533, 561

or (for Molecular Microbiology) Cellular, Molecular and Microbial Biology 421, 443 and two of 431, 523, 543, 549, Biology 335.

1.0 FCE – Options from the Field.

2.0 FCE – Non-science options. ***Note:*** *1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*

3.5 FCE – Options

Required Courses – Honours Program

Same as in Major Program except:

0.5 FCE – Options from the Field are replaced by Cellular, Molecular and Microbial Biology 451.

0.5 FCE – Options from the Field are replaced by Cellular, Molecular and Microbial Biology 507.95.

1.0 FCE – Options are replaced by Cellular, Molecular and Microbial Biology 530.

Recommendations

- Students are advised to emphasize either a Molecular Microbiology or a Molecular Cell Biology route to be better equipped for further study and employment in those areas. This listing provides recommended options for students wishing to create a program of courses that explores their particular areas of interest and supports their career goals. It is not expected that students will be able to include all of the suggestions in one area in their programs; neither is the list exhaustive nor exclusive. Some courses may have prerequisites that are not included in the listing.

  Molecular Cell Biology

  Biochemistry 537, 547, 555, Botany 501, Cellular, Molecular and Microbial Biology 403, 413, 505, 511, 519, 523, 531, 533

  Molecular Microbiology

  Biochemistry 537, 561, Biology 335, Botany 501, Cellular, Molecular and Microbial Biology 421, 431, 443, 523, 543, 549, Medical Sciences 612, 613

- Some recommended options are Biochemistry 471, 537, 541, 543, 547, Biology 315, Statistics 333, Zoology 375, 377
- Courses in Marine Science may be taken for credit during the summer and/or students may elect to spend the fall of either the third or fourth year attending the **Bamfield Fall Program**. Refer to the **Marine Science course listings** for details.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion of the Biological Sciences core program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Biochemistry 443	Cellular, Molecular and Microbial Biology 527
Cellular, Molecular and Microbial Biology 411	Cellular, Molecular and Microbial Biology 413 or 431 or option
Cellular, Molecular and Microbial Biology 403 or 443	Cellular, Molecular and Microbial Biology 451 (for Honours), option from the Field (for Majors)
Cellular, Molecular and Microbial Biology 421 or option	Option
Non-science option	Non-science option
Fourth Year	
Fall	**Winter**
Cellular, Molecular and Microbial Biology 530 (for Honours), option (for Majors)	Cellular, Molecular and Microbial Biology 530 continued (for Honours), option (for Majors)
One of : Cellular, Molecular and Microbial Biology 511, 519 or 549	Cellular, Molecular and Microbial Biology 507.95 (for Honours), option from the Field (for Majors)
One of: Cellular, Molecular and Microbial Biology 511, 519 or 549 or option	One of: Cellular, Molecular and Microbial Biology 505, 523, 531, 533, or one of: 523, or 543
Cellular, Molecular and Microbial Biology 421 or option	One of: Cellular, Molecular and Microbial Biology 505, 523, 531, 533 or 543
Non-science option	Non-science option

12. Programs in Ecology

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Ecology

- Biology 231, 233, 311, 313, 315, 331, 401, 451, 591, 619
- Botany 327*
- All courses labelled Ecology
- Zoology 375*, 377*
- Marine Science 430, 450, 500**, 507**, 525, 537
- Certain Medical Science courses***

**A maximum of two of these courses may be counted towards the field.*

*** Applicability to the field depends upon the actual course content. Approval will have to be granted on an individual basis. Check the list published by the Department each February.*

**** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Degree Requirements), in particular, the regulations on the distribution of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties.

10.0 FCE – Common first and second years* including Biology 315 (from Second Year)

0.5 FCE – Biology 401

3.5 FCE – Ecology 413, 417, 419, 425, 429, 439, 501

2.0 FCE – Non-science options. ***Note:*** *1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*

4.0 FCE – Options

**Students have the option of completing Chemistry 353 or an option if Chemistry 353 is not chosen.*

Required Courses – Honours Program

Same as in Major Program except:

1.0 FCE – Options are replaced by Ecology 530.

Recommendations

- This listing provides recommended options for students wishing to create a program of courses that explores their particular areas of interest and supports their career goals. It is not expected that students will be able to include all of the suggestions in one area in their programs; neither is the list exhaustive nor exclusive. Many courses have prerequisites that are not listed.

General Ecology

Biology 451, Botany 327, 441; Marine Science 430; Zoology 375, 477.01 or 477.02; Geography 201; Geology 201 or 209

Aquatic Ecology

Botany 327; Ecology 491, 527, 607; Marine Science 420, 430, 450, 537, 572, 574; Zoology 375; Chemistry 311/315, 351/353, 411/415; Geography 307, 511; Geology 201 or 209

Behavioural Ecology

Ecology 491, 527; Zoology 461, 477.01 or 477.02, 567, 577, 583; Anthropology 351, 361; Psychology 205

Community and Ecosystem Ecology

Biology 335; Botany 327, 441; Ecology 527; Marine Science 430, 537; Zoology 375, 477.01 or 477.02; Geography 201; Geology 201 or 209

Fish and Wildlife Ecology

Biology 451, Botany 327, 441; Ecology 527; Marine Science 430, 450, 540, 544, 574; Zoology 477.01 or 477.02, 483, 567, 577, 583; Economics 377; Geography 333, 433

Physiological Ecology

Botany 303, 503; Ecology 527; Zoology 483, 575

Population Ecology

Biology 451; Botany 323, 441; Ecology 491, 527, 677; Zoology 375, 477.01 or 477.02, 567, 577, 583

Terrestrial Ecology

Biology 335; Botany 441; Ecology 491, 527; Zoology 477.01 or 477.02; Chemistry 311/315, 351/353, 411/415; Geography 333, 433; Geology 201 or 209

- Students wishing to emphasize evolutionary, behavioural and population ecology are advised to take Biology 401, Ecology 429 and 439 one year and Ecology 417, 419 and 501 the next year. Those students wishing to emphasize community and ecosystems ecology are advised to take Biology 401, Ecology 417 and 419 one year, and Ecology 429, 439 and 501 the next year.
- Recommended options from other Faculties: Economics 201; Geography 305, 321, 333, 421; Greek and Roman Studies 211; History 371, 477.01, 477.02; Philosophy 275, 279, 367.
- Courses in Marine Science may be taken for credit during the summer and/or students may elect to spend the fall of either the third or fourth year attending the **Bamfield Fall Program**. Refer to the **Marine Science course listings** for details.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion of the Biological Sciences core program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Ecology 417 or 429	Biology 401
Ecology 425	Ecology 419 or 439
Ecology 413 or option	Option
Option	Option
Non-science option	Non-science option
Fourth Year	
Fall	**Winter**
Ecology 530 (for Honours), option (for Majors)	Ecology 530 continued (for Honours), option (for Majors)
Ecology 417 or 429	Ecology 419 or 439
Ecology 413 or option	Ecology 501
Option	Option
Non-science option	Non-science option

Ecology Co-operative Education

Application deadline: December 1.

See the subsection on "Co-operative Education/ Internship Programs" in Section III (Faculty Regulations) and the major section on "Co-operative Education/ Internship" of this Calendar.

Co-operative Education programs are five-year degree programs which include 16 months of supervised work experience in various industrial and government workplaces. Minimally, students must be in their second year in the Biological Sciences program with a grade point average of 2.30 before applying for admission to the BSc Ecology Co-operative Education program. A grade point average of 3.30 is required for entry into the BSc Honours Ecology Co-operative Education program. In addition, students must complete the courses outlined for the second year of the Ecology program with the same minimum grade point average before commencing the first co-operative education placement (the summer following second year).

Required Courses

20.0 FCE – Same as Ecology Majors or Honours

16 months – Co-operative Education work terms (Co-operative Education 543.01, 543.02, 543.03, 543.04)

Suggested Program Sequence

- All courses in the common second-year program must be completed prior to the start of the first work term.
- The sequence below is only one of several possibilities; students should consult the Ecology Division Co-op Coordinator for other suggestions.

see Common Second Year		
		Summer Four-month Co-op or defer to Summer of Year Three
Third Year		
(Available to Honours students, and Major students after satisfactory completion of the Biological Sciences core program that includes Biology 231, 233, 311, 313 and 331.)		
Fall	**Winter**	**Summer**
Four-month Co-op	Biology 401	
	Ecology 419 or option	

	Option	
	Option	
	Non-science option	
Fourth Year		
***Fall**	**Winter**	**Summer**
Ecology 417 or option	Four-month Co-op	Four-month Co-op
Ecology 425		
Ecology 429 or option		
Ecology 413 or option		
Non-science option		
Fifth Year		
Fall	**Winter**	
Ecology 530 (for Honours), option (for Majors)	Ecology 530 continued (for Honours), option (for Majors)	
Ecology 417 or option	Ecology 419 or option	
Ecology 429 or option	Ecology 439	
Ecology 413 or option	Ecology 501	
Non-science option	Non-science option	

13. Programs in Zoology

See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under Biological Sciences.

Courses constituting the field of Zoology

- Biology 231, 233, 311, 313, 315, 331, 401, 451, 501, 591, 619
- Cellular, Molecular and Microbial Biology 403, 527, 615
- Ecology 491, 527
- Marine Science 440, 500*, 501*, 507*, 502*, 515, 540, 544, 546, 572, 574, 582
- Certain Medical Science courses**
- All courses in the Calendar labelled Zoology except Zoology 269, 361, 363.

** Applicability to the field depends upon the actual course content. Approval will have to be granted on an individual basis. Check the list published by the Department each February.*

*** No more than one FCE of such courses (approved by the Department prior to registering in the course) can be counted towards the Major Field.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Item 4 (Degree Requirements), in particular, the regulations on the number of courses at the 200 level and above allowed in a program and on the List of Science-Equivalent Courses in Other Faculties (Table I).

10.0 FCE – Common first and second years, including Physics 211 or 221, and 223 (from First Year) and Chemistry 353, Zoology 375 and 377 (from Second Year)

2.0 FCE – Biology 315, Zoology 461, 463, 471

1.0 FCE – Zoology courses from the 400- and 500-level offerings (excluding 461, 463, 471)

0.5 FCE – Options from the Field.

2.0 FCE – Non-science options.
***Note:** 1 FCE from the Faculty of Humanities and 1 FCE from the Faculty of Social Sciences form part of the minimum 4.0 FCE non-science degree requirements. The other 2 FCE may come from anywhere including Humanities and Social Sciences.*

4.5 FCE – Options

Required Courses – Honours Program

Same as in Major Program except:

1.0 FCE – Options are replaced by Zoology 530.

Recommendations

- This listing provides recommended options for students wishing to create a program of courses that explores particular areas of interest and that provides support for career goals. Students may not be able to include all suggestions of a given area in their programs; neither is the list exhaustive nor exclusive. Many courses have prerequisites that are not listed.

Animal Development and Morphology

Anthropology 457, Biology 401, Cellular, Molecular and Microbial Biology 403, 505, Kinesiology 261, 263, Medical Science 619.03, Zoology 475, 477.01, 477.02, 531, 573

Animal Physiology

Biochemistry 471, 547, Biology 501, Cellular, Molecular and Microbial Biology 527, Medical Science 553, 623, 627, 629, 631, Zoology 575, 595, 597, 691, 699

Animal Biodiversity and Systematics

Biology 401, 451, 619, Ecology 429, 439, 491, 527, Geology 307, 391, Zoology 475, 477.01, 477.02, 571, 621

Evolutionary and Ecological Physiology

Biology 401, Botany 303, Ecology 429, Marine Science 515, 546, Zoology 475, 477.01, 477.02, 567, 575, 691

General (Cell) Physiology

Biology 501, Botany 503, Cellular, Molecular and Microbial Biology 403, 413, 527, Medical Science 615, 619.01, Zoology 531, 573, 595, 597

Invertebrate Biology

Ecology 417, 419, 491, Geology 391, Marine Science 440, 572, 582, Zoology 475, 483, 567

Vertebrate Biology

Ecology 527, Kinesiology 261, Marine Science 540, 544, 574, Zoology 477.01, 477.02, 531, 567, 571, 573, 577, 583

- Courses in Marine Science may be taken for credit during the summer and/or students may elect to spend the fall of either the third or fourth year attending the **Bamfield Fall Program**. Refer to the **Marine Science course listings** for details.

Suggested Program Sequence

Third Year	
(Available to Honours students, and Major students after satisfactory completion the Biological Sciences core program that includes Biology 231, 233, 311, 313 and 331.)	
Fall	**Winter**
Zoology 461	Biology 315
Zoology 471	Zoology 463
Option	Option
Option*	Option
Non-science option	Non-science option
**It is highly recommended that students take Biochemistry 443*	
Fourth Year	
Fall	**Winter**
Zoology 530 (for Honours), option (for Majors)	Zoology 530 continued (for Honours), option (for Majors)
Option	Option
Option	Option
Option	Option
Non-science option	Non-science option

14. Collaborative Program – Environmental Science

Students may pursue a BSc program in Environmental Science with a concentration in Biological Sciences. This is a single degree, four year program which is jointly administered by the Faculty of Science and the Faculty of Social Sciences. Program details are listed in the Collaborative Programs section of this Calendar. Since this is a multidisciplinary program with restricted entry, students should consult the Director of the Environmental Science program at their earliest opportunity.

15. Double Major in the Department of Biological Sciences

Programs with two major fields in the Department of Biological Sciences may be completed in the following manner:

- The minimum requirements for both major fields must be fulfilled.

- For all programs the five half courses constituting the Biocore (i.e., Biology 231, 233, 311, 313, 331) will be counted towards both majors.
- For all major fields in the Department of Biological Sciences, no course beyond the Biocore will be counted towards both major fields. If a course constitutes a requirement in both major fields, it will be counted towards only one and a substitution must be made to fulfill the requirements of the other major field.
- It is not possible to combine the Biological Sciences major with any other program offered by the Department into a double-major program.

For further details consult the Office of Student Affairs, Department of Biological Sciences.

16. Minor in Biological Sciences

Programs in the Biological Sciences are enrollment limited. Students who declare a Minor in the Biological Sciences are subject to the same selection criteria as students who declare a Major or a Concentration in this area. See the subsections on "Enrollment Limitations" in Section III (Faculty Regulations) and in Section V (Program Details) under the earlier part of Biological Sciences.

The application deadline for this minor is **March 1**.

The requirements for a minor in Biological Sciences are:

1.0 FCE – Any two of Biology 231, 233, 311, 313 or 331

4.0 FCE – courses at the 300 level or higher, except Biology 305, 307, or Botany 309, and Zoology 269

Students will be limited to a maximum of 5.0 FCE of courses offered by the Department.

Note: *This minor is available only to students who are not majoring in the Department of Biological Sciences or are not Natural Sciences concentrators in Biological Sciences. This is the single minor program offered by the Department and none of the other programs exist as minors. Students must be aware that preference in enrollment in many courses offered by the Department of Biological Sciences is given to Majors or Natural Sciences Concentrators within the Department.*

17. Combined Degree with Computer Science

The five-year program, sponsored jointly by the Department of Biological Sciences and the Department of Computer Science, leads to both the Bachelor of Science in Biological Sciences and the Bachelor of Science in Computer Science degrees. The program requires careful selection of courses in order to complete the requirements of both the Departments.

Students wishing to embark on the sequence of courses leading to this combined degree may enter the combined program in year one. Otherwise, they may enter the Biological Sciences or Computer Science major program and apply to the combined degree program in subsequent years.

Once admitted to the combined program, a student may elect to remain in it, or switch to either of the two separate degree programs, as long as the requirements of each program continue to be met. Failure to meet requirements will result in a student being required to withdraw from the combined or separate programs, as the case may be.

A total of 25 full-course equivalents are required, which includes the core courses of both programs, options within each field and non-science options. The requirements are as follows:

5.5 FCE Biology 231, 233, 311, 313, 331, Biochemistry 393, Chemistry 201, 203 , 351, Mathematics 249 and 221

3.0 FCE Options from the Field of Biological Sciences, except Biology 205, 305, 307, Biochemistry 341, Botany 309 and Zoology 269

1.0 FCE Options from the Field of Biological Sciences at the 400 or 500 level

0.5 FCE Chemistry 353 or option

1.0 FCE Mathematics 271 and Mathematics option

9.0 FCE Required courses and options in Computer Science (for details see the Computer Science section of this Calendar)

0.5 FCE Philosophy 279 or 377

4.0 FCE Non-science options as follows (check Table I in Section III for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

0.5 FCE Option

Note: *Students interested in pursuing the combined degree in Biological Sciences and Computer Science should contact the undergraduate advisors of both departments to discuss the program. To be able to finish in 5 years, the course sequence needs to be chosen carefully.*

Chemistry

Degrees Offered In Chemistry

	Chemistry	Applied Chemistry	Chemical Physics
UNDERGRADUATE	BSc		
	BSc Honours		BSc Honours
		BSc co op	
		BSc Honours co op	
	BSc/BA*	BSc/BA*	BSc/BA*

*Combined Degree with the Faculty of Humanities and Social Sciences

GRADUATE	MSc	MSc	
	PhD	PhD	

1. Programs Offered

BSc in Chemistry

BSc Honours in Chemistry

BSc in Applied Chemistry Co-operative Education

BSc Honours in Applied Chemistry Co-operative Education

BSc Honours in Chemical Physics

Minor in Chemistry

2. Departmental vs. Faculty Regulations

Programs in the Department of Chemistry are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to read the Faculty Regulations in Section III first.

Students should consult the Degree Navigator periodically to ensure that requirements are being met. Students are also strongly urged to consult the Department at all stages of their program.

3. Departmental Information

Department Head: B.A. Keay
Department Office: SA 105A
Telephone: (403) 220-5340
Undergraduate Advisor: (403) 220-5353
Fax: (403) 284-1372
Web Site: http//www.chem.ucalgary.ca/
E-mail: uginfo@chem.ucalgary.ca

4. Enrollment Limitations

Enrollment Limitations in Programs

Due to limited enrollment capacity in many senior courses in which there is a laboratory component, the Chemistry programs have a maximum capacity. For details on entry to the programs, see the Faculty regulations.

Enrollment Limitations in Courses

Enrollment in many courses offered by the Department of Chemistry is limited by laboratory space. The following courses are available in the first instance only to those students in good standing who meet the prerequisite(s) and have been admitted into a major or Natural Sciences program that requires the course(s): Chemistry 311, 315, 331, 333, 351, 353, 355, 371, 373, 453, 471, 515, 535 and 555.

Consult the Master Timetable for details regarding enrollment in these courses.

5. Programs in Chemistry

Admission

See also Section III (Faculty Regulations), Subsection 2 (Admission).

Courses constituting the field of Chemistry

All courses labelled Chemistry except Chemistry 209, 341, 357, 409, 429, 459 and 579

Biochemistry 341, 393 and 443

Required Courses - Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

1.0 FCE – Chemistry 201, 203

1.0 FCE – Physics 211 or 221, 223

0.5 FCE – Mathematics 251 or 249

or

Applied Mathematics 217

0.5 FCE – Mathematics 253 or 263

5.5 FCE – Chemistry 311, 315, 331, 333, 351, 355, 371, 373, 453, 471, 531 or 533

3.0 FCE – From the field of Chemistry of which at least 1.5 FCE in addition to Chemistry 531 or 533 must be 500-level courses

0.5 FCE – Physics 323

1.0 FCE – Mathematics 221, 331

4.0 FCE – Non- Science Options as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

0.5 FCE – Science 311

or

Communications Studies 363

1.0 FCE from the Faculty of Humanities

1.0 FCE from the Faculty of Social Sciences

1.5 FCE from any faculty outside Science including Humanities and Social Sciences

3.0 FCE – Options

Required Courses - Honours Chemistry

The same as in the Major program except that the 3.0 FCE Options are replaced by

1.0 FCE – Chemistry 502

0.5 FCE – Physics 321 or Biochemistry 393 or Mathematics 353 or any Chemistry course at the 500 level (or above) or any other senior Science courses by the consent of the Department

1.5 FCE – Options

Required Courses - Minor in Chemistry

1.0 FCE – Chemistry 201 and 203

2.0 FCE – Chemistry 311, 331, 351 and 371 or 373

2.0 FCE – Courses from the field of Chemistry at the 300 level or above

Recommendations

For students who do not have a background in the use of computers, Computer Science 203 is recommended as a first year option.

Communications Studies 363 and Science 311 are limited in enrollment. Students may complete one of them in the Fall or Winter Session as dictated by the course capacities.

Chemistry 515 is strongly recommended for students planning careers in analytical or environmental chemistry.

Suggested Program Sequences

(a) Major Program

First Year	
Fall	**Winter**
Chemistry 201	Chemistry 203
Physics 211 or 221	Physics 223
Mathematics 251 or 249 or Applied Mathematics 217	Mathematics 253 or 263
Option	Option
Non-science option	Non-science option
Second Year	
Chemistry 311	Chemistry 315
Chemistry 351	Chemistry 355
Physics 323	Chemistry 371
Mathematics 221	Mathematics 331
Communications Studies 363 or	Communications Studies 363 or
Science 311or Non-science option	Science 311 or Non-science option
Third Year	
Chemistry 373	Chemistry 471
Chemistry 331	Chemistry 333
Chemistry 453	Option
Option	Option
Non-science option	Non-science option
Fourth Year	
Chemistry 531 or Option	Chemistry 533 or Option
Option	Option
Option	Option
Option	Non-science option
Non-science option	Non-science option

(b) Honours Program

As above except that Physics 321 replaces one of the options in Third Year, and

Chemistry 502 replaces two of the options in Fourth Year.

6. Programs in Applied Chemistry Co-operative Education

Co-operative Education programs include a minimum of sixteen months of supervised work experience in various industrial, governmental or academic laboratories and thus require a minimum of five calendar years to complete.

Admission

See also Section III (Faculty Regulations), Subsection 2 (Admission).

Students following the suggested Applied Chemistry program sequence normally begin this program at the beginning of the second year. For formal entry into the Applied Chemistry Co-operative Education program see the Calendar section “Co-operative Education/Internship.”

The first year of the program as specified in this Calendar (see below) must have been completed with a minimum grade point average of 3.30 overall and in the required Chemistry, Mathematics and Physics courses before the student may apply for admission to the BSc Honours Applied Chemistry Co-operative Education program, or a minimum grade point average of 2.70 overall and in the required Chemistry, Mathematics and Physics courses before the student may apply for admission to the BSc Applied Chemistry Co-operative Education program

Students must be registered in the second year of the Chemistry Majors or Honours program and must apply to the Career Services Office by December 1.

Before commencing the first Co-operative Education work term, students must have completed a minimum of 8.0 FCE appropriate to the Chemistry degree program. They must have attained a minimum grade point average of 2.70 over the following second

year courses: Chemistry 311, 331 and 351 and they must have completed Chemistry 315, 333 and 355.

The Department requires that a minimum overall GPA of 2.70 at each annual review be maintained for continuation in the program (see Faculty regulations for the Honours Co-operative Education Program).

Note: *The detailed Co-operative Education program sequence as well as additional rules and regulations must be obtained from the Chemistry Department Office (SA109).*

Courses constituting the field of Applied Chemistry

All courses labelled Chemistry except Chemistry 209, 341, 357, 409, 429, 459 and 579

Co-operative Education 503

Biochemistry 341, 393 and 443

Required Courses - Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses)

1.0 FCE – Chemistry 201, 203

1.0 FCE – Physics 211 or 221, 223

0.5 FCE – Mathematics 251 or 249

or

Applied Mathematics 217

0.5 FCE – Mathematics 253 or 263

6.5 FCE – Chemistry 311, 315, 331, 333, 351, 355, 371, 373, 425, 453, 471, 515, 531 or 533

2.5 FCE – From the field of Chemistry of which at least 1.0 FCE in addition to Chemistry 515 and 531 or 533 must be 500-level courses

0.5 FCE – Physics 323

1.0 FCE – Mathematics 221, 331

4.0 FCE – Non- Science Options as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

0.5 FCE – Science 311

or

Communications Studies 363

1.0 FCE from the Faculty of Humanities

1.0 FCE from the Faculty of Social Sciences

1.5 FCE from any faculty outside Science including Humanities and Social Sciences

2.5 FCE – Options

16 months – Co-operative Education 503.01, 503.02, 503.03 and 503.04

Required Courses - Honours Program

The same as in the Major program except that the 2.5 FCE options are replaced by

1.0 FCE – Chemistry 502

1.5 FCE – Options

Recommendations

For students who do not have a background in the use of computers, Computer Science 203 is recommended as a first year option.

Of the five work terms indicated in the sequence below, four are required.

Suggested Program Sequences

(a) Major Program

First Year		
Fall	**Winter**	**Spring Summer**
Chemistry 201	Chemistry 203	
Mathematics 251or 249 or Applied Mathematics 217	Mathematics 253 or 263	
Physics 211 or 221	Physics 223	
Option	Non-science option	
Non-science option	Non-science option	
Second Year		
Chemistry 311	Chemistry 315	COOP 503.01
Chemistry 331	Chemistry 333	
Chemistry 351	Chemistry 355	
Communi-cations Studies 363 or Science 311 or option	Communi-cations Studies 363 or Science 311 or option	
Mathematics 221	Mathematics 331	
Third Year		
COOP 503.02	Chemistry 425	COOP 503.03
	Chemistry 371	
	Physics 323	
	Option	
	Non-science option	
Fourth Year		
Chemistry 373	COOP 503.04	COOP 503.05
Chemistry 453		
Chemistry 515		
Option		
Non-science option		
Fifth Year		
Chemistry 531 or Option	Chem 471	
Option	Chemistry 533 or Option	
Option	Option	
Option	Non-science option	
Non-science option	Non-science option	

(b) Honours Program

As above except that Chemistry 502 replaces two of the options in Fifth Year.

7. Program in Honours Chemical Physics

This program is offered in conjunction with the Department of Physics and Astronomy.

Admission

See also Section III (Faculty Regulations), Subsection 2 (Admission).

Courses constituting the field of Chemical Physics

Chemistry 201, 203, 331, 333, 351, 355, 371, 373, 471, 502, 571, 573 and 577

Physics 211, 221, 223, 225, 301, 321, 323, 325, 341, 343, 347, 355, 443, 455, 457, 449, 491, 543, 591, 598, 599

Required Courses - Honours Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses)

1.0 FCE – Chemistry 201, 203

1.0 FCE – Physics 211 or 221, 225

0.5 FCE – Applied Mathematics 217

or

Mathematics 251 or 249

0.5 FCE – Mathematics 221

0.5 FCE – Applied Mathematics 219

0.5 FCE – Computer Science 231

3.5 FCE – Chemistry 331, 333, 351, 355, 371, 373, 471

0.5 FCE – One of Chemistry 571 or 573 or 577

2.5 FCE – Physics 341, 343, 355, 455, 543

1.0 FCE – Chemistry 502 or Physics 598

1.5 FCE – Applied Mathematics 307, 309, 433

0.25 FCE – Physics 491

0.25 FCE – Physics 591

4.0 FCE – Non- Science Options as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

1.0 FCE from the Faculty of Humanities

1.0 FCE from the Faculty of Social Sciences

2.0 FCE from any faculty outside Science including Humanities and Social Sciences

2.5 FCE – Options

Recommendations

Science 311 or Communications Studies 363 is recommended as one of the options.

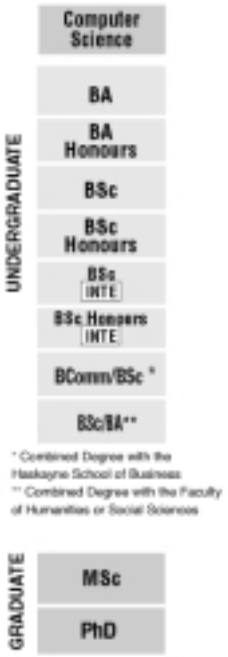
Suggested Program Sequences

Honours Program

First Year	
Fall	**Winter**
Chemistry 201	Chemistry 203
Applied Mathematics 217 or Mathematics 251 or 249	Applied Mathematics 219
Mathematics 221	Computer Science 231
Physics 211 or 221	Physics 225
Non-science option	Non-science option
Second Year	
Chemistry 351	Chemistry 355
Physics 341	Physics 343
Physics 355	Chemistry 371
Applied Mathematics 307	Applied Mathematics 309
Non-science option	Non-science option
Third Year	
Chemistry 373	Chemistry 471
Chemistry 331	Chemistry 333
Physics 455	Physics 491
Applied Mathematics 433	Option
Non-science option	Non-science option
Fourth Year	
Chemistry 502 or Physics 598	Chemistry 502 or Physics 598
Physics 543	Option or Chemistry 571 or 573 or 577
Option or Chemistry 571 or 573 or 577	Physics 591
Option	Option
Non-science option	Option
	Non-science option

Computer Science

Degrees Offered in Computer Science



1. Programs Offered

- BSc and BSc Honours in Computer Science
- BA and BA Honours in Computer Science
- BSc and BSc Honours in Computer Science Internship
- BSc and BComm in Computer Science and Business
- BSc in Computer Science and Biological Sciences
- BSc Double Major in Computer Science and General Mathematics
- Minor in Computer Science

2. Department vs. Faculty Regulations

Programs in the Department of Computer Science are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to start by reading the Faculty Regulations in Section III first. Students should consult the Degree Navigator periodically to ensure that requirements are being met.

3. Department Information

Department Head: K.E. Barker
Department Office: ICT 602
Telephone: (403) 220-6015
Undergraduate Advisor: ICT 602
Fax: (403) 284-4707
Web Site: http://www.cpsc.ucalgary.ca/
E-mail: cpsc@cpsc.ucalgary.ca

4. Limitation of Enrollment in Computer Science

The number of places in Computer Science programs is limited. Once admitted, a place in a Computer Science program is assured for students advancing through subsequent years with satisfactory performance. However, due to limited capacity in many senior Computer Science options, it may not always be possible to accommodate every student's first choice of courses.

Priority registration in the second and third year Computer Science courses required for a BSc in Computer Science (Computer Science 313, 325, 331, 349, 413, and 457) is given to students who have been admitted to a Computer Science program.

The Department reserves a certain number of places for students who wish to gain admission to the third year of a Computer Science program by transferring from other institutions or programs. Any student requesting admission at this level is subject to "Admission Requirements" as stated in the Academic Regulations section of this Calendar and, in addition, must have completed the required Computer Science and Mathematics courses (Computer Science 231, 233, 313, 331, 333 (or SENG 311), Mathematics 221, and Mathematics 271) or their equivalents with a grade of "C-" or better in each course. If demand exceeds capacity, selection for these places will be based on the grade point average over the most recent course work to a maximum of five FCE (University of Calgary courses and/or transferable courses taken at other institutions).

5. Advanced Placement in Computer Science

Students in International Baccalaureate (IB) and Advanced Placement (AP) programs may be eligible for advanced credit in Computer Science courses, including Computer Science 231 and 233. See the Academic Regulations section of this Calendar (Alternatives to Regular Course Credit) for additional details.

Other students with backgrounds in Computer Science equivalent to Computer Science 231 or 231/233 may request advanced placement in Computer Science in order to have admission and prerequisite requirements for these courses waived, after successful completion of an advanced placement examination. Interested students should see the Academic Regulations

section of this Calendar (Alternatives to Regular Course Credit) for additional details, and contact the Department of Computer Science to apply.

6. Programs in Computer Science

Admission

See the subsections on Enrollment Limitations in Section III (Faculty Regulations) and in Section V (Program Details) under Computer Science.

Courses constituting the field of Computer Science

- All courses labelled Computer Science except Computer Science 203 and 215;
- Applied Mathematics 491;
- Pure Mathematics 329;
- All courses labelled Software Engineering.

Required Courses – BSc Major Program

All Computer Science majors must have satisfactorily completed or be concurrently registered in Computer Science 313, 325, 331, and 349 in order to register in 400- and 500-level Computer Science courses.

5.0 FCE - Computer Science 231, 233 (Computer Science 235 plus another 0.5 FCE from the field of computer science can replace 231 and 233.), 265, 313, 325, 331, 349, 413, 457 and Software Engineering 311 (or Computer Science 333).

2.0 FCE - Mathematics 221, 249 or 251, 271, and one of Statistics 211 or Mathematics 321. (Mathematics 321 has Mathematics 253 as a prerequisite.)

0.5 FCE - Philosophy 279 or 377.

4.0 FCE - Taken from the field of Computer Science: one and one-half numbered 500 or above, two numbered 400 or above, and one-half numbered 300 or above.

4.0 FCE - Non-science options as follows (check Table I in Section III for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences.

4.5 FCE - Options

The Department offers several concentrations that can provide focus on specific areas of computer science. Students interested in these concentrations need to choose their options, including the options taken in the first two years of the program, carefully to fulfill the concentration requirements.

Required Courses – BSc Honours Program

All Computer Science Honours students must have satisfactorily completed or be concurrently registered in Computer Science 313, 325, 331 and 349 in order to register in 400- and 500-level courses.

6.5 FCE - Computer Science 231, 233 (Computer Science 235 plus another 0.5 FCE from the field of computer science can replace 231 and 233.), 265, 313, 325, 331, 349, 413, 457, Software Engineering 311 (or Computer Science 333), one of Computer Science 502 or 510 or 594 and one of 511, 513, 517 or 519.

2.0 FCE - Mathematics 221, 249 or 251, 271, and one of Statistics 211 or Mathematics 321. (Mathematics 321 has Mathematics 253 as a prerequisite.)

1.0 FCE - Philosophy 279 or 377, and Philosophy 379

3.5 FCE - Taken from the field of Computer Science: two numbered 500 or above, and one and one-half numbered 400 or above.

4.0 FCE - Non-science options as follows (check Table I in Section III for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences.

3.0 FCE - Options

The Department offers several concentrations that can provide focus on specific areas of computer science. Students interested in these concentrations need to choose their options, including the options taken in the first two years of the program, carefully to fulfill the concentration requirements.

Required Courses – BA Major Program

All Computer Science majors in this program must have satisfactorily completed or be concurrently registered in Computer Science 331, 349 and Software Engineering 311 in order to register in 400- and 500-level Computer Science courses.

4.0 FCE - Computer Science 231, 233 (Computer Science 235 plus another 0.5 FCE from the field of computer science can replace 231 and 233), 265, 331, 349, 441, 481, and Software Engineering 311 (or Computer Science 333).

1.5 FCE - Mathematics 221, 249 or 251, and 271.

1.0 FCE - Philosophy 279 and 379.

3.0 FCE - Taken from the field of Computer Science: one numbered 500 or above, one and one-half numbered 400 or above, and one-half numbered 300 or above.

4.0 FCE - Non-science options as follows (check Table I in Section III for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences.

6.5 FCE - Options; no more than 1 FCE from the Faculty of Science or science equivalent. (See Table I in Section III, Faculty Regulations, for ineligible courses.)

Recommendations

- Computer Science 001, 002, and Mathematics 041 are recommended but not required. These are offered during Block Weeks preceding the beginning of session, but may not be available in all years.
- Mathematics 253 and 321 are not required for a BSc in Computer Science but are strongly recommended. As Mathematics 253 is required by several concentrations, taking Mathematics 253 and 321 in year 1 and 2 provides more flexibility in choosing a concentration in year 3 and 4. Students unable to take these courses should take Statistics 211.
- Students unable to take Philosophy 279 in first year may substitute Philosophy 377 and should take this course in the Fall of second year. Philosophy 379 is not required for a BSc in Computer Science but is recommended. This course is required for an Honours BSc in Computer Science.
- Communications Studies 363 is strongly recommended but not required. Students interested in taking a technical writing course who are unable to register in Communications Studies 363 should consider Science 311.
- Courses offered by the Haskayne School of Business are often a good choice for non-science options for future software developers. Calendar entries from the Haskayne School of Business show: “Students have the opportunity to take courses offered by the Haskayne School of Business without the stated prerequisites, with the written permission of the Associate Dean (Undergraduate Programs) as appropriate, upon the recommendation of the instructor of the course. However, should a student fail to achieve satisfac-

tory standing in any course for which the stated prerequisite(s) is (are) lacking, he/she may be required to successfully complete the stated prerequisite(s) prior to being permitted to repeat the course. Students are required to have consent of the Haskayne School of Business Office before registering in 600-level courses offered by the Haskayne School of Business."

Recommended Program Sequence BSc (Majors and Honours)

Students interested in a specific concentration need to choose their computer science, science and non-science options according to the concentration requirements. This includes options taken in year 1 and 2 of the program.

First Year	
Fall	**Winter**
Computer Science 001	
Computer 231 Science or 235	Mathematics 041
Mathematics 221	Computer Science 233
Mathematics 249 or 251	Computer Science 265
Philosophy 279	Mathematics 271
Non-science option	Mathematics 253 or Statistics 211 or option
	Non-science option
Second Year	
Computer Science 002	
Computer Science 325	Computer Science 313
Computer Science 331	Software Engineering 311 or Computer Science 333
Statistics 211 or Mathematics 321 or option	Computer Science 349
Option	Philosophy 379*
Communications Studies 363 or Non-science option	Communications Studies 363 or Non-science option
Third Year	
Computer Science 413	Computer Science 400-level option
Computer Science 457	Computer Science 400-level option
Computer Science option	Computer Science 400-level option
Option	Option
Non-science option	Non-science option
Fourth Year	
Computer Science 502 or 510 or 594*	Computer Science 502 or 510 or 594*
Specified Computer Science 500-level option*	Computer Science 500-level option
Computer Science 400-level option	Computer Science 500-level option
Option	Option
Non-science option	Non-science option

**Required for Honours program. Majors may substitute optional courses as their program and concentration allows.*

Concentrations

Students may focus their program on one of six areas of interest by including a specified set of courses, into their Major or Honours degree. Successful completion will mean that the area of concentration will appear on the transcript. The concentrations and course requirements are:

A. Concentration in Computer Game Design

- Mathematics 253 and 331;
- Physics 211 or 221 and 1.5 FCE from the Faculty of Science other than Computer Science;
- Computer Science 453 and 585;
- One of Computer Science 441, 461, or 481;
- One of Computer Science 587, 589 or 591;
- One of Computer Science 433, 531, or 535;
- One FCE selected from:

  Art 231, 233, 241, 243, 339, 341, 343, 345, 347

  Drama 222, 317, 319

  English 231, 393, 395, 399

  Communications Studies 201, 367

  Operations Management 301

  any course named Music Theory and Composition.

B. Concentration in Software Engineering

- Software Engineering 411 and Computer Science 481;
- Computer Science 594;
- Software Engineering 421 or 443;
- One and one-half FCE chosen from any Software Engineering course at the 400 or 500 level or from Computer Science 411, 433, 471, 501, 525, 565, or 567. At most one-half FCE can be chosen at the 400 level;
- At least one FCE of the non-science options need to be chosen from courses offered by the Haskayne School of Business;
- ***Note:*** *Students concentrating in software engineering are strongly recommended to take Mathematics 323 as part of their science options;*
- ***Note:*** *Recommended courses from the Haskayne School of Business include Business and Environment 291, Management Studies 391, Operations Management 301, 317 403, 407, Management Information Systems 463, 465, Accounting 317, Entrepreneurship and Innovation 201, 381, 403, Marketing 317, 341, Economics 201. Computer Science students who want to take courses from the Haskayne School of Business are advised that the Haskayne School of Business will consider waiving the prerequisites for senior courses (particularly Management Information Systems 463 and 465) on an individual request basis. Students should contact the area chair regarding prerequisite waivers;*
- ***Note:*** *Operations Management 411 and Management Information Systems 455 will not be accepted for credit towards the software engineering concentration;*
- ***Note:*** *Students pursuing the software engineering concentration are advised to look at the 5 year, combined degree BSc in Computer Science/BComm that is offered jointly by the Faculty of Science and the Haskayne School of Business (see below in Section 9 of the Department of Computer Science Calendar entry).*

C. Concentration in Algorithms and Complexity Theory

- Computer Science 511;
- At least three of Computer Science 491, 513, 517, 519, 557, 653, 661, 667, Pure Mathematics 321, 329;
- Philosophy 379;
- Mathematics 253, 311, 321;
- Pure Mathematics 315;
- At least three of Mathematics 323, 349, 353, 371, Pure Mathematics 419, 427, 429, 431, 503, 519, 529.

D. Concentration in Scientific Computation

- Computer Science 461, 471, 491 and one of 501, 517, 531 or 559;
- Mathematics 253 and 331;
- Applied Mathematics 311 and 413;
- 2 FCE in Science outside of Computer Science and Mathematics.

E. Concentration in Programming Languages and Compilers

- Computer Science 401, 411, 417, 510, 523;
- ***Note:*** *Philosophy 379 is strongly recommended.*

F. Concentration in Computer Graphics

- Mathematics 253 and 349;
- Computer Science 453 and 481;
- One FCE: Computer Science 491 and an advanced computational course to be approved by the Department;
- One FCE from Computer Science 587, 589, or 591;
- One-half FCE chosen from Art 231, 233, 241, 339, 341 or Physics 211, 221.

7. BSc Major and Honours in Computer Science Internship Programs

The Internship programs in Computer Science are five-year (20 FCE) degree programs that include a 12- or 16-month Internship period of supervised work experience.

Before starting their first Internship work period, students must meet the admission requirements specified in the Co-operative Education/Internship section of this Calendar. In addition, students must be Computer Science majors or Computer Science honours students, and must currently be taking and/or have completed between 15 and 17.5 FCE appropriate to their degree program, including

(a) Computer Science 313, 325, 331, 349, and Software Engineering 311 (or Computer Science 333);

(b) At least one of Computer Science 413 or 457;

(c) Philosophy 279 or 377;

(d) An additional three FCE in the field of Computer Science, including two and one-half courses numbered 400 or above, and one half course numbered 300 or above.

Students should have a minimum grade point average of 2.50 calculated over the most recent course work to a maximum of five FCE at the time of application to the Internship Major program. Honours students in good standing at time of application will be admitted to the Internship Honours program.

Students who are very close to these admission criteria are also encouraged to apply; admission will be decided on a case by case basis.

Students must apply to Career Services prior to completing the admission requirements outlined above, and by the dates given below. Transcripts must show that the student is enrolled in any courses necessary to complete the admission requirements. Application dates are:

- December 1 for a May 1 first Internship placement;
- May 1 for a September 1 first Internship placement;
- September 1 for a January 1 first Internship placement.

Requirements

Students in the BSc in Computer Science Internship program must meet all requirements for the BSc Major in Computer Science degree program. Students in the BSc Honours in Computer Science Internship program must meet all requirements for the BSc Honours in Computer Science program, with one exception: The honours requirement for one of Computer Science 502, 510 or 594 is replaced by one FCE in the field of Computer Science numbered 400 or above (which may include one of these courses).

In addition to the above requirements, students must complete the following three courses (which represent the individual Internship work terms):

Internship 503.01, 503.02, 503.03

(Internship 503.04 is recommended but not required.)

Students must take all their Internship work terms consecutively and be registered full time. Upon completion of each Internship work term, the student must present a work term report to the Department of Computer Science Internship Representative. Reports and work terms are evaluated on a CR/F grade, based on job performance and completion of a work term report that meets the standards of the Department of Computer Science. Students should also be aware of the policy concerning course withdrawal, as specified in the Co-operative Education/ Internship section of this Calendar.

For further details and information, see the Department of Computer Science Web Page (http://www.cpsc.ucalgary.ca/Coop/), or contact the Department of Computer Science and ask for the Department of Computer Science Internship Representative.

Program Sequence

The Internship period, consisting of the consecutive Internship 503.01, 503.02, 503.03 and optional 503.04 Internship work terms, is normally taken shortly after completing the required courses as indicated above. This typically occurs after year three (minimum fifteen FCE) but before completing year four (maximum seventeen and one-half FCE).

The combination of Internship and study sessions will allow completion of the program in five years.

8. Double Major in Computer Science and General Mathematics

Admission into the Double Major program in Computer Science and General Mathematics is governed by the same criteria as other Computer Science programs; see Limitations of Enrollment in Computer Science above.

Requirements for this program are extremely tight, and students should choose courses carefully in order to ensure that all courses can be used to satisfy graduation requirements. Students interested in this program should consult the Department of Computer Science or the Department of Mathematics and Statistics for additional information about course selection.

9. Combined Degree, BComm/BSc (Computer Science)

The five-year program, sponsored jointly by the Haskayne School of Business and the Department of Computer Science, leads to both the Bachelor of Science and the Bachelor of Commerce degrees. The program requires careful selection of courses in order to complete the requirements of both the Haskayne School of Business and the Faculty of Science.

Students wishing to embark on the sequence of courses leading to this combined degree may enter the combined program in year one, otherwise they may enter the Faculty of Science in first year and be accepted into the Computer Science program. By the end of the second year of studies students should then apply to the Haskayne School of Business, either to pursue the Bachelor of Commerce degree or to pursue the combined degree.

Once admitted to the combined program, a student may elect to remain in it, or switch to either of the two separate degree programs, as long as the requirements of each Faculty continue to be met. Failure to meet requirements will result in a student being required to withdraw from the combined or separate programs, as the case may be.

For program details, please see the Haskayne School of Business section of this Calendar.

10. Combined Degree, BSc (Computer Science)/ BSc (Biological Sciences)

The five-year program, sponsored jointly by the Department of Biological Sciences and the Department of Computer Science, leads to both the Bachelor of Science in Computer Science and the Bachelor of Science in Biological Sciences degrees. The program requires careful selection of courses in order to complete the requirements of both the Departments.

Students wishing to embark on the sequence of courses leading to this combined degree program may enter the combined program in year one, otherwise they may enter the Faculty of Science in first year and be accepted into the Computer Science program or the Biological Sciences program.

Once admitted to the combined program, a student may elect to remain in it, or switch to either of the two separate degree programs, as long as the requirements of each program continue to be met. Failure to meet requirements will result in a student being required to withdraw from the combined or separate programs, as the case may be.

For program details, please see the Department of Biological Sciences section of this Calendar.

11. Required Courses – Minor Program

- 3.5 FCE - Computer Science 231, 233, 265, 313, 331, 349 and Software Engineering 311.
- 1.0 FCE – Mathematics 221 or 211; Mathematics 271.
- 0.5 FCE – Philosophy 279 or 377.

- 1.5 FCE – courses in the field of Computer Science. 0.5 FCE must be numbered 400 or above and 1.0 FCE must be numbered 300 or above.

All students wishing to obtain a Minor in Computer Science must have satisfactorily completed or be concurrently registered in Computer Science 313, 331, and 349 in order to register in 400- and 500-level courses. Admission into a minor program in Computer Science is governed by the same criteria as admission into the major programs; see Limitation of Enrollment in Computer Science above.

Geology and Geophysics

Degrees Offered in Geology and Gephysics

	Geology	Geophysics	Applied and Environmental Geology
UNDERGRADUATE	BSc	BSc	BSc
	BSc Honours	BSc Honours	BSc Honours
	BSc/BA*	BSc/BA*	BSc/BA*
GRADUATE	MSc	MSc	
	PhD	PhD	

* Combined Degree with the Faculty of Humanities or Social Sciences

1. Programs Offered

- BSc and BSc Honours in Geology, Applied and Environmental Geology, Geophysics
- Minors in Geology, Applied and Environmental Geology, Geophysics and Earth Science

Collaborative Programs

The Earth Science and Environmental Science (Geology) programs are single degree, four year programs jointly administered by the Faculty of Science and the Faculty of Social Sciences.

Program details are listed in the Collaborative Programs section of this Calendar. Since these are multidisciplinary programs with restricted entry, students should consult the respective program Directors at their earliest opportunity.

Double Major and Double Degree Programs

- Double major programs combining any two of Geology, Applied and Environmental Geology, Geophysics, Earth Science or Environmental Science (Geology) are allowed.
- Double degree programs are allowed combining Geophysics with one of Geology, Applied and Environmental Geology, or Environmental Science (Geology)

2. Department vs. Faculty Regulations

Programs in the Department of Geology and Geophysics are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to read the Faculty Regulations in Section III first.

Students should consult the Degree Navigator periodically to ensure that requirements are being met. Students are also strongly urged to consult the Department at all stages of their program.

APEGGA Requirements

The practice of geology and geophysics in Alberta is governed by Provincial law and regulated by the Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA). Members of the Rundle Group and the Geophysics Society are automatically student members of APEGGA.

In order to meet the requirements of professional registration, specific academic training and four years of appropriate full-time experience as a geologist- or geophysicist-in-training following graduation are needed.

Students are strongly advised to plan their program to meet the requirements for professional registration.

Current syllabus information is available in the Departmental Office.

3. Department Information

Department Head: L.R. Lines
Undergraduate Advisor: 220-5850
Department Office: ES 118
Telephone: 220-5841
Fax: 284-0074
Web Site: http://www.geo.ucalgary.ca/
E-mail: geoscience@ucalgary.ca

4. Enrollment Limitations

Program Enrollment Limits

The Department of Geology and Geophysics limits enrollment in all programs. Students may be directly admitted into the Geology, Applied and Environmental Geology or Geophysics Major programs and, once admitted, a place in these programs is assured for students advancing through the second and subsequent years with satisfactory performance. Admission will be granted for Fall Session only and will be based upon academic merit. Due to limited enrollment capacity in many senior courses, it will not always be possible to accommodate every student's choice of optional geology courses in the third and subsequent years.

As space permits, the Department will accept a certain number of students who wish to gain admission to the second or third year of the Geology, Applied and Environmental Geology, Geophysics, Earth Science, or Environmental Science (Geology) Major or Minor programs or the Natural Science (Geology and Geophysics) Concentration program by transferring from other institutions or programs. Any student requesting admission at this level is subject to "Admission Requirements" as stated in the Academic Regulations section of this Calendar and, in addition, must meet the following criteria:

Completion of the following courses with a grade of "C-" or better in each course:

For Geology, Applied and Environmental Geology, Earth Science, Environmental Science (Geology):

- Geology 201 and 203
- Chemistry 201 and 203
- Mathematics 251 or 249 or Applied Mathematics 217 and one of Mathematics 253 or 263 or 221

For Geophysics:

- Geology 201 and 203
- Physics 211 or 221 and 223
- Mathematics 251 or 249 or Applied Mathematics 217 and Mathematics 253 or 263

For Natural Sciences program Concentration in Geology and Geophysics:

- Geology 201 and 203
- Chemistry 201 and 203
- Mathematics 251 or 249 or Applied Mathematics 217 and Mathematics 253 or 263
- Physics 211 or 221 and 223

In the event that the number of students choosing one of these programs exceeds the number that can be accommodated by available resources, students will be admitted to that program in descending rank order of academic performance until the enrollment limit is reached.

Academic performance will be measured on the basis of the grade point average calculated over the most recent five FCE (University of Calgary courses and/or transferable courses taken at other institutions). (New admissions to the University are always subject to the "Admission Requirements" as stated in the Academic Regulations section of this Calendar.)

Course Enrollment Limitations

Geology 311, 313, 337, 341, 373, 381, 391, 401, 429, 437, 439, 441, 503, 541, Geophysics 355, 453, 457, 549, 557, and 559 are limited enrollment courses.

Students registered in one of the following programs will have priority in the indicated courses:

Geology

Geology 311, 313, 337, 341, 373, 381, 391, 401, 429, 437, 439, 541, Geophysics 355, 453, 559

Applied and Environmental Geology

Geology 311, 313, 337, 341, 373, 381, 401, 429, 437, 439, 441, 503, Geophysics 355, 453, 559

Geophysics

Geology 311, 341, 381, 401, 541, Geophysics 355, 453, 457, 549, 557, and 559

Natural Sciences Program (Geology and Geophysics)

Geology 311, 313, 337, 341, 381, 429, Geophysics 355, 453, 457, 557, and 559

Earth Science

Geology 311, 337, 341, 381, 391

Environmental Science (Geology)

Geology 311, 313, 337, 341, 373, 381, 401, 429, 503, Geophysics 355

5. Geology Programs

Admission

See the sections on "Enrollment Limitations" under the Department of Geology and Geophysics and under Section III (Faculty Regulations).

Courses constituting the field of Geology

All courses labelled Geology excluding Geology 209, 301, 303, 307, 309, 317, 377, 399, 415, 471, and 499.

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

7.5 FCE - Geology 201, 203, 311, 313, 337, 339, 341, 381, 391, 429, 443, 437, 439, 461, 555

2.0 FCE - courses in the field of Geology

1.0 FCE - Chemistry 201, 203

0.5 FCE - Geophysics 355 or 453

0.5 FCE - Mathematics 251 or 249 or Applied Mathematics 217

0.5 FCE – Mathematics 253 or 263 or Applied Mathematics 219

0.5 FCE – Mathematics 221

1.0 FCE - Physics 211 or 221, 223

1.0 FCE - Science or Engineering options from the following:

- Applied Mathematics 311, 413, 415
- Biology 231, 233
- Chemistry 311, 315, 331, 333, 351, 353, 371, 373
- Computer Science 215, 231, 233
- Mathematics 311, 331, 349, 353
- Physics 321, 323, 325
- Statistics 211, 213, 357
- Zoology 375

1.0 FCE - Science or Engineering options from the following:

- Petroleum Engineering 507, 513, 515
- courses in the field of Geophysics
- 0.5 FCE from the field of Geology

4.0 FCE – Non- Science options as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

0.5 FCE - Option

Note: *600-level courses are available to fourth year students with prerequisites and consent of the Department.*

Required Courses – Honours Program

Same as Major Degree Program in Geology except the 1.0 FCE listed in the "Science or Engineering options" section and the 0.5 FCE option are specified as follows:

- 1.0 FCE – Geology 510
- 0.5 FCE – Geophysics 453 or 465
- 0.5 FCE – Science option other than Geology or Geophysics

Required Courses – Minor Program

5.0 FCE in the field of Geology

Suggested Program Sequence (Majors and Honours)

First Year	
Fall	**Winter**
Geology 201	Geology 203
Chemistry 201	Chemistry 203
Mathematics 251 or 249	Mathematics 253 or 263
Physics 211 or 221	Physics 223
Non-science option	Non-science option
Second Year	
Geology 311	Geology 313
Geology 337*	Geology 339**
Geology 381	Geology 341
Geology 391	Geophysics 355
Mathematics 221	Non-science option
Non-science option	
Third Year	
Geology 429	Geology 443
Geology 437*	Geology 439**
Geophysics 453 or 465***	Geology 461
Geology option	Geology option
Science option	Non-science option
Non-science option	
Fourth Year	
Geology option	Geology 555
Geology 510***	Geology 510***
Geology option	Science option
Non-science option	Non-science option

**Geology 337 and 437 run for about 10 days prior to the Fall Session*
***Geology 339 and 439 run for about 12 days after the Winter Session*
****Required for the Honours Program (Majors may substitute science or other optional courses)*

Note: *In addition to these field school courses, students are permitted to register in 2.5 FCE in each of the Fall and Winter Sessions.*

6. Applied and Environmental Geology Programs

Admission

See the sections on "Enrollment Limitations" under the Department of Geology and Geophysics and under Section III (Faculty Regulations).

Courses constituting the field of Applied and Environmental Geology:

- Geology 201, 203, 311, 313, 337, 339, 341, 373, 381, 401, 429, 437, 439, 441, 503, 505, 571, 597
- Geophysics 355

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

8.5 FCE - Geology 201, 203, 311, 313, 337, 339, 341, 373, 381, 401, 429, 437, 439 or 441, 503, 505, 571, 597

1.0 FCE - Chemistry 201, 203

1.0 FCE - Geophysics 355, 465

0.5 FCE - Mathematics 251 or 249 or Applied Mathematics 217

0.5 FCE - Mathematics 253 or 263 or Applied Mathematics 219

1.0 FCE - Mathematics 221, 331

1.0 FCE - Physics 211 or 221, 223

0.5 FCE - Statistics 357

2.0 FCE Science or Engineering options chosen in consultation with the Department

4.0 FCE – **Non- Science options** as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

Note: *Students interested in APEGGA registration are advised to check the APEGGA requirements prior to selecting optional Science or Engineering courses.*

Note: *600-level courses are available to fourth year students with prerequisites and consent of the Department.*

Required Courses – Honours Program

Same as Major Degree Program in Applied and Environmental Geology except that 1.0 FCE Science or Engineering option is replaced by Geology 510.

Required Courses – Minor Program

- Geology 373, 401, 503, 505, 571
- 2.5 FCE selected from:
  Geology 311, 313, 337, 339, 341, 381, 429,
  Geophysics 355, 457, 465

Suggested Program Sequence (Majors and Honours)

First Year	
Fall	**Winter**
Geology 201	Geology 203
Chemistry 201	Chemistry 203
Mathematics 249 or 251	Mathematics 253 or 263
Physics 211 or 221	Physics 223
Non-science option	Non-science option
Second Year	
Geology 311	Geology 313
Geology 337*	Geology 339**
Geology 381	Geology 341
Mathematics 221	Geology 373
Non-science option	Non-science option
Third Year	
Geology 401	Geology 439 or 441**
Geology 429	Mathematics 331
Geology 437*	Statistics 357
Science or Engineering option	Geophysics 355
Non-science option	Non-science option
Fourth Year	
Geology 503	Geology 505
Geology 597	Geology 571
Geophysics 465	Science or Engineering option
Geology 510 ***	Geology 510 ***
Non- science option	Non-science option

** Geology 337 and 437 run for about 10 days prior to the Fall Session*
***Geology 339, 439 and 441 run for about 12 days after the Winter Session*
****Required for the Honours Program (Majors substitute science or engineering optional courses)*

Note: *In addition to these field school courses, students are permitted to register in 2.5 FCE in each of the Fall and Winter Sessions.*

7. Geophysics Programs

Admission

Application deadline: March 1

See the sections on "Enrollment Limitations" under the Department of Geology and Geophysics and under Section III (Faculty Regulations).

Courses constituting the field of Geophysics

- All courses labelled Geophysics excluding Geophysics 365 and 375
- Geology 201, 203, 341, 381
- Physics 211, 221, 223, 321, 323

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

4.5 FCE - Geophysics 355, 359, 453, 457, 547, 549, 551, 557, 559

2.0 FCE - Geology 201, 203, 341, 381

0.5 FCE - course in the field of Geology

0.5 FCE - Applied Mathematics 415

1.0 FCE - Chemistry 201, 203

0.5 FCE - Computer Science 215 or 231

0.5 FCE - Mathematics 251 or 249 or Applied Mathematics 217

1.5 FCE - Mathematics 221, 253 or 263, 331

2.0 FCE - Physics 211 or 221, 223, 321, 323

1.0 FCE - **Science or Engineering options** from the following:

- Applied Mathematics 311, 413, 433
- Applied Physics 427, 407, 573, 575
- Petroleum Engineering 507, 513, 515
- Physics 325, 341, 343, 347, 443, 455, 533
- Pure Mathematics 421
- Statistics 357
- courses in the field of Geophysics
- courses in the field of Geology

4.0 FCE – **Non- Science options** as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

2.0 FCE - Options

Note: *600-level courses are available to fourth year students with prerequisites and consent of the Department.*

Required Courses – Honours Program

Same as Major Degree Program in Geophysics except that the 1.0 FCE "Science or Engineering options" and 2.0 FCE "Options" are replaced by the following:

1.5 FCE - Applied Mathematics 413, Geophysics 509, Statistics 357

1.5 FCE – Options

Required Courses – Minor Program

- Geophysics 355, 359, 453
- Geology 201, 203
- Physics 211 or 221, 223
- Geology 341 or Physics 321
- Plus two of Geophysics 547, 551, 557, 559

Suggested Program Sequence (Majors and Honours)

Faculty of Science

First Year	
Fall	**Winter**
Geology 201	Geology 203
Mathematics 249 or 251	Mathematics 253 or 263
Chemistry 201	Chemistry 203
Physics 211 or 221	Physics 223
Non-science option	Non-science option
Second Year	
Geophysics 359	Geophysics 355
Geology 381	Mathematics 331
Mathematics 221	Statistics 357*
Physics 323	Option
Non-science option	Non-science option
Third Year	
Geophysics 453	Geology 341
Applied Mathematics 413*	Geophysics 457
Computer Science 215 or 231	Applied Mathematics 415
Physics 321	Option
Non-science option	Non-science option
Fourth Year	
Geophysics 549**	Geophysics 547
Geophysics 551	Geophysics 557
Geophysics 509 *	Geophysics 559
Geology option	Option
Non-science option	Non-science option

**Required for the Honours Program (Majors may substitute science or engineering or other optional courses)*
*** Geophysics 549 field component runs for about 12 days prior to the Fall Session*

Degrees Offered in Mathematics and Statistics

	Applied Math	Pure Math	Statistics	Actuarial Science	General Mathematics
UNDERGRADUATE	BA	BA	BA	BA	BA
	BA Honours	BA Honours	BA Honours	BA Honours	
	BSc	BSc	BSc	BSc	BSc
	BSc Honours	BSc Honours	BSc Honours	BSc Honours	
				BA co-op	
				BA Honours co-op	
				BSc co-op	
				BSc Honours co-op	
				BComm/BSc*	
	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**	BSc/BA**
					BSc or BA/BEd***
GRADUATE	MSc	MSc	MSc	MSc	
	PhD	PhD	PhD	PhD	

* Combined Degree with the Haskayne School of Business
** Combined Degree with the Faculty of Humanities or Social Sciences
*** Combined Degree with the Faculty of Education

Mathematics and Statistics

1. Programs Offered in Mathematics and Statistics

- BA and BA Honours in Applied Mathematics, Pure Mathematics, Statistics, Actuarial Science
- BSc and BSc Honours in Applied Mathematics, Pure Mathematics, Statistics, Actuarial Science
- BA or BSc in General Mathematics
- BA or BSc and BA or BSc Honours in Actuarial Science Co-operative Education
- BComm/BSc Combined Degree in Actuarial Science and Business
- BSc or BA/BEd (Master of Teaching Program) Combined Degree in General Mathematics in Education
- Minors in Applied or Pure Mathematics, Statistics and Actuarial Science

2. Department vs. Faculty Regulations

Programs in the Department of Mathematics and Statistics are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to read Section III (Faculty Regulations) first.

Students are advised to check the Degree Navigator periodically to ensure that all requirements are being met.

3. Department Information

Divisions

- **Division of Applied Mathematics**
- **Division of Pure Mathematics**
- **Division of Statistics and Actuarial Science**

Courses offered by the Department bear the labels Mathematics, Applied Mathematics, Pure Mathematics, Statistics, and Actuarial Science. Note that (1) the course descriptions appear in the back of this Calendar in five non-contiguous alphabetically arranged blocks, and (2) "Mathematics" is a course label but not a Major field.

All students intending to pursue a Major or Honours program in Applied Mathematics, Pure Mathematics, Statistics, or Actuarial Science should consult the Undergraduate Director. The Undergraduate Director can provide advice on such important matters as specialized programs available within the field, recommended course sequences, possible combinations of Major and Minor fields and recommended undergraduate study leading to graduate study.

Mathematics and Statistics
Department Head: T. Bisztriczky
Department Office: MS 476
Undergraduate Director: V. Stastna
Undergraduate Office: MS 476
Telephone: (403) 220-5203
Fax: (403) 282-5150
Web Site: http://www.math.ucalgary.ca
E-mail: undergrad@math.ucalgary.ca.

4. Mathematics Diagnostic Test

Mathematics II, offered by Continuing Education, with a grade of "D" or better is acceptable in lieu of Pure Mathematics 30 for general admissions requirements.

Students who wish to enroll in courses in the Faculty of Science for which Pure Mathematics 30 is a prerequisite, and who wish to use Mathematics II to satisfy that prerequisite, must achieve a grade of "C-" or higher in Mathematics II.

Students whose programs require Mathematics 211 or 221 and/or 249 should note that entry to these courses is restricted to students who have met one of the following three prerequisites:

(a) a grade of 70% or higher in Mathematics 30 or Pure Mathematics 30;

(b) a grade of "B-" or better in the non-credit courses Mathematics II or College Algebra and Trigonometry offered by Continuing Education.

(c) a grade of 70% on the Mathematics Diagnostic Test administered by the Department of Mathematics and Statistics.

For entry to Mathematics 251, students must present one of the above and Mathematics 31.

Notes:

1. *Students meeting prerequisite (a) should enroll directly into Mathematics 211 or 221 and/or 249; students meeting prerequisite (a) plus Mathematics 31 should enroll directly into Mathematics 251; all other students must take either Mathematics II or College Algebra and Trigonometry or must write the Mathematics Diagnostic Test.*
2. *The prerequisite for Mathematics II is Mathematics I or Pure Mathematics 20. Students who have not completed one of these prerequisites (including those who have completed Applied Mathematics 30) are directed to begin with Mathematics I.*
3. *Students who have completed Pure Mathematics 20 or Mathematics 20, but feel their skills are not current enough to take Mathematics II, are encouraged to take the Mathematics II Assessment Test administered by Continuing Education.*
4. *Students from outside Alberta, who may have previously studied the material in Mathematics I may also be required to take the Mathematics II Assessment Test.*

The Mathematics Diagnostic Test is a one hour test of the student's mastery of topics in Mathematics 10, 20 and 30. It is offered four times per year. Newly admitted students who wish to write the Mathematics Diagnostic Test are advised to do so at their earliest convenience after they have received their notice of admission.

The test will be offered during the week preceding the start of classes in each of the Fall, Winter, Spring and Summer Sessions.

The test fee is $50.00 for each writing. The fee must be paid at the Fees Office in advance of the test date; students will be required to present proof of payment for admission to the test.

The test is administered on a computer and the results are available to the student immediately.

The Mathematics Diagnostic Test has the same status as a University final examination. Accordingly, any form of cheating will be considered grounds for suspension or expulsion from the University. Proof of identity will be required during the test. Students more than 30 minutes late will not be admitted to the examination.

Information about the test is available from the Undergraduate Office in the Department of Mathematics and Statistics.

5. Special Assessment (Challenge Examinations)

Students who are enrolled in Mathematics 211 or 221 or 249 or 251 or 253, but who feel that they have already mastered the course material, may take a challenge examination during the first week of classes. Students who pass the test may be granted special assessment status for that course and direct entry into Mathematics 253, 271, 311 or 349. Credit will be given for the course taken by special assessment, a grade assigned, and the regular course fee will be assessed. Students interested in pursuing special assessment should consult the Department during the first week of classes.

6. Core Courses

All programs include the following common core of courses:

- Mathematics 211 or 221
- Mathematics 251 or 249 **or** Applied Mathematics 217
- Mathematics 253 or 263
- Mathematics 311
- Mathematics 321
- Mathematics 349
- Mathematics 353
- Computer Science 231 or 215.

7. Recommended First and Second Year Sequence

First Year for all Programs	
Fall	**Winter**
Mathematics 251 or 249 **or** Applied Mathematics 217	Mathematics 253 or 263*
Mathematics 211 or 221	Computer Science 231 or 215
Humanities **or** Social Sciences option	Humanities **or** Social Sciences option
Option	Option
Non-Science option	Non-Science option

Second Year for all Programs	
Fall	**Winter**
Mathematics 349	Mathematics 353
Mathematics 321	Mathematics 323 or Pure Mathematics 315***
Mathematics 311	Option or Actuarial Science 327**
Option or Applied Mathematics 311 or Actuarial Science 325**	Option
Non-Science option	Non-Science option

**Students in the Department of Mathematics and Statistics programs are strongly recommended to take Mathematics 263 for an early exposure to rigorous analysis in preparation for senior required courses.*
***Students in the Actuarial Science program should choose Actuarial Science 325 and 327; students in the Applied Mathematics program should choose Applied Mathematics 311.*
****Students in Statistics, Actuarial Science, or Applied Mathematics concentration programs should choose Mathematics 323; students in Pure Mathematics, Pure Mathematics concentration, or Applied Mathematics major programs should choose Pure Mathematics 315*

8. Programs in Applied Mathematics

Courses constituting the field of Applied Mathematics

- All courses labelled Applied Mathematics
- All courses labelled Mathematics except Mathematics 205, 271 and 331
- Pure Mathematics 315, 421, 431, 435, 445, 521, 545

Required Courses –Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

0.5 FCE - Mathematics 221

0.5 FCE - Mathematics 251 or 249 **or** Applied Mathematics 217

2.5 FCE - Mathematics 253 or 263, 311, 321, 349, 353

0.5 FCE - Computer Science 231 or 215

0.5 FCE - Applied Mathematics 311

0.5 FCE - Pure Mathematics 315 or Mathematics 323

1.0 FCE - Two from the list:
Physics 211 or 221, 223,
Astronomy 211, 213,
Chemistry 201, 203,
Computer Science 233, 313, 331,
Biology 231, 233,
Geophysics 355, 365

1.0 FCE - Applied Mathematics 413, Mathematics 411

1.0 FCE - Pure Mathematics 435, 445

0.5 FCE - Pure Mathematics 421 or 521

0.5 FCE - Applied Mathematics 491

0.5 FCE - Applied Mathematics 411 or 425 or 451 or 493

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

6.5 FCE – Options

Required Courses –Honours Program

The first 9.0 FCE required in the Honours program, up to and including Applied Mathematics 491, are the same as in the Major program. The remaining 11.0 FCE required in the Honours program are:

0.5 FCE - Applied Mathematics 411

0.5 FCE - One from the list: Applied Mathematics 425, 451, Pure Mathematics 545.

1.0 FCE - Any 500 level or above in Applied Mathematics.

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

5.0 FCE - Options

Other Requirements

Students in the Major and Honours programs of Applied Mathematics are required to fulfill an oral component. Normally, it is fulfilled by presenting a satisfactory talk or oral report of a mathematical nature to an appropriate audience. Consult the Undergraduate Director for details.

Recommendations

It is recommended that the 200- and 300-level courses listed above be taken in the first two years of study. Students should consult with the Undergraduate Director on a regular basis throughout their program.

Concentrations

Students may focus their program on one of two areas of interest by including a specified set of courses into their Major degree. Successful completion will mean that the area of concentration will appear on the transcript. Students should carefully plan their course selections to ensure that prerequisites for upper-level courses are obtained. Consultation with the Undergraduate Director on a regular basis is highly recommended.

A: Concentration in Mathematical Finance and Risk Management

The first 4.5 FCE required in the Concentration, up to and including Applied Mathematics 311, are the same as in the Major program. The remaining 15.5 FCE required in the Concentration are:

1.0 FCE - Mathematics 323 and Computer Science 233

1.5 FCE - Pure Mathematics 421, 435, 445

1.0 FCE - Statistics 407, 409

0.5 FCE - Mathematics 411

3.5 FCE - Applied Mathematics 371, 413, 481, 483, 491, 493, 581

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

4.0 FCE - Options

B. Concentration in Computational Applied Mathematics

The first 4.5 FCE required in the Concentration, up to and including Applied Mathematics 311, are the same as in the Major program. The remaining 15.5 FCE required in the Concentration are:

2.0 FCE - Mathematics 323, Computer Science 233, 331 and 333 or Software Engineering 311

1.5 FCE - Pure Mathematics 421, 435, 445

0.5 FCE - Mathematics 411

3.5 FCE - Applied Mathematics 371, 413, 425, 451, 491, 493, 503

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

4.0 FCE - Options

Required Courses - Minor Program

0.5 FCE - Mathematics 221

0.5 FCE - Mathematics 251 or 249 or Applied Mathematics 217

0.5 FCE - Mathematics 253 or 263
or Applied Mathematics 219

1.0 FCE - Mathematics 311, 349

0.5 FCE - Mathematics 353
or Applied Mathematics 309

0.5 FCE - Applied Mathematics 311 or 307

1.5 FCE - From the list:
Mathematics 321, 323, Applied Mathematics 371, any course labelled Applied Mathematics at the 400 level or above.

9. Programs in Pure Mathematics

Courses constituting the field of Pure Mathematics

- Mathematics 221, 249, 251, 253, 263, 271, 311, 321, 323, 349, 353, and 401
- Applied Mathematics 217 and 311
- All courses labelled Pure Mathematics

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

0.5 FCE - Mathematics 221

0.5 FCE - Mathematics 251 or 249
or Applied Mathematics 217

2.5 FCE - Mathematics 253 or 263, 311, 321, 349, 353

0.5 FCE - Pure Mathematics 315

0.5 FCE - Computer Science 231 or 215

0.5 FCE - Applied Mathematics 311

0.5 FCE - Mathematics 323
or Computer Science 233
or Physics 211 or 221

0.5 FCE - Mathematics 411

1.5 FCE - Pure Mathematics 431, 435, 445

0.5 FCE - Pure Mathematics 421 or 521

0.5 FCE - Pure Mathematics 415 or 423 or 427

0.5 FCE - One of:
Mathematics 271, 401, Pure Mathematics 371, 419, 425, or any 500-level course in Pure Mathematics, Applied Mathematics, or Statistics

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

7.0 FCE – Options

Required Courses – Honours Program

The requirements for the Honours program are the same first 4.5 FCE as in the Major program up to and including the 0.5 FCE - Computer Science 231 or 215, plus the following:

0.5 FCE - One of:

Applied Mathematics 311, Mathematics 323, Computer Science 233, Physics 211 or 221

2.5 FCE - Pure Mathematics 431, 435, 445, 505, 511

0.5 FCE - Pure Mathematics 545 or Applied Mathematics 411

0.5 FCE - Pure Mathematics 421 or 521. Choice must be Pure Mathematics 521 if Applied Mathematics 411 is chosen in item above.

1.0 FCE - Any courses at the 400 level or above in Pure Mathematics

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

6.5 FCE - Options

Other Requirements

Students in the Major and Honours programs of Pure Mathematics are required to fulfill an oral component. Normally, it is fulfilled by presenting a satisfactory talk or oral report of a mathematical nature to an appropriate audience. Consult the Undergraduate Director for details.

Recommendations

It is recommended that the 200- and 300-level courses listed above be taken in the first two years of study. It is highly recommended that students take Philosophy 279 or 377 to complement Mathematics 271. Students should consult with the Undergraduate Director on a regular basis throughout their program.

It is recommended that students include an international component in their program. Consult the Undergraduate Director for details.

Concentrations

Students may focus their program on one of two areas of interest by including a specified set of courses into their Major or Honours degree. Successful completion will mean that the area of concentration will appear on the transcript. Students should carefully plan their course selections to ensure that prerequisites for upper-level courses are obtained. Consultation with the Undergraduate Director on a regular basis is highly recommended.

A. Concentration in Cryptography

For Major with Concentration: The first 3.5 FCE required in the Major Concentration, up to and including Mathematics 353, are the same as in the Major program. The remaining 16.5 FCE required in the Major Concentration are:

0.5 FCE - Mathematics 271

1.0 FCE - Computer Science 231, 233

0.5 FCE - Computer Science 265, 313 or 331

4.5 FCE - Pure Mathematics 315, 329, 419, 427, 429, 431, 435, 445, 529

1.0 FCE - Applied Mathematics 311 and Mathematics 411

0.5 FCE - Pure Mathematics 421 or 521

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

4.5 FCE - Options

For Honours with Concentration:

10.0 FCE – Same as the Major Concentration program above, up to and including Pure Mathematics 529.

1.0 FCE - Pure Mathematics 505, 511

0.5 FCE - Pure Mathematics 545 or Applied Mathematics 411

0.5 FCE - Pure Mathematics 421 or 521 (Choice must be 521 if Applied Mathematics 411 is chosen in item above)
- 4.0 FCE - Non-Science options, same as Major Concentration program.

4.0 FCE – Options

B. Concentration in Computational Discrete Mathematics

For Major with Concentration: The first 3.5 FCE required in the Major Concentration, up to and including Mathematics 353, are the same as in the Major program. The remaining 16.5 FCE required in the Major Concentration are:

0.5 FCE – Mathematics 271

1.0 FCE – Computer Science 231, 233

0.5 FCE – Computer Science 265 or 331 (331 is recommended)

4.5 FCE – Pure Mathematics 315, 371, 419, 427, 431, 435, 445, 471, 519

1.0 FCE – Applied Mathematics 311 and Mathematics 411

0.5 FCE – Pure Mathematics 421 or 521

4.0 FCE – Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

4.5 FCE - Options

For Honours with Concentration:

10.0 FCE – Same as the Major Concentration program above, up to and including Pure Mathematics 519

1.0 FCE – Pure Mathematics 505, 511

0.5 FCE - Pure Mathematics 545 or Applied Mathematics 411

0.5 FCE - Pure Mathematics 421 or 521 (Choice must be 521 if Applied Mathematics 411 is chosen in item above)

4.0 FCE - Non-Science options, same as Major Concentration program.

4.0 FCE - Options

Required Courses – Minor Program

5.0 FCE – Selected from the field of Pure Mathematics.

The selection might include:
- Mathematics 221
- Mathematics 251 or 249 or Applied Mathematics 217
- Mathematics 253 or 263, 311, 349, 353.

10. Programs in Statistics

Courses constituting the field of Statistics

- Mathematics 211, 221, 249, 251, 253, 263, 311, 321, 323, 349, 353, and 401
- Applied Mathematics 217

- All Statistics courses numbered 400 or higher

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

0.5 FCE - Mathematics 211 or 221

0.5 FCE - Mathematics 251 or 249
or Applied Mathematics 217

3.0 FCE - Mathematics 253 or 263, 311, 321, 323, 349, 353

0.5 FCE - Computer Science 231 or 215.

1.5 FCE - Statistics 421, 429, 513, 515

3.0 FCE - Selected from any courses labelled Statistics at the 400 level or above

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

7.0 FCE - Options

Required Courses – Honours Program

The first 6.0 FCE required in the Honours program, up to and including Statistics 421, 429, 513, 515, are the same as in the Major program. The remaining 14.0 FCE required in the Honours program are:

4.0 FCE - Selected from any courses labelled Statistics at the 400 level or above

0.5 FCE - Pure Mathematics 435

0.5 FCE - Pure Mathematics 445 or 421.

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

5.0 FCE - Options

Recommendations

It is recommended that 200- and 300-level courses listed above should be taken in the first two years of study. Pure Mathematics 421 is a recommended option. Students should consult with the Undergraduate Director on a regular basis throughout their program.

For Statistics majors who wish to pursue a Computer Science minor, see Section 16 below.

Required Courses - Minor Program

0.5 FCE - Mathematics 251 or 249 or Applied Mathematics 217

2.5 FCE - Mathematics 253 or 263, 321, 323, 349 and 353

2.0 FCE - Selected from any courses labelled Statistics at the 400 level or above.

11. Programs in Actuarial Science

Courses constituting the field of Actuarial Science

- Mathematics 211, 221, 249, 251, 253, 263, 311, 321, 323, 349, 353, 401
- All courses labelled Actuarial Science
- Statistics 407, 421, 429 , 433, 437, 505
- Applied Mathematics 217

Note: *Courses in Risk Management and Insurance are not included in the field, but are relevant and are recommended electives for Actuarial Science students. Interested students should consult the Division or the Chair in Risk Management and Insurance in the Haskayne School of Business.*

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

0.5 FCE - Mathematics 211 or 221

0.5 FCE - Mathematics 251 or 249
or Applied Mathematics 217

3.0 FCE - Mathematics 253 or 263, 311, 321, 323, 349, 353

0.5 FCE - Computer Science 231 or 215

2.0 FCE - Actuarial Science 325, 327, 427, 527

0.5 FCE - Statistics 421

3.0 FCE – Selected from the list:
courses labelled Actuarial Science, Statistics 407, 429, 433, 437, 505.

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

6.0 FCE - Options

Not every 400- and 500-numbered Statistics and Actuarial Sciences course is offered every year. Students in third year should ensure they take a sufficient number of these in order to graduate at the end of their fourth year.

Required Courses – Honours Program

The first 10.0 FCE required for the Honours program are the same as the first 10.0 FCE in the Major program, up to and including the 3.0 FCE selected from a list. The remaining 10.0 FCE are as follows:

1.0 FCE - Selected from the list:
all Actuarial Science courses;
any course in Economics at the 400 level or above;
any course in Risk Management and Insurance at the 300 level or above;
any additional 400- or 500-level course in Statistics

4.0 FCE - Non-Science options as follows: (check Table I, Section III for ineligible courses)
- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

5.0 FCE – Options

Recommendations

- It is recommended that 200- and 300-level courses listed above should be taken in the first two years of study. Not every 400- and 500-numbered Statistics and Actuarial Sciences course is offered every year. Students should consult with the divisional office to plan for the upcoming cycle of offered courses as well as for a progress assessment on a regular basis throughout their program.
- The following courses are some of the recommended options for Actuarial Science students in second (or subsequent) years:

  Accounting 317

  Communication Studies 361, 363

  Economics 301

  Economics 309 or 357

  Risk Management and Insurance 317 (strongly recommended).

  Options in first year should be selected with these second year options in mind, in order to satisfy prerequisites. At least one half course in Economics is strongly recommended.
- The following courses are some of the recommended options for Actuarial Science students in third and fourth years:

  Finance 317

  Finance 443, 463

Risk Management and Insurance 449, 459, 559.01, 559.02

Actuarial Science students are advised to register for Finance 317 in the Winter Session of their third year as it is not normally available to them in Fall Session.

- While a university program will prepare you to join the ranks of the actuarial profession, it is also important for a student to begin writing the professional examinations of the Society of Actuaries and/or Casualty Actuarial Society as soon as possible – but normally not before the end of second year studies – if he or she wishes to find employment in the actuarial industry after graduation. The professional examinations are normally offered on campus twice a year. For more information, please contact an advisor in the Division of Statistics and Actuarial Science.

Required Courses - Minor Program

0.5 FCE - Mathematics 249 or 251 **or** Applied Mathematics 217

0.5 FCE - Mathematics 253 or 263

2.0 FCE - Mathematics 321, 323, 349 and 353

1.0 FCE - Actuarial Science 325 and 327

1.0 FCE - Selected from the following:

all Actuarial Science courses, Statistics 407, 421, 433, 437.

12. Actuarial Science Co-operative Education Program

Admission

Application deadlines: December 1, May 1, and September 1. Students are normally required to apply to the Career Services Office.

The Actuarial Science Co-operative Education programs are five-year degree programs which include 16 months of supervised work experience in various companies and government agencies. Students who wish to enter the Actuarial Science Co-operative Education program are urged to discuss their pre-admission course selection with the Department of Mathematics and Statistics as early in their program as possible.

Students must have successfully completed at least eight FCE appropriate to their degree program, including Mathematics 321 and 323 and Actuarial Science 327, before commencing the first co-operative education placement. Students must have a minimum grade point average of 2.70 in the field before commencing the Co-operative Education major program, or a minimum grade point average of 3.30 in the field before commencing the Co-operative Education honours program.

Requirements

- Students must complete the following four courses in addition to the regular requirements for the BA or BSc and the BA or BSc Honours in Actuarial Science degree programs: Co-operative Education 501.01, 501.02, 501.03, 501.04. Co-operative Education 501.05 is not required but may be completed.
- In addition to the Faculty and Departmental regulations governing Honours and Major programs and the regulations governing Co-operative Education programs, the following regulations apply. A minimum grade point average of 2.70 must be maintained for continuation in the BA or BSc degree programs. A minimum grade point average of 3.30 must be maintained for continuation in the BA or BSc Honours degree program. In the Co-operative Education programs students must take study and work sessions consecutively and be registered full time. The Co-operative Education courses are in addition to the normal requirements for the BA or BSc degree programs in Actuarial Science. Students must complete the same required courses and number of courses as required for a student completing the traditional degree program. Upon completion of each Co-operative Education work term, the student must present a work term report to the Co-operative Education representative in the Division of Statistics and Actuarial Science.

Program Sequence

The first four-month work term (Co-operative Education 501.01) is normally taken in the summer between years two and three. The remaining four-month work terms are taken during the last three years of the program. (Note that additional faculty requirements are not included.) Other combinations of work and study sessions are also possible.

It is suggested that students follow either Sequence A or Sequence B.

Sequence A

First Year		
Fall	**Winter**	**Spring/ Summer**
Mathematics 211 or 221	Computer Science 231 or 215	
Mathematics 251 or 249 or Applied Mathematics 217	Mathematics 253 or 263	
Second Year		
Mathematics 321	Mathematics 323	Co-operative Education 501.01
Mathematics 311	Mathematics 353	
Mathematics 349	Actuarial Science 327	
Actuarial Science 325		
Third Year		
Co-operative Education 501.02	Required courses in Actuarial Science or Statistics offered this session	Co-operative Education 501.03
Fourth Year		
Statistics 421, Actuarial Science 427 and other required courses in Actuarial Science or Statistics offered this session	Co-operative Education 501.04 and other required courses in Statistics offered this session	Co-operative Education 501.05 (optional) and/or remaining required courses in Statistics to complete the program
Fifth Year		
Remaining courses in Statistics or Actuarial Science to complete the program	Remaining courses in Statistics or Actuarial Science to complete the program	

Sequence B

First Year		
Fall	**Winter**	**Spring/ Summer**
Mathematics 211 or 221	Computer Science 231 or 215	
Mathematics 251 or 249 or Applied Mathematics 217	Mathematics 253 or 263	
Second Year		
Mathematics 321	Mathematics 323	Co-operative Education 501.01
Mathematics 311	Mathematics 353	
Mathematics 349	Actuarial Science 327	
Actuarial Science 325		
Third Year		
Statistics 421, Actuarial Science 427 and other required courses in Actuarial Science or Statistics offered this session	Co-operative Education 501.02	Required courses in Statistics or Actuarial Science offered this session

Fourth Year		
Co-operative Education 501.03	Required courses in Statistics offered this session	Co-operative Education 501.04
Fifth Year		
Co-operative Education 501.05 Optional) and/or remaining courses in Statistics or Actuarial Science to complete the program	Remaining required courses in Statistics or Actuarial Science to complete the program.	

13. General Mathematics Program

Courses constituting the field of General Mathematics

- All courses offered by the Department of Mathematics and Statistics, and Computer Science 491.

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

0.5 FCE - Mathematics 211 or 221

0.5 FCE - Mathematics 249 or 251

or Applied Mathematics 217

2.5 FCE - Mathematics 253 or 263, 311, 321, 349, 353

0.5 FCE - Computer Science 231 or 215.

0.5 FCE - Selected from the field of General Mathematics

1.0 FCE - Selected from the field of General Mathematics at the 300-level or above

2.0 FCE - Selected from the field of General Mathematics at the 400-level or above

4.0 FCE - Non-science options as follows: (check Table I, Section III for ineligible courses)

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty outside Science including Humanities and Social Sciences

8.5 FCE - Options from anywhere

Other Requirements

Students in the program of General Mathematics are required to fulfill an oral component. Normally, it is fulfilled by presenting a satisfactory talk or oral report of a mathematical nature to an appropriate audience. Consult the Undergraduate Director for details.

Recommendations

1. Mathematics 205.
2. A Minor to complement this Major is strongly recommended, e.g., in Economics, Physics, Computer Science, or Music.
3. It is recommended that students include an international component in their program.

   Students should consult with the Undergraduate Director on a regular basis throughout their program.

14. Double Major and Major/Minor Combinations

A Double Major program combining any two of Pure Mathematics, Applied Mathematics, Statistics or Actuarial Science can be obtained by a program of study meeting the requirements of both Major programs. A Major in General Mathematics cannot be combined with any other Major or Minor program offered by the Department of Mathematics and Statistics. Note in particular the Faculty of Science requirement that at least seven FCE in each of the two fields be included. For Major/Minor combinations within Pure Mathematics, Applied Mathematics, Statistics and Actuarial Science, the student must obtain the permission of the Undergraduate Director.

Combined degree programs are not available within the Department of Mathematics and Statistics.

15. Statistics Major with Computer Science Minor

A student intending to obtain a BSc in Statistics with a Minor in Computer Science should take Computer Science 231 (rather than Computer Science 215) in the first year of study. Computer Science 233 and Mathematics 271 should also be included in the first year program. Subsequent courses necessary for the Computer Science Minor are listed in the Computer Science portion of the Calendar. The student should consult the Department of Computer Science section about enrollment limitations in Computer Science courses.

16. Combined Degree in General Mathematics in Education and BEd (Master of Teaching Program)

Admission

Intention to register with Education deadline: March 1

The combined BA or BSc (General Mathematics in Education)/BEd (Master of Teaching Program), administered by the Faculty of Science, is a five year degree program which leads to both the Bachelor of Arts or Bachelor of Science (General Mathematics in Education) and Bachelor of Education (Master of Teaching Program) degrees. This program requires careful selection of courses in order to ensure completion of proper prerequisites for senior level courses.

The BA or BSc (General Mathematics in Education) degree will not be awarded until the student has completed all five years of the program.

A maximum of fifteen students will be accepted in the program in any one year. Admission to the program is on a competitive basis and meeting the minimum requirements does not guarantee admission.

Application

(i) Students will be admitted to the program by the Faculty of Science and must apply before March 1 after completing their first year of studies. In order to be considered for admission, students must have completed a minimum of four FCE which must include Mathematics 221, 251, 253 or 263; one of Mathematics 205, 271, Statistics 201 or 211; and either Computer Science 231 or 215, with a grade of "C-" or better in each, and also have a grade point average of at least 2.50 calculated over the most recent course work to a maximum of five FCE.

(ii) A Faculty of Education Statement must be submitted in support of the application (structured resume which includes the names of three referees).

Entry

(i) Admission will be granted in the Fall Session only. Students will be admitted to the program in descending rank order of grade point average calculated over the most recent course work to a maximum of five FCE (University of Calgary courses and/or transferable courses taken at other institutions). All grades within a session will be included except where the number of courses taken within a session exceeds that required to fulfill (to a maximum of) five FCE, in which case the highest grades will be used. Spring and Summer Session courses taken after May 1 will not count towards determining admissibility if taken in the year of application.

(ii) Students accepted into the program have three years from the time of acceptance to commence the Faculty of Education component of the program. Students not registering for this component within that time will be considered to have left the combined program and remain as Science students only. Students may also choose to leave the combined program at any time and continue a program within the Faculty of Science. Regular Science program regulations will apply to these students.

(iii) Satisfactory completion of the Effective Writing Requirement as outlined in the Academic Regulations section of this Calendar.

Intention to Register

Students must have completed the 15.0 FCE required for the initial Science portion of the program (see below under Program Structure) with a minimum GPA of 3.00 over the last 5 FCE taken.

A student must notify the Faculty of Education no later than March 1 of the year that he or she intends to begin the Faculty of Education portion of the program.

Requirements

Compared to the General Mathematics major, students in this combined degree program (General Mathematics in Education major) are not required to complete Mathematics 321 and 353, but are required to complete at least one half course in English. Fifteen FCE in the Faculty of Science part of the program must be completed for graduation purposes.

Students who withdraw from the Education component of the combined degree program will be required to complete additional courses to obtain the BA or BSc in General Mathematics.

The General Mathematics in Education degree is only awarded to students who complete all five years of the combined degree program.

Recommended Course Sequence

Although this course sequence appears flexible with respect to course choices, students should carefully plan their course selections to ensure that prerequisites for upper-level courses are obtained. For example, students interested in taking senior statistics courses should take Mathematics 321 and 323 in Year 2, item 2.; students interested in senior Pure Mathematics courses should take Pure Mathematics 315 in Year 2, item 2.; students interested in senior Applied Mathematics courses should take Applied Mathematics 311 in Year 2, item 2., etc.

First Year

1. 0.5 FCE English and 0.5 FCE Non-Science option
2. Mathematics 251 or 249, and 221
3. Mathematics 253 or 263 and 0.5 FCE from the list: Mathematics 205, 271, Statistics 201 or 211
4. Computer Science 231 or 215 and 0.5 FCE Science or Non-Science option
5. 1.0 FCE Non-Science option

Second Year

1. Mathematics 349 and 311
2. 1.5 FCE – from the list: Applied Mathematics 311, Pure Mathematics 315, 329, Mathematics 321, 323, 353
3. 0.5 FCE Pure Mathematics 319
4. 1.0 FCE Science or Non-Science option
5. 1.0 FCE Non-Science option

Third Year

1. 2.0 FCE at the 400 level or higher offered by the Department
2. 3.0 FCE senior level options

Fourth Year

Studies in

1. Learners and learning/Teachers and teaching; School and Workplace placements.
2. Curriculum Studies (areas of specialization and interdisciplinarity)/ Educational contexts; School placements.

Fifth Year

1. Tutorials, directed studies; Project work in area of specialization and interdisciplinarity; School placements (13 weeks for 4 days per week)
2. Action research (minor thesis); School or workplace placement (for work related to action research project)

   It is a Faculty of Science requirement that students must take at least 1.0 FCE in the Faculty of Humanities and at least 1.0 FCE in the Faculty of Social Sciences.

   It is recommended that some courses in the history or philosophy of science and technology be included in the program. Possibilities are: Engineering 481, General Studies 341, Science, Technology and Society 325, History 371, Philosophy 367, Greek and Roman Studies 221.

   It is the responsibility of the student to include the prerequisites for courses in Third Year, Item 1 in his or her program.

17. Combined Degree Program in Actuarial Science and Business

For information on the combined degree BComm/BSc (Actuarial Science) program see the Haskayne School of Business section of this Calendar for details.

18. Actuarial Science and Economics or Statistics

Double Major programs are offered in Actuarial Science and Economics and in Actuarial Science and Statistics. See the Actuarial Science/Statistics Division for program details.

19. General Mathematics and Computer Science

A Double Major program is also offered in General Mathematics and Computer Science. Admission into this program is governed by the same criteria as other Computer Science and Mathematics/ Statistics programs. Requirements for this program are extremely tight and students should choose courses carefully in order to ensure that all courses taken can be used to satisfy graduation requirements. Students interested in this program should consult the Department of Computer Science or the Department of Mathematics and Statistics for information about course selection and admission criteria.

Physics and Astronomy

Degrees Offered in Physics and Astronomy

	Physics	Astrophysics	Applied Physics	Chemical Physics
UNDERGRADUATE	BSc	BSc	BSc	
	BSc Honours	BSc Honours		BSc Honours
	BSc/BA*	BSc/BA*	BSc/BA*	BSc/BA*
	*Combined Degree with the Faculty of Humanities or Social Sciences			
GRADUATE	MSc	MSc		
	PhD	PhD		

1. Programs offered in Physics and Astronomy

BSc in Physics, Astrophysics, Applied Physics

BSc Honours in Physics, Astrophysics, Chemical Physics

Minors in Physics and Astrophysics

2. Department vs. Faculty Regulations

Programs in the Department of Physics and Astronomy are governed by a combination of general Faculty of Science regulations and the additional program specific regulations listed below. It is essential for students to be familiar with both sets of regulations. It is helpful to read Section III of the Faculty Regulations first.

Students should consult the Degree Navigator periodically to ensure that requirements are being met. Students are also strongly urged to consult the Department at all stages of their program.

3. Department Information

Department Head: R. B. Hicks
Assistant Head: W. J. F. Wilson
Program Advisor: W. J. F. Wilson
Department Office: SB 605
Telephone: (403) 220 - 5385
Fax: (403) 289 - 3331
Web Site: http://www.phas.ucalgary.ca

4. Programs in Physics

Courses constituting the field of Physics

All courses labelled Physics

Applied Physics 407, 427, 571, 573, 575, 577, 579

Astrophysics 609

Required Courses - Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

1.0 FCE - Physics 211 or 221, 225

0.5 FCE - Mathematics 221

0.5 FCE - Applied Mathematics 217 or Mathematics 249 or 251

0.5 FCE - Applied Mathematics 219

1.0 FCE - Chemistry 201, 203

0.5 FCE – Computer Science 231

7.0 FCE – Physics 301, 325, 341, 343, 347, 355, 443, 449, 455, 471, 491*, 499, 591*, 597, 599 or 598

0.5 FCE – Applied Physics 407

2.0 FCE – Applied Mathematics 307, 309, 413, 433

4.0 FCE – **Non-Science options** as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty other than Science
- 2.5 FCE – Options

** Physics 491 and 591 are quarter courses, with a combined credit value of 0.5 FCE.*

***Note:** Students transferring into the Physics program from the Applied Physics program may replace Physics 597 with Applied Physics 599.*

Required courses - Honours Program

Same as in Major Program except that Physics 599 and 2.5 FCE Options are replaced by:

1.0 FCE - Physics 598

1.0 FCE - Physics 457, 543

0.5 FCE - Option in the field of Physics at the 500 or 600 level

0.5 FCE – Option

Recommendations

(a) Courses whose numbers start with 0 are taught during block week prior to commencement of regular courses. These courses are recommended, but not required. No credit is given for these courses and no fees are charged.

(b) It is strongly recommended that Applied Mathematics 217 be taken in preference to Mathematics 249 or 251 whenever the option to do so exists.

Suggested Program Sequences

(a) Major Program

First Year	
Fall	**Winter**
Computer Science 001(intended to precede Computer Science 231; may be taken in January if available).	Physics 225
Physics 211 or 221	Computer Science 231
Mathematics 221	Applied Mathematics 219
Applied Mathematics 217	Chemistry 203
Chemistry 201	Non-science option
Non-science option	
Second Year	
Physics 020	Physics 325
Physics 301	Physics 343
Physics 341	Applied Mathematics 309
Physics 355	Option
Applied Mathematics 307	Non-science option
Non-science option	
Third Year	
Physics 030	Physics 031
Physics 455	Physics 347
Applied Mathematics 413	Physics 443
Applied Mathematics 433	Physics 471
Non-science option	Physics 491*
Non-science option	Applied Physics 407
Fourth Year	
Physics 040	Physics 041
Physics 449	Physics 499
Physics 599 (Physics 598 may	Physics 591*

be taken instead)	
Physics 597	Option
Option	Option
Non-science option	Option
	Non-science option

** Physics 491 and 591 are quarter courses.*

(b) Honours Program

First Year	
Same as for the Physics Major program	
Second Year	
Fall	**Winter**
Physics 020	Physics 325
Physics 301	Physics 343
Physics 341	Physics 347
Physics 355	Applied Mathematics 309
Applied Mathematics 307	Non-science option
Non-science option	
Third Year	
Physics 030	Physics 031
Physics 449	Physics 443
Physics 455	Physics 457
Applied Mathematics 413	Physics 471
Applied Mathematics 433	Applied Physics 407
Non-science option	Physics 491* Physics 499
Fourth Year	
Physics 040	Physics 041
Physics 598	Physics 598
Physics 543	Physics 591*
Physics 597	Option
Non-science option	500-level Physics
Non-science option	Non-science option

** Physics 491 and 591 are quarter courses.*

Minor in Physics

- Physics 211 or 221, 225
- Four FCE at the 300 level or higher in the field of Physics
- Mathematics prerequisites as needed

5. Applied Physics Program

Courses constituting the field of Applied Physics

All courses labelled Applied Physics

All courses labelled Physics

Required Courses

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

1.0 FCE – Physics 211 or 221, 225

0.5 FCE – Mathematics 221

0.5 FCE – Applied Mathematics 217
or Mathematics 249 or 251

0.5 FCE – Applied Mathematics 219

1.0 FCE – Chemistry 201, 203

0.5 FCE – Computer Science 231

2.5 FCE – Applied Physics 407, 599, plus 1.5 FCE Applied Physics

5.0 FCE – Physics 301, 325, 341, 343, 347, 355, 443, 449, 455, 491*, 591*

2.0 FCE – Applied Mathematics 307, 309, 413, 433

4.0 FCE – **Non- Science options** as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty other than Science

2.5 FCE – Options

** Physics 491 and 591 are quarter courses, with a combined credit value of 0.5 FCE.*

Suggested Program Sequence

Note: *At least 1.5 FCE options in the Applied Physics Third and Fourth Year Sequence must be from Applied Physics. The schedule of course offerings may change from year to year, so students should consult with the Department when developing their course sequences.*

First and Second Years	
Same as for the Physics Major program	
Third Year	
Fall	**Winter**
Physics 030	Physics 031
Physics 455	Physics 347
Applied Mathematics 413	Physics 443
Applied Mathematics 433	Physics 491*
Option	Applied Physics 407
Non-science option	Non-science option
Fourth Year	
Physics 040	Physics 041
Physics 449	Applied Physics 599
Option	Physics 591*
Option	Option
Option	Option
Non-science option	Option
	Non-science option

** Physics 491 and 591 are quarter courses,*

Applied Physics/Physics Combinations

Students in the Applied Physics program are not allowed to declare a Minor in Physics. A double Major in Applied Physics and Physics is not allowed.

6. Programs in Astrophysics

Courses constituting the field of Astrophysics

- Astronomy 211 and 213
- All courses labelled Astrophysics
- Physics 030, 031, 040, 041, 211, 221, 223, 225, 301, 321, 323, 325, 341, 343, 347, 355, 443, 449, 455, 457, 499, 533, 543, 598, 599

Required Courses – Major Program

See also Section III (Faculty Regulations), Subsections 4A (Program Requirements – Major Programs) and 5B (Course Selection – Introductory Courses).

1.0 FCE – Astronomy 211, 213

1.0 FCE – Physics 211 or 221, 225

0.5 FCE – Mathematics 221

0.5 FCE – Applied Mathematics 217
or Mathematics 249 or 251

0.5 FCE – Applied Mathematics 219

1.0 FCE – Chemistry 201, 203

0.5 FCE – Computer Science 231

3.0 FCE – Astrophysics 401, 403, 409, 501, 503, 507

4.5 FCE – Physics 301, 325, 341, 343, 347, 355, 443, 491*, 591*, 599 or 598

2.0 FCE – Applied Mathematics 307, 309, 413, 433

4.0 FCE – **Non-Science options** as follows (check Table I in Section III, Faculty Regulations, for ineligible courses):

- 1.0 FCE from the Faculty of Humanities
- 1.0 FCE from the Faculty of Social Sciences
- 2.0 FCE from any faculty other than Science

1.5 FCE – Options

** Physics 491 and 591 are quarter courses, with a combined credit value of 0.5 FCE.*
***Note**: Suggested Science options are Physics 501, 503, 505, 507, Computer Science 491.*

Required courses – Honours Program

Same as in Major program, except that Physics 599 or 598, and 1.0 FCE Options are replaced by:

2.0 FCE - Physics 449, 455, 457, 543

Suggested Program Sequence

(a) Major Program

First Year	
Fall	**Winter**
Computer Science 001(intended to precede Computer Science 231; may be taken in January if available).	Astronomy 213
Astronomy 211	Physics 225
Physics 211 or 221 Chemistry 201	Chemistry 203 Computer Science 231
Mathematics 221	Applied Mathematics 219
Applied Mathematics 217	
Second Year	
Physics 020	Physics 325
Physics 301	Physics 343
Physics 341	Physics 347
Physics 355	Applied Mathematics 309
Applied Mathematics 307	Non-science option
Non-science option	
Third Year	
Physics 030	Astrophysics 031
Astrophysics 409	Astrophysics 403
Astrophysics 401 or 507 (offered every other year, alternately; see 4th year sequence below)	Physics 443
Applied Mathematics 413	Option
Applied Mathematics 433	Physics 491*
Non-science option	Option
	Non-science option
Fourth Year	
Physics 040	Physics 041
Astrophysics 501	Astrophysics 503
Astrophysics 507 or 401 (offered every other year, alternately; see 3rd year sequence above)	Physics 591*
Physics 599 (Physics 598 may be taken instead)	Option
Non-science option	Non-science option
Non-science option	Non-science option

** Physics 491 and 591 are quarter courses.*

(b) Honours Program

First and Second Years	
Same as for the Astrophysics Major program	
Third Year	
Fall	**Winter**
Physics 030	Astrophysics 031
Astrophysics 409	Astrophysics 403
Astrophysics 401 or 507 (offered every other year, alternately; see 4th year sequence below)	Physics 443
Physics 455	Physics 457
Applied Mathematics 413	Physics 491*
Applied Mathematics 433	Non-science option
	Non-science option
Fourth Year	
Physics 040	Physics 041
Astrophysics 501	Astrophysics 503
Astrophysics 507 or 401 (offered every other year, alternately; see 3rd year sequence above)	Physics 591*
Physics 449	Non-science option
Physics 543	Non-science option
Non-science option	Non-science option

** Physics 491 and 591 are quarter courses.*

Minor in Astrophysics

1.0 FCE - Astronomy 211, 213

2.0 FCE - Courses labelled Astrophysics

3.0 FCE - Physics 211 or 221, 225, 301, 325, 341, 355

0.5 FCE - Mathematics 221

1.5 FCE - Applied Mathematics 217, 219, 307.

7. Chemical Physics Program (Honours)

This program is offered in conjunction with the Department of Chemistry. Details about the program are given under “Chemistry.”

8. Collaborative Program in Environmental Science (Major)

Students may pursue a BSc program in Environmental Science with a concentration in Physics. This is a single-degree, four-year program which is jointly administered by the Faculty of Science and the Faculty of Social Sciences. Program details are listed in the Collaborative Programs section of this Calendar. Since this is a multidisciplinary program with restricted entry, students should consult the Director of the Environmental Science program at their earliest opportunity.

VI. Pre-Professional Preparation for Degree Programs at this and Other Institutions

1. Dentistry - The University of Alberta, Edmonton

Introduction

Please note that there is no formal pre-Dentistry program at the University of Calgary.

Applicants for admission to the Dentistry program at the University of Alberta, Edmonton, may complete the required pre-professional studies for admission at the University of Calgary in the Faculty of Science.

The requirements for admission to the Dentistry program are at least two years of university work (five full-course equivalents must be taken during one academic year, i.e., Fall/Winter Sessions) with appropriate standing and credit in Chemistry 201 and 203; Chemistry 351 and 353; one of Biochemistry 341 or 393; Physics 211 or 221 and 223; Biology 231 and 233; Statistics 213; and English 240 or 202 or two of 231, 233, 235, 237, 239.

Admission to the Faculty of Science

Students from the high schools of Alberta seeking admission into the Faculty of Science to prepare for Dentistry will be required to meet the admission standards of the Faculty.

The above, plus at least two years in the Faculty of Science constitutes matriculation into the first year of Dentistry, leading to the degree of Doctor of Dental Surgery (DDS).

Admission to Dentistry

All students wishing to enter the first professional year of Dentistry are required to make application on or before November 1.

The earliest date for filing application by an applicant is July 1 of the previous year.

Deposit – Upon notification of acceptance successful applicants will be required to confirm their intention to register by submitting a non-refundable deposit within a specified time. The deposit will be credited toward payment of tuition upon completion of registration.

Aptitude Test

Before acceptance, successful scores in the Canadian Dental Aptitude Test (DAT) written in February and/or November are required. If the test is taken more than once, the best set of scores will be used. To meet minimum requirements, a score of 15 or more must be achieved in Reading Comprehension, Perceptual Ability and Manual Dexterity. DAT results must be submitted to the Admissions Office January 15 of the year admission is sought. The DAT must have been written within the last five years and, at the latest, the autumn prior to admission. Information may be obtained by writing to the Dental Aptitude Test Program, Canadian Dental Association, 1815 Alta Vista Drive, Ottawa, Ontario, K1G 3Y6. Application forms for the test may be obtained through the Office of the Registrar, University of Calgary.

Interview

Competitive applicants will be interviewed by a team to determine if they possess the personal qualities necessary for the profession. Candidates will be advised of the schedule for the interviews.

2. Medicine - Various Institutions

Introduction

Please note that there is no formal pre-Medical program at the University of Calgary.

Applicants for admission to various Canadian medical programs may complete the required pre-professional studies while registered in the Faculty of Science. Since the Faculty of Science admits students only to its degree programs, students are advised to choose a Faculty of Science program that best fits their professional aspirations and which at the same time permits them to work toward completing the chosen Science program, i.e., it is important to satisfy both Faculty of Science program requirements as well as pre-professional requirements.

Admission to the Faculty of Science

Students seeking admission into the Faculty of Science to prepare for Medicine will be required to meet the admission standards of the Faculty of Science. The above plus at least two years in the Faculty of Science constitutes matriculation into the first year of Medicine, leading to the degree of Doctor of Medicine (MD).

Admission to Medicine

At an early date, students should consult the calendar that describes the medical program of interest and understand its admission requirements and deadlines. Students should then plan their Faculty of Science program so that pre-medical requirements can be completed while satisfying the requirements of their science program. Students interested in the medical program at the University of Calgary should consult the Faculty of Medicine section of this Calendar for relevant information.

3. Optometry - The University of Waterloo, Ontario

Introduction

An agreement exists between Ontario and the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, New Brunswick and Prince Edward Island. Under the terms of this agreement, the University of Waterloo, School of Optometry may offer places in the first professional year to applicants, who are residents of contract Provinces, when such candidates are judged to possess qualifications equal by both academic and non-academic criteria to candidates from other Provinces. There are up to seven places to which Alberta will contribute to the incurred educational costs. Ultimately, the University of Waterloo is not required to or limited to take seven Albertans since offers are based on applicant competitiveness. Students wishing to apply for admission to the School of Optometry under this co-operative agreement must have completed a prescribed one or two year pre-professional program. Students attending the University of Calgary would complete this program in the Faculty of Science.

Admission to the University of Calgary

Applicants are required to meet the normal admission requirements for the Faculty of Science. In addition to English and Mathematics it is strongly recommended that applicants possess senior matriculation standing in Physics, Chemistry and Biology.

Admission to the University of Waterloo, School of Optometry

Applicants are selected on a competitive basis considering scholarship, interest, motivation, general qualifications for the profession and recommendations. Applicants should have at least a second class honours standing, i.e., "B" or better, in order to be considered for admission. Interviews may be arranged in Alberta. There is no age limit for applicants. Applications will not normally be accepted from foreign students on student visas or from permanent residents who have not held this status for 12 months prior to admission to the School of Optometry.

In order to apply for admission under the co-operative agreement between the Province of Alberta and the Province of Ontario, applicants must meet certain criteria for residency in Alberta. For information regarding these criteria please contact:

Alberta Learning

7th Floor, Commerce Place
10155 – 102 Street N. W.
Edmonton, Alberta T5J 4L5

To apply for admission to the School of Optometry at the University of Waterloo, University of Calgary students must complete the Ontario University Application Centre Form #105 as an essential first step in the application procedure. Candidates can apply online starting approximately mid-October to the OUAC. From the homepage, follow the links to the undergraduate program WB – Optometry. OUAC will send your application to the University of Waterloo who will then issue the School of Optometry application.

Prescribed Pre-Professional Program

The modified first year program for prospective Optometry students is as follows:

1. Physics 211 or 221/223
2. Mathematics 249 or 251/253*
3. Biology 231/233
4. Chemistry 201/203
5. Psychology 205 and a half Junior Elective**

** Students proceeding directly to Mathematics 253 in the Fall Session should complete Mathematics 211 during the Winter Session.*

*** The half junior elective may be selected from courses offered by the Faculties of Humanities or Social Sciences. (English and Introductory Ethics courses are required pre-Optometry prerequisites.) This course cannot be of the same subject content as one required in the upper years of the Optometry program.*

Students successfully completing the above first year program are eligible to apply for admission to the first professional year at the University of Waterloo.

The second year of the pre-professional program should include courses in Organic Chemistry, Biochemistry, Genetics, Physiology (Human or Mammalian), Microbiology and Statistics. Other recommended courses include: Cell Biology, Human Anatomy, Histology, Embryology, Physical Optics and Vertebrate Zoology. Students should note that the University of Calgary does not offer equivalent courses in all of the above subject areas. Students requiring assistance in course selection should contact the Undergraduate Programs Office.

4. Veterinary Medicine - Western College of Veterinary Medicine, Saskatoon, Saskatchewan

Introduction

Please note that there is no formal pre-Veterinary Medicine program at the University of Calgary.

There are four Veterinary Colleges in Canada: the Ontario Veterinary College, University of Guelph, Guelph, Ontario, which is responsible for Ontario; the Atlantic Veterinary College, Charlottetown, Prince Edward Island, which is responsible for the Maritime Provinces; École de Médecine Vétérinaire, Université de Montréal, Saint-Hyacinthe, Quebec, which provides instruction for French-speaking Canadians; and the Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, which serves the four western provinces. Thus it is to be expected that Alberta candidates will make application to the Western College of Veterinary Medicine. Students should contact the Western College of Veterinary Medicine web site: www.usask.ca/wcvm for admission information.

Anyone requiring detailed or specific information about any one of the above institutions should contact the Dean of the College concerned.

Admission to the University of Calgary

Students from high schools in Alberta seeking admission into the Faculty of Science to prepare for Veterinary Medicine will be required to meet the admission standards of the Faculty. English 30, Mathematics 30 or Pure Mathematics 30, Chemistry 30, Biology 30 and one of Physics 30, Social Studies 30 or a language other than English at the 30 level must be included in the matriculation program.

Note: Mathematics 31 is strongly recommended as an additional subject for those entering the BSc program.

Admission Requirements

- English 240 or 202, or two of 231, 233, 235, 237, 239
- Biology 231, 233, 311, 331
- Chemistry 201, 203, 351, 353
- Physics 211 or 221, 223
- Mathematics: One full-course equivalent, e.g., two of: Mathematics 211, 249 or 251, 253, Statistics 213
- Biochemistry 393, 443
- Electives: sufficient to complete 15 full-course equivalents.

All courses must be beyond the senior matriculation level.

Students are advised to consult the first three years of the suggested Zoology program course sequence (listed earlier in this section of the Calendar). In this way, students are satisfying the requirements for both pre-Veterinary Medicine and a Zoology Major program.

Students are reminded that acceptance into a program of Veterinary Medicine cannot be guaranteed on the basis of any minimum academic achievement level. Should any limitations be necessary for any reason selection would be based mainly on relative academic performances and an interview.