170 Members of the Faculty

170.1 Officers of the Faculty

Dean
RE Peter, PhD, FRSC

Associate Deans
GA Chambers, PhD
JS Nelson, PhD
WA Graham, PhD

Assistant Dean
DE Williams, BSc

Student Services Officer
JM Stanley, BA

Director of Biological Sciences Animal Service
DG McKay, PhD

170.2 Distinguished University Professor

RE Taylor, PhD

170.3 Honorary Professors of Science

JA Jacobs, DSc
RW Stewart, PhD, FRSC, FRS, DSc

170.4 Biological Sciences

Professor and Chair
SE Jensen, PhD

Professors and Associate Chairs
JB Bell, PhD
DD Cass, PhD
WM Samuel, PhD

Killam Memorial Professor of Science
DW Schindler, DPhil, DSc, FRSC

Professors
JF Addicott, PhD
A Ahmed, PhD
RJ Bayer, PhD
SA Boutin, PhD
JP Chang, PhD
DAM Craig, PhD
RS Currah, PhD
MRT Dale, PhD
PM Fedorak, PhD
RC Fox, PhD (Geology)
LS Frost, PhD
RH Gooding, ScD
SJ Hannon, PhD
BS Heming, PhD
J Hoddimott, PhD
RB Hodgetts, PhD
WR Kaufman, PhD
BK Mitchell, PhD
FE Nargang, PhD
JS Nelson, PhD (and Associate Dean of Science)
WJ Page, PhD
AR Palmer, PhD
RE Peter, PhD, FRSC (and Dean of Science)
MA Pickard, PhD
EE Prepas, PhD
LJ Reha-Krantz, PhD (AHFMR Scientist)
KLJ Roy, PhD
MA Russell, PhD
JR Spence, PhD
AN Spencer, PhD
NE Stacey, PhD
GW Stemke, PhD
RA Stockey, PhD
C Strobeck, PhD
GJ Taylor, PhD
WM Tomm, PhD
DH Vitt, PhD
MVH Wilson, PhD

Associate Professors
SE Bayley, PhD
M Belosevic, PhD
WJ Gallin, PhD
DJ Gifford, PhD
JI Goldberg, PhD
AG Good, PhD
BA Keddie, PhD
BK Leskiw, PhD (AHFMR Scholar)
J Locke, PhD
HE McDermid, PhD
CA Paszkowski, PhD
J Roland, PhD

Assistant Professors
JM Foght, PhD
GW Owttrim, PhD
DB Pilgrim, PhD

Faculty Service Officer II
ME Haag, MSc

Administrative Professional Officers
G Law, BASc
LN Strafford, MPM

170.5 Chemistry

Professor and Chair
G Horlick, PhD, FRSC

Faculty Service Officer IV and Assistant Chair
MA Armour, PhD

Professors
DR Bundle, PhD
FF Cantwell, PhD
RG Cavell, PhD
DLJ Clive, PhD
M Cowie, PhD
NJ Dovichi, PhD
DJ Harrison, PhD
O Hindsgaul, PhD
RB Jordan, PhD
G Kotovych, PhD
BG Kratochvil, PhD (Associate VP Research)
H-J Liu, PhD
JW Lown, PhD
RED McClung, PhD
MM Palcic, PhD
J Takats, PhD
JC Vederas, PhD

Associate Professors
BL Clarke, PhD
M A Klobukowski, PhD
L Li, PhD
JA Plambeck, PhD
J Stryker, PhD

Assistant Professors
SH Bergens, PhD
NA Branda, PhD
W Jaeger, PhD
GR Loppnow, PhD
A Mar, PhD
MT McDermott, PhD

Faculty Service Officers IV
AM Hogg, PhD
TT Nakashima, PhD

Faculty Service Officers III
L M Browne, PhD
N Gee, PhD

Faculty Service Officer II
R McDonald, PhD

Administrative Professional Officers
A Adam, BSc
RJ Gardner

170.6 Computing Science

Professor and Chair
PG Sorenson, PhD

Professors and Associate Chairs
RG Goebel, PhD
MW Green, PhD

Professors
WW Armstrong, PhD
P Gburzymski, PhD
S Cabay, PhD
TA Marsland, PhD
MT Özsu, PhD
J Schaeffer, PhD

Associate Professors
A Basu, PhD
JC Culberson, PhD
R Elio, PhD
ES Elmallah, PhD
P Gburzynski, PhD
HJ Hoover, PhD
B Joe, PhD
X Li, PhD
UM Maydell, MSc
P Rudnicki, PhD
LK Stewart, PhD
DA Szafron, PhD
PG van Beek, PhD
J-H You, PhD
L-Y Yuan, PhD
H Zhang, PhD

Assistant Professors
JW Buchanan, PhD
JJ Harms, PhD
L Liu, PhD
RC Unrau, PhD

Faculty Service Officers III
C Descheneau, PhD
C Smith, MSc
SF Sutphen, MSc

Administrative Professional Officer
BR Pinchbeck, PhD

170.7 Earth and Atmospheric Sciences

Professor and Chair
B Jones, PhD

Professors and Associate Chairs
EL Jackson, PhD
BE Nesbitt, PhD

Professors
IA Campbell, PhD
BDE Chatterton, PhD
DM Cruden, PhD (Engineering)
JH England, PhD
P Erdmer, PhD
RC Fox, PhD
MJ Hodgson, PhD
EP Lozowski, PhD
K Muehlenbachs, PhD
SG Pemberton, PhD
NW Rutter, PhD, FRSC
J Shaw, PhD
OFG Sitwell, PhD
JD Wilson, PhD

Associate Professors
T Chacko, PhD
GP Kershaw, PhD
RW Luth, PhD
H-G Machel, PhD
RB Rains, PhD
GW Reuter, PhD
B Rivard, PhD
MJ Sharp, PhD

Assistant Professors
ABGT Bush, PhD
RA Creaser, PhD
LM Heaman, PhD
CA Mendoza, PhD

Administrative Professional Officer
GM Johnston, BA, MA

170.8 Mathematical Sciences

Professor and Chair
SD Riemenschneider, PhD

Professors and Associate Chairs
GE Swaters, PhD
JG Timourian, PhD

Associate Professor and Associate Chair
I Baggs, PhD

Professors
AN Al-Hussaini, PhD
W Allegretto, PhD
BN Allison, PhD
KF Andersen, PhD
PL Antonelli, PhD
HH Brungs, PhD
GH Cliff, PhD
Z Ditzian, PhD
RJ Elliott, PhD
LH Erbe, PhD
HI Freedman, PhD
CS Hoo, PhD
PM Hooper, PhD
R-Q Jia, PhD
HP Kunzle, PhD
AT-M Lau, PhD
JD Lewis, PhD
ACF Liu, PhD
G Ludwig, PhD
JW Macki, PhD
TB Moodie, PhD, FIMA
RV Moody, PhD, FRSC
JS Muldowney, PhD
A Pianzola, PhD
AH Rhentulla, PhD
T de F Rogers, PhD
SK Sehgal, PhD
JW-H So, PhD
N Tomczak-Jaegermann, PhD, FRSC
AR Weiss, PhD
DP Wiens, PhD
SW Willard, PhD
YS Wong, PhD
V Zizler, RNDr, PhD

Associate Professors
JF Carriere, PhD
KC Carriere, PhD
GA Chambers, PhD (and Associate Dean of Science)
E Gombay, PhD
RJ Karunamuni, PhD
D Kelker, PhD
M Kovalyov, PhD
WZ Krawcewicz, PhD
M Légaré, PhD
JE Lewis, PhD
Y Lin, PhD
LW Marcoux, PhD
G Peschke, PhD
RA Poliquin, PhD
NGN Prasad, PhD
BA Schmuland, PhD
SS Shen, PhD
M Shirvani, PhD
HJ Van Roessel, PhD
W-S Young, PhD

Assistant Professors
A Cadenillas, PhD
Y Wu, PhD

170.9 Physics

Professor and Chair
JC Samson, PhD

Associate Professor and Associate Chair
JR Beamish, PhD

Killam Memorial Professor of Science
V Frolov, PhD

Professors
BA Campbell, PhD
AZ Capri, PhD
RF Egerton, PhD
ME Evans, PhD
ZW Gortel, PhD
J Gray, PhD
LG Greeniaus, PhD
F Hron, DNatSci
DP Hube, PhD
DG Hughes, PhD
FW Jones, PhD
JA Kernahan, PhD
FC Khanna, PhD
P Kitching, PhD
WJ McDonald, PhD
E Nyland, PhD
DN Page, PhD (CIAR Fellow)
EH Pinnington, PhD
MM Razavy, PhD
G Rostoker, PhD
W Rozmus, PhD
HS Sherif, PhD
TJT Spanos, PhD
J Stephenson, PhD
JA Tuszynski, PhD

Associate Professors
MR Freeman, PhD
JA Jung, PhD
JL Pinfold, PhD
NL Rodning, PhD
DR Schmitt, PhD

Assistant Professor
DM Gingrich, PhD

Faculty Service Officer III
DJ Austen, PhD

Faculty Service Officer II
J Couch, MSc

Administrative Professional Officer
MA Henderson, BSc

170.10 Psychology

Professor and Chair
E Lechelt, PhD

Professors
CHM Beck, PhD
DS Grant, PhD
ML Spetch, PhD
DR Treit, PhD
D L Wahlsten, PhD

Associate Professors
WF Bischof, PhD
C Heth, PhD

Assistant Professors
AF Kingstone, PhD (AHFMR Scholar)
DR Wong-Wylie, PhD

Faculty Service Officer III
GP Finley, MSc

170.11 Additional Members of Faculty Council

President and Vice-Chancellor
R Fraser, PhD

Registrar of the University
BJ Silzer, MEd

Professors
G Bell, PhD (Physical Education and Recreation)
EV Blackburn, PhD (Faculté Saint-Jean)
T Daniel, PhD (Business)
J Drummond, PhD (Nursing)
RL Eadie, PhD (Engineering)
B Gustafson, PhD (Education)
EG Hahter, PhD (Pharmacology)
S Harvey, PhD (Medicine)
E Karpinski, PhD (Physiology)
J Kennelly, PhD (AgFor)
EE Kraus, PhD (Pharmacy and Pharmaceutical Sciences)
WT Wolodko, PhD (Biochemistry)
R Young, PhD (Arts)

Representatives
J Crozier, BSc (Alumni Affairs)
C Pate, PGeol (APEGGA)
DE Purdy, BSc, MBA (APEGGA)

Undergraduate Students of the Faculty

Graduate Students of the Faculty

171 Faculty Regulations

171.1 Faculty Overview

The Faculty of Science offers degrees in Actuarial Science, Applied Mathematics, Atmospheric Science, Biochemistry, Biological Sciences (Cell Biotechology, Environmental Biology, Invertebrate Biology, Microbiology, Molecular Genetics, Physiology and Developmental Biology, Plant Biology Systematics and Evolution), Chemistry, Cell Biology, Computing Science, Computing Science with a Business Minor, Environmental Earth Sciences, Environmental Physical Sciences, Geology, Geophysics, Mathematical Physics, Mathematics, Mathematics and Economics, Mathematics and Finance, Neuroscience, Paleontology, Pharmacology, Physics, Physiology, Psychology, and Statistics.

A Business Minor and an Arts Minor are available in the BSc General programs.

An Industrial Internship option is available in BSc Honors and Specialization programs.

Preprofessional (e.g. Pre-Medicine, Pre-Dentistry, Pre-Optometry, Pre-Pharmacy) patterns may be taken in the Faculty (see §172.20).

171.2 Degrees and Certificates

The Faculty offers three programs leading to the Bachelor of Science (BSc) degree: Honors, Specialization, and General.

The four-year Honors programs are primarily for students who seek careers in scientific research. In addition, they provide preparation for admission to graduate school which leads to a Master of Science (MSc) or a Doctor of Philosophy (PhD) degree.

The four-year Specialization programs do not concentrate on one subject to as great an extent as the Honors programs. This allows students to choose from a broader range of courses and to take a greater number of courses in a secondary area of interest. They can provide the background necessary for admission to graduate schools, in some cases, and permit the attainment of a professional status in others.

The four-year General program aims to provide a general education with a scientific emphasis for students who seek careers in business, teaching, medicine, dentistry, etc.

It should be noted that, in many cases, transfer from one degree program to another can be easily arranged to suit changing ambitions, needs, or academic qualifications of the student.

Regulations governing the Honors, Specialization, and General degree programs will be found in §172.1 followed by descriptions of each degree program arranged under the subject headings (§172.1 to §172.19).

Special Certificates are offered for students who already hold a BSc degree from this university.

171.3 Admission

General admission requirements for the University are set out in §§13 and 14. Specific admission information for the Faculty of Science is detailed in §15.16.

171.4 Definitions

The following terms, definitions, and abbreviations are used throughout this section of the Calendar.

(1) **Approved Option**
In the Faculty of Science section of this Calendar, the term “approved option” appears only within the description of Honors and Specialization programs. For students registered in an Honors or Specializations BSc program an “approved option” is a course (from Arts, Science, or another Faculty) approved in writing by the department directing the student’s program.

General program students interested in taking courses from Faculties other than Arts or Science should see §171.8(1).

(2) **Arts Option**
Those courses offered by the Faculty of Arts for which the student is eligible as well as any Christian Theology courses listed in §211, Course Listings. Note: Students registered in the Faculty of Science may not take ECON 395, 396, POL S 316, SOC 210, 315 for degree credit.

(3) **Courses Attempted**
Refers to university or university transfer courses completed with a final grade and excludes courses from which a student has withdrawn with permission.

(4) **Courses Successfully Completed**
Refers to university or university transfer courses having a final grade of 4.0 or higher.

(5) **Course Weight**
A unit of course weight is an indication of the instructional credit assigned to a course and is designated by the ★ symbol after the course number and name. Units of course weight are used to form a part of the degree requirements and are also used in calculating a student’s Grade Point Average (GPA) and Quality Index (QI).

(6) **Full Session**
The instructional period from September to April and is often referred to as the Winter Session.

(7) **Full-Session Course**
A full-session course means a single course with ★6.

(8) **Half Session**
The instructional periods from September to December or January to April.

(9) **Half-Session Course**
A half-session course means a single course with ★3.

(10) **Intersession**
The instructional periods of May/June (first term) and July/August (second term).

(11) **Junior Course**
Those courses numbered 199 or lower. Note: Any 200-level course without a 100-level (or higher) prerequisite will be counted as a junior course.

(12) **Normal Course Load**
A normal, full academic course load is ★30 during the Winter Session.

(13) **Option**
The term "option" where it appears in programs means a course chosen by the student from offerings by the Faculties of Arts or Science, provided the necessary prerequisite requirements have been met.

(14) **Science Option**
Those courses offered by the Faculty of Science for which the student is eligible. Note: Not all courses offered by the Faculty of Science are available to students registered in the Faculty of Science.

(15) **Senior Course**
Those courses numbered 200 to 499. Note: Any 200-level course without a 100-level (or higher) prerequisite will be counted as a junior course.

(16) **Session**
Refers to either Winter Session or Intersession.

(17) **Winter Session**
The instructional period of September to April.

(18) **Year of Program**
Year of program, as referred to throughout the Science section of the Calendar, is defined below. Students who are applying to, or continuing in, the Faculty of Science are considered to be in

a. Year 1 if they have successfully completed up to ★29 of their degree program;
b. Year 2 if they have successfully completed between ★30 and ★59 of their degree program;
c. Year 3 if they have successfully completed between ★60 and ★89 of their degree program;
d. Year 4 if they have successfully completed at least ★90 of their degree program.

171.5 Cumulative Grade Point Average (CGPA)

The cumulative grade point average is the weighted average over all courses attempted while registered in this Faculty (in all sessions including Intersession) since first admission to this Faculty (or the effective date of these regulations, whichever is later). The only exception is that for students who have been required to withdraw from the Faculty and who are subsequently readmitted on the basis of work done elsewhere, the CGPA will be computed only on courses taken following readmission.

The calculation of the CGPA is also subject to the following rules:

(1) An alphabetic grade of ABF will be counted as a numeric grade of 1.0 in the computation of the CGPA.

(2) An alphabetic grade of WF will be counted as a grade of 1.0 in the computation of the CGPA.

(3) Grades of Credit, No Credit, and Pass-Fail will not be included in the computation of the CGPA.

(4) The CGPA will be rounded to the nearest decimal place using standard rounding rules–that is, it will be rounded up with a value of 5.0 or greater in the first nonsignificant place and rounded down with a value of 4.0 or less in the first nonsignificant place.

171.6 Sessional Grade Point Average (GPA)

The GPA refers to the sessional average and the following are the rules for its computation:

$$\text{GPA} = \frac{\text{sum of (grade x units of course weight)}}{\text{sum of units of course weight}}$$

(1) The GPA for any session shall be based on the final grades in all courses taken during that session, including half-session courses repeated in the second term and courses extra to the degree program;

(2) An alphabetical grade of ABF will be counted as a numeric grade of 1.0 in the computation of the common GPA;

(3) An alphabetical grade of WF will be counted as a numeric grade of 1.0 in the computation of the common GPA;

(4) Grades of Credit, No Credit, and Pass-Fail will not be included in the computation of the common GPA;

(5) The Winter Session GPA or sessional GPA will be rounded to the nearest decimal place using standard rounding rules–that is, it will be rounded up with a value of 5.0 or greater in the first nonsignificant place and rounded down with a value of 4.0 or less in the first nonsignificant place.

171.7 Academic Standing

Academic Record
Students should be aware that their academic record (transcript) is a continuing one and that all matters relating to courses, grades, academic standing, and probation will permanently appear on the academic record.

Academic Standing
Each student's academic performance is reviewed at the end of each Winter Session. Decisions regarding continuation will be based on courses completed up to and including the current Winter Session only. Any courses completed in the first term of the Intersession, following the period under review, will not be considered as part of the decision on academic standing. Continuation in the Faculty of Science requires a CGPA of at least 5.0 on all courses attempted while registered in the Faculty of Science.

171.7.1 Continuation in an Honors Program

Continuation in an Honors Program is by recommendation of the department concerned and requires a minimum GPA of 6.5 on a full course load (★30) in the preceding Winter Session. Some departments have higher or additional requirements. See the description of Honors programs in individual department sections for details.

Those Honors students who do not meet the continuation requirements of their program may apply to transfer to a BSc Specialization program or to the BSc General program, provided they meet the continuation requirements of those programs. Students whose CGPA is between 4.5 and 4.9 may be permitted to continue in the BSc General program on Academic Warning.

Students in an Honors program, whose CGPA at the end of Winter Session is below 4.5 will be required to withdraw. Such students can only apply for readmission after attending another postsecondary institution, at which time they can apply for admission as a transfer student under the conditions described in §14.2.1(3).

171.7.2 Continuation in a Specialization Program

Continuation in a Specialization program is by recommendation of the department concerned and requires a GPA of at least 5.5 in the preceding Winter Session. Some departments have higher or additional requirements. See the description of Specialization programs in individual department sections for details.

Those Specialization students who do not meet the continuation requirements of their program may apply to transfer to the General program, provided they meet the minimum continuation requirements of the General program. Students whose CGPA is between 4.5 and 4.9 may be permitted to continue in the BSc General program on Academic Warning.

Students in a Specialization program, whose CGPA at the end of Winter Session is below 4.5 will be required to withdraw. Such students can only apply for readmission after attending another postsecondary institution, at which time they can apply for admission as a transfer student under the conditions described in §14.2.1(3).

171.7.3 Continuation in the General Program

(1) **Satisfactory Standing**
To remain in satisfactory standing in the Faculty of Science, students must maintain a CGPA of at least 5.0.

(2) **Marginal Standing – Academic Warning**
Students in the General program whose CGPA at the end of Winter Session is between 4.5 and 4.9 will be deemed to have a Marginal Standing. Subject to the next paragraph, they will be allowed to continue in the BSc General program for one further Winter Session on Academic Warning.

Only one period of attendance on Academic Warning will be allowed while registered in the Faculty of Science. Students who have received an Academic Warning in any previous year and whose CGPA at the end of Winter Session is between 4.5 and 4.9 will be required to withdraw from the Faculty. Such students can only apply for readmission after attending another postsecondary institution at which time they can apply for admission as a transfer student under the conditions described in §14.2.1(3).

Note: Students under academic warning are only permitted to interrupt their programs with the prior written approval of the Associate Dean. If students on academic warning interrupt their programs for more than 12 months without prior approval, readmission will normally not be granted unless the student meets the current readmission criteria.

(3) **Unsatisfactory Standing – Required to Withdraw**

Students whether in an Honors, Specialization, or the General program, whose CGPA at the end of Winter Session is below 4.5 will be required to withdraw. Any registration in the second term of Intersession and in the subsequent Winter Session will be cancelled.

Such students can only apply for readmission after attending another postsecondary institution, at which time they can apply for admission as a transfer student under the conditions described in §14.2.1(3).

(4) **Probation**

Students who have been required to withdraw and who have successfully appealed that decision will be placed on Probation. (See also §23.6.1(3).)

Probationary students will be given one Winter Session in which to clear probation and will not be eligible for any extension of Probation beyond one Winter Session.

Probation students must successfully complete ★24 during their one Probationary Winter Session. To clear Probation they must achieve a GPA of at least 5.0 on all work attempted during that Winter Session. The CGPA will then be calculated from the beginning of the Probationary Winter Session.

Probationary students who have failed to complete successfully at least ★24 with at least a 5.0 GPA on all work attempted during that Winter Session will have failed Probation and be required to withdraw. Students who have failed Probation will not normally be readmitted to the Faculty.

Only one period of Probation will be allowed while registered in the Faculty of Science. For students who clear Probation, the CGPA is then calculated from the beginning of the successful Probationary Winter Session. Students who have cleared Probation and whose CGPA again falls below 5.0 will not be permitted to continue on Academic Warning, nor will they be allowed a second period of Probation. Such students will be required to withdraw and will not normally be readmitted to the Faculty of Science.

(5) **Scholarship**

The basis for scholarship consideration is passing grades in all courses on a load of at least ★30.

(6) **First Class Standing**

First class standing in a given year is awarded to any student who obtains a GPA of not less than 7.5 while enrolled in a full, normal academic load (★30) during the Winter Session.

This is also referred to as the Dean's Honor Roll.

(7) **Continuation in Programs**

Students will normally be permitted to continue in their degree program if the degree requirements for the year's work are met. These requirements vary among the programs, consequently the appropriate program in §171 should be consulted for further details.

171.7.4 Graduation Year

Students who have completed ★120 or more and who have either not applied to graduate, or who have applied but have not met graduation requirements, will be permitted to register only in those courses necessary to complete their current program as expeditiously as possible. Such students must have the written approval of the Associate Dean of Science for every course beyond ★120 in which they register. Students in Honors or Specialization programs must also have the written approval of their Departmental Advisor.

171.8 Courses

(1) **Selection of Courses**

Students are responsible for familiarizing themselves with program requirements and limitations as specified in the Calendar, for ensuring their programs are properly planned in accordance with degree specifications, and for the completeness and accuracy of their registration. Please read the Calendar carefully before registering in courses, and if you are in doubt about any regulations pertaining to your program, consult the Faculty of Science Office (CW 223 Biological Sciences) for clarification.

Students registered in the Faculty of Science must select courses offered by the Faculty of Arts or by the Faculty of Science. In some instances, courses from other Faculties may be permitted by permission of the Dean or designee. Written approval from the Faculty of Science is required if more than ★30 are taken in a Winter Session, except in those Honors and Specialization programs requiring more than ★30 in a given year.

(2) **Selection of First-Year Courses**

Beginning first-year students who have completed no credits toward their programs, must restrict their registration to junior courses. Such students may take senior courses in first year only with the prior written consent of the Department concerned and the prior written approval of the Dean or designee.

(3) **Withdrawal from Courses**

Courses from which the student withdraws up to and including the last day for registration in the first and second terms will not appear on the student's record. Courses from which the student withdraws after the last day of registration and up to and including the last day for dropping courses will appear with a grade of "W" (Withdrew with permission) on the transcript.

Students who withdraw from a course after the deadline date and who thereby receive a grade of withdraw-failing (WF) will have a grade of 1.0 applied in arriving at the GPA for the purpose of determining the CGPA.

The deadlines for withdrawing from courses are listed in §11.

(4) **Prerequisites**

Courses with prerequisite requirements may only be used for degree credit if the prerequisite requirements are met.

A grade of 4.0 is the minimum grade acceptable in a course which is to be used as a prerequisite.

Where a prerequisite is stated, it is understood that equivalent courses may be used to satisfy the requirement. In addition, the department offering a course with prerequisite requirements may waive the prerequisite in writing. (Prerequisite waiver forms are available from the Faculty of Science office and the Department offices).

Students who are unsure if they meet the prerequisite requirements in a course, or who wish to obtain permission to have a prerequisite waived, should consult the department offering the course.

(5) **Repeating Courses**

No student will be permitted to repeat any University course, whether a failed course or a course having a grade of W, more than once except for reasons deemed sufficient by the Council of the Faculty in which the student is enrolled. For Science students, the Faculty of Science will withhold credit or indicate the course is extra to degree on any course which contravenes this regulation.

Normally a student will not be permitted to repeat a course in which a grade of 4.0, or more, has been received.

Only two exceptions are permitted and each requires advanced written approval of the Dean or designee:

a. when a higher grade is necessary for a course that is required in one of the degree programs;

b when a student in the last year of a degree program repeats a course(s), in order to raise the GPA to the level required by the degree program.

A student who repeats a course in which a grade of 4.0 or more has been received, without written permission of the Faculty of Science, will have the grade attained on the initial passing of the course used for the purpose of meeting degree requirements and no credit will be assigned to the repeated course.

(6) **Reexamination**

See §23.5.5.

171.9 Graduation

(1) **Application for Graduation**

Students who intend to receive a BSc (General, Specialization, or Honors) Degree or Special Certificate must apply for the Degree or Certificate at the Faculty Office by February 1 for Spring Convocation or by September 1 for Fall Convocation.

(2) **Degree Requirements**

All BSc Degrees require a minimum of ★120. Courses with weights of ★0 are offered for credit only, and, although they may be required in specific degree programs, cannot be used for meeting the minimum units of course weight requirement in any degree program.

(3) **Convocation**

All requirements for graduation at Spring Convocation must be met by the end of a Winter Session. Those completing degree requirements during Intersession will graduate at the Fall Convocation.

(4) **First-Class Honors**

First-class Honors Degrees are awarded to any student in an Honors program who obtained a GPA of not less than 7.5 over the last two

Winter Sessions provided the student was enrolled in a full academic load (★30) during each Winter Session.

(5) **With Distinction**

The notation "With Distinction" is inscribed on the parchment of a candidate for a General or Specialization degree if the candidate has obtained a GPA of not less than 7.5 over the last ★60 and provided the student was enrolled in a full academic load (★30) during each Winter Session of the last two years.

Further regulations regarding academic standing, promotion, and graduation vary from program to program within the Faculty of Science, and are therefore given in §172 below. Regulations for Honors, Specialization, and General programs will be found in §172.1. Regulations for preprofessional patterns in §172.22.

171.10 Appeals and Grievances

A copy of Faculty of Science regulations regarding appeals on grades, academic standing and early readmission may be obtained from the Faculty Office (CW 223 Biological Sciences Building).

Note: There are time deadlines for submission of appeals. Contact the Faculty for details.

171.11 Visiting Student Status

Permission to attend another institution as a Visiting Student is contingent on the student remaining in good academic standing in the Faculty of Science at the University of Alberta.

A student while registered in the Faculty of Science will not be given permission to register as a Visiting Student at another institution if the equivalent course is given on campus in the same term, except in the case of formal exchange programs.

172 Programs of Study

172.1 The Degree of BSc in the Honors, Specialization, and General Programs

172.1.1 Honors Programs

A minimum of ★120 normally taken in four consecutive academic years, is required for the completion of the Honors program for the degree of BSc with Honors. These programs are designed to provide specialization in the chosen subject or subjects as well as the higher standard implied by the term "Honors."

Honors programs are available in the Departments of Biochemistry, Biological Sciences, Chemistry, Computing Science, Geography, Geology, Mathematical Sciences, Pharmacology, Physics, Physiology, and Psychology. Honors is the preferred program for students planning to pursue graduate study.

Admission

Admission requirements for each of the above programs are set out in §15.16.3.

Selection of Courses

The following regulations govern Honors programs:

(1) In each year, an Honors student's program must be approved by an Honors advisor in the student's department and by the Faculty Office.

(2) A minimum of ★72 in Science is required in most Honors programs. Certain departments may require more than ★72 in Science courses.

(3) A student normally must take at least ★18 in Arts courses as part of the requirements for the Honors degree.

(4) Normally no more than ★42 in junior courses are permitted in Honors programs.

Note: Any 200-level course without a 100-level (or higher) prerequisite will be counted as a junior course for this purpose.

(5) Certain non-Arts and non-Science courses appropriate to the program may be permitted in Specialization programs with the prior written approval of the Department directing the student's program.

Applicants to the BSc Specialization program who have taken non-Arts and non-Science courses prior to application, will have the potential transfer credit for such courses assessed at the time of admission to the program.

Course Load Requirements

Students in Honors programs must take at least ★30 during the Winter Session of each year of the program. Exceptions to this requirement must be approved by the Department and the Faculty Office.

Academic Standings and Graduation

The following regulations govern Honors programs:

(1) Continuation in an Honors program is by recommendation of the department concerned and requires a GPA of at least 6.5 in each of the preceding Winter Sessions. See description of Honors programs of individual departments for additional requirements relating to continuation in the Honors program.

(2) A student who fails to attain the standard necessary for continuance in Honors must withdraw from the Honors program. In so doing the student may transfer to a Specialization program with the appropriate department's approval, or to the General program in the Faculty of Science. Students applying to transfer from an Honors program to Specialization or General must meet the continuation standards for the program concerned.

(3) A student who fails to complete the requirements for a degree with Honors in the fourth year may be granted the Specialization degree or the General degree upon application provided the courses taken and the standing attained are satisfactory. Such students must apply to transfer to a Specialization or General program.

(4) Degrees with Honors are awarded in two classes: First Class Honors and Honors. For First Class Honors, a GPA of at least 7.5 on the ★60 for the last two Winter Sessions is required. For Honors, a GPA of at least 6.5 on ★30 in each Winter Session is required.

(5) Students transferring to Honors from Specialization or General programs, or other Faculties or universities with credit for fewer than ★30 are allowed to make up the deficiency or deficiencies, i.e., ★3 to ★27 during, or after taking the full program of courses in each of the Winter Sessions after entering the Honors program.

Residence Requirement

A student transferring to the Faculty of Science with advanced standing will be required to complete at least ★60 (normally the last 60) while registered in the Faculty of Science at the University of Alberta.

Time Limits for Completion of Program

Normally an Honors program must be completed in four consecutive Winter Sessions. An Honors program may be interrupted only by special permission of the Department and the Dean.

Admission

Admission requirements can be found in §15.16.3.

Program selection: two forms of cooperative work are available:

(1) Full-time employment for a period of not less than three months and not more than one year; such periods, integrated into the normal academic program, are referred to as "work terms."

(2) Part-time employment equivalent in working hours to no less than ★3; such employment is referred to as a "work assignment."

Registration: work terms and work assignments must be approved in advance by the department concerned and the Dean's Office. Retroactive approval will not be granted.

Withdrawal: students may withdraw from a cooperative program on completion of a work term or work assignment, or at any time during a normal academic term, and may continue in the academic Honors program of their Department without penalty, providing that the requirements of these programs have been met.

172.1.2 Specialization Programs

Four-year programs, comprising a minimum of ★120, are available providing education to a professional level and leading to the degree of BSc with Specialization.

Specialization programs are available in the Departments of Biochemistry, Biological Sciences, Chemistry, Computing Science, Earth and Atmospheric Sciences, Mathematical Sciences, Pharmacology, Physics, and Psychology.

A five-year (★150) BEd/BSc (Specialization in Science and Education) program with majors and minors in Biological, Mathematical, and Physical Sciences is also available see §§15.5.2 and 74.5.

Admission

Admission requirements for each of the above programs are set out in §15.16.4.

Selection of Courses

The following regulations govern Specialization programs:

(1) In each year, a Specialization student's program must be approved by a Specialization advisor in the appropriate Department and by the Faculty Office.

(2) A minimum of ★72 in Science is required in most Specialization programs. Certain Departments may require more than ★72.

(3) A student must take at least ★18 in Arts courses as part of the requirements for most Specialization degrees.

(4) Normally no more than ★42 in junior courses are permitted in Specialization programs.

Note: Any 200-level course without a 100-level (or higher) prerequisite will be counted as a junior course for this purpose.

(5) Certain non-Arts and non-Science courses appropriate to the program may be permitted in Specialization programs with the prior written approval of the Department directing the student's program.

Applicants to the BSc Specialization program who have taken non-Arts and non-Science courses prior to application, will have the potential transfer credit for such courses assessed at the time of admission to the program.

Course Load Requirements

Students in Specialization programs should normally take at least ★30 during the Winter Session of each year of the program. Exceptions must be approved by the Department and the Faculty of Science.

Academic Standings and Graduation

The following regulations govern the Specialization programs:

(1) Continuation in a Specialization program is by recommendation of the Department concerned and requires a GPA of at least 5.5 in each of the preceding Winter Sessions. See description of Specialization programs of individual departments for additional requirements relating to promotion in the Specialization program.

(2) A student who fails to attain the standard necessary for continuation in the Specialization program will be required to withdraw from that program. In so doing the student may apply to transfer to the General program in the Faculty of Science. Students applying to transfer from a Specialization to the General program must meet the continuation CGPA of 5.0.

(3) A student who fails to complete the requirements for a Specialization degree in the fourth year may be granted the General degree forthwith upon application provided the courses taken and the standing attained are satisfactory. Such students must apply to transfer to the General program.

(4) For graduation, a program of at least ★120 credited to the degree.

(5) BSc Specialization degrees with Distinction are awarded when students achieve a GPA of at least 7.5 on the last ★60 provided the student was enrolled in a normal course load (★30) during each Winter Session of the last two years.

Residence Requirement

A student transferring to the Faculty of Science with advanced standing will be required to complete at least ★60 applicable to the BSc program while registered at the University of Alberta. This must include at least ★30 of the last ★60 applicable to the BSc program.

Time Limits for Completion of Program

The Faculty of Science and the Department may permit a student to complete the requirements for a Specialization degree over a longer period of time than four years.

172.1.3 General Programs

The BSc General program is designed to provide a student with a diversified education in more than one branch of study and includes a major and minor Subject or Area of Concentration. Students must major in a Science Subject or Area of Concentration. Students may elect to minor in a Science Subject or Area of Concentration or in an Arts Subject of Concentration. In addition to providing for a BSc General Degree, this program allows for subsequent transfer to Specialization and Honors programs. Students who intend to transfer to an Honors program must complete ★30 in each Winter Session preceding admission to the Honors program. Students enrolled in the General program who intend to transfer to another program should consult the appropriate admission requirements for the particular program of interest in §15.16 and carefully select their first-year core courses in accordance with the requirements of the specific program.

Students who tentatively plan to transfer to an honors or specialization program should initially complete courses toward a Science or Arts minor in accordance with BSc General regulations.

The three-year BSc General program is no longer offered. The deadline for completion of the three-year General degree was April 30, 1994.

Admission

Admission requirements for the BSc (General) Programs are set out in §15.16.1.

The following regulations govern the General program:

(1) In each year, a student's program must be approved by an advisor in the student's major Subject or Area of Concentration and by the Faculty Office.

(2) To obtain a BSc General Degree a student must receive credit in ★120. At least ★72 and not more than ★102 must be in Science. At least ★18 and not more than ★48 must be in Arts.

(3) Each student must complete a major Subject or Area of Concentration. The major Subject or Area must be in Science. A minimum of ★36 and a maximum of ★48 are required in the major Subject or Area of Concentration, with no more than ★18 at the junior level. Each student must also either

a. complete a second major which also must be a Subject or Area of Concentration in Science. Students who complete a second major in Science will have the Double Majors recorded on their transcripts and diplomas; or

b. complete a minor Subject or Area of Concentration. The minor Subject or Area of Concentration may be in Science or a student may present a Subject of Concentration in Arts or Business. For a list of Arts Subjects available as a minor refer to "Minors" below. For information about admission to the Business minor see §15.16.2. The requirements for a Business minor appear in §172.1.4. At least ★24 and not more than ★36 are required in the minor Subject or Area of Concentration with no more than ★12 at the junior level. If the minor Subject of Concentration is in Arts then additional requirements as specified by the Arts Department may be required. Students are responsible for meeting any additional departmental requirements as specified in the Faculty of Arts §§54.1 - 54.26.

Majors

A Major Subject of Concentration consists of Science courses taken in one particular discipline (subject), e.g., Chemistry, Mathematics, Physics. (Note that in order to complete a major in a particular subject, there must be sufficient courses available to BSc General students. Registration in some courses is restricted. See the course descriptions in §211 and consult with a Faculty of Science advisor if you need advice on the choice of a major.)

A Major Area of Concentration consists of Science courses taken from one of the four following groups:

Biological Sciences: Biochemistry, Botany, Entomology, Genetics, Marine Science, Microbiology, Paleontology, Pharmacology, Physiology, Zoology, and courses titled Biology.

Physical Sciences: Astronomy, Biochemistry, Chemistry, Geophysics, Mathematical Physics, and Physics.

Mathematical Sciences: Computing Science, Mathematics, Statistics and Applied Probability.

Earth and Atmospheric Sciences: EAS courses (see §172.7), Geophysics and Paleontology.

Minors

A Minor Subject of Concentration consists of Science or Arts courses taken in a single discipline (subject) in the Faculty of Science (e.g., Chemistry, Mathematics, Physics) or in one of the subjects or areas in the Faculty of Arts as noted below. A minor Area of Concentration may be chosen from one of the areas noted above, i.e., Biological Sciences, Physical Sciences, Mathematical Sciences, or Earth Sciences. A BSc General—Minor in Business is also available. See §172.1.4.

If the Minor Subject of Concentration chosen is from Arts, the above requirements and any further requirements as specified by the Arts Department must be met. (See the Faculty of Arts §§54.1 – 54.26 for specific requirements for minors, by Department.) The following Arts subjects may be offered as a minor Subject of Concentration: Anthropology; Art and Design (including Art, Art History, and Design); Canadian Studies; Central/East European Studies; Chinese; Classics (including Ancient History, Art, Classical Literature in Translation); Comparative Literature; Drama; East Asian Studies; Economics; English; Film Studies; French; Geography**; German; Greek and Latin; History, Ancient or Medieval History, or Women's History; Italian; Japanese; Latin American Studies; Linguistics; Music; Native Studies; Philosophy; Political Science; Psychology**; Religious Studies; Russian; Scandinavian; Spanish; Ukrainian; Women's Studies.

**The Major Subject or Area of Concentration and Minor Subject of Concentration may not share courses from the same department. The following combinations are not allowed:

Earth Sciences/Arts Geography

Science Psychology/Arts Psychology

Courses in a major or minor Subject of Concentration may not overlap. For example, if the major Area of Concentration is the

Mathematical Sciences, and the minor Subject of Concentration is Statistics, then the major may be made up of Mathematics courses and Computing Science courses, but no Statistics courses. The minor would consist exclusively of Statistics courses.

(4) The General program is characterized by a First-Year Core of courses which must include the following:

a. ★6 from among junior courses offered by the Department of English (normally ENGL 101).

b. ★6 from among junior courses offered by the Departments of Computing Science, Mathematical Sciences (to be chosen from MATH 113 or 114 or 117; MATH 115 or 118; MATH 120 or 127; MATH 153; CMPUT 101 or 114; CMPUT 102 or 115; STAT 141 or 151).

c. ★6 from among junior courses in the Departments of Chemistry or Physics (to be chosen from CHEM 101; CHEM 102; CHEM 161; CHEM 163; PHYS 100 or 109; PHYS 101 or 102 or 108; ASTRO 120; ASTRO 122).

d. ★6 from among junior Science courses titled Biology, Earth and Atmospheric Sciences, or Science Psychology (to be chosen from BIOL 107; BIOL 108; EAS 101; EAS 102; EAS 103; PSYCO 104).

e. ★6 from among 100-level courses in Arts or Science (Students interested in the Business Minor must take ECON 101 and 102).

(5) Normally at least ★30 at the junior level must be successfully completed before a student may register in senior-level courses.

(6) Not more than ★42 of all courses taken can be at the junior level.

(7) Each student must successfully complete a minimum of ★12 at the 300-level (or higher) in the major Subject or Area of Concentration and, in addition, at least ★6 at the 300-level (or higher) in the minor Subject or Area of Concentration.

(8) Subject to receiving written approval from the Faculty of Science Office prior to registration, a maximum of ★12 may be taken from Faculties other than Arts or Science. For applicants to the BSc General who have already taken courses from Faculties other than Arts or Science, potential transfer credit for such courses will be assessed at the time of admission to the program.

Such subjects are not included as part of the major or minor Subject or Area of Concentration, nor toward the minimum requirement of ★18 in Arts, nor toward the minimum requirement of ★72 in Science.

Note: In Women's Studies minor Subject of Concentration, courses not in Arts or Science but in the list of "cross-listed courses" may be counted toward the minor Subject of Concentration in Women's Studies (see §54.26.2).

Course Load Requirements

Students in the General Program should normally take ★30 during the Winter Session of each year of the program.

Academic Standings and Graduation

The following regulations govern General Programs:

(1) To obtain a BSc General degree, a GPA of at least 5.0 must be attained on the last ★60 credited to the degree. Moreover, a GPA of at least 5.5 must be attained in all courses in the major Subject or Area of Concentration.

(2) BSc General degrees with Distinction are awarded when students achieve a GPA of 7.5 or higher over the last ★60, provided the student has satisfactorily completed at least a normal academic load of ★30 during the Winter Sessions of the last two years at the University of Alberta.

Residence Requirement

A student transferring to the Faculty of Science with advanced standing will be required to complete at least ★60 applicable to the BSc program while registered at the University of Alberta. This must include at least ★30 of the last ★60 applicable to the BSc program.

Time Limits for Completion of Program

The Faculty of Science may permit a student to complete the requirements for a General degree over a longer period of time than four years or meet the requirements in a shorter time by attending Intersession.

172.1.4 BSc General – Minor in Business

Note: All requirements for the BSc General program as set out in §172.1.3 must be met.

BSc General program students who are admitted to the Minor in Business quota must complete the following:

(1) ECON 101, 102

(2) ★18 to ★30 in courses offered by the Faculty of Business including: ACCTG 311; ORG T 301; two of FIN 301, MGTSC 352, MARK 301, ORG T 311.

Notes:

(1) Several of the above courses have one or more Arts or Science courses as prerequisites. These prerequisites must be met.

(2) Students completing a minor in Business must still choose a major that is in Science and must satisfy the requirement that at least ★72 of the ★120 credited to the degree be in Science.

(3) Students minoring in Business must still complete at least ★18 in Arts. ECON 101 and ECON 102 constitute six of those required Arts units.

Once admitted to the minor in Business, students in the BSc General program will be allowed to continue in the Business minor as long as they remain in good standing in the BSc General program. BSc General program students who have been admitted to the minor in Business and who subsequently apply to transfer to a Specialization or Honors program which has a Business component controlled by quota, will have to apply and compete for admission to that quota.

172.1.5 Special Certificates

An applicant holding a BSc degree from the Faculty of Science at the University of Alberta may qualify for a certificate indicating that the requirements for the equivalent of a BSc Honors degree (§171.1.1) or a BSc Specialization Degree (§171.1.2) have been met. To qualify for a Special Certificate, at least ★30 additional must be completed and all admission, program, academic standing, and graduation requirements of the equivalent degree must be met. Admission to a Special Certificate program requires approval of both the appropriate Department and the Faculty Office. The specific course requirements are determined, at the time of admission, by the appropriate Department and the Faculty Office. The Special Certificate is not available to degree holders from other Faculties at the University of Alberta or from other universities. Further information can be obtained by consulting the Faculty of Science Student Services Office.

172.1.6 The BSc After a Previous Undergraduate Degree (Other than a BSc from the Faculty of Science at the University of Alberta)

An applicant holding an undergraduate degree may qualify for the BSc General (four-year) degree, a BSc Specialization degree, or a BSc Honors degree by meeting the following requirements:

(1) satisfactorily complete a minimum of ★60 (normally the last 60) while registered in the Faculty of Science at the University of Alberta.

(2) satisfy all admission requirements (see §15.16), as well as program, academic standing, and graduation requirements of the particular degree program. (See §171.1.1 for Honors, §171.1.2 for Specialization, and §171.1.3 for General Program.)

Admission to a Specialization program and an Honors program requires approval of both the appropriate Department and the Faculty Office. The specific course requirements for a degree program are determined, at the time of admission, by the appropriate Department (for Specialization and Honors) and the Faculty Office. The BSc after a previous undergraduate degree is available to holders of undergraduate degrees from other Faculties at the University of Alberta and from other universities. Further information can be obtained by consulting the Faculty of Science Student Services Office.

Note: A holder of a BSc degree from another university is not eligible for a BSc General After Degree.

Only those students admitted to the after-degree program for the three-year General degree prior to July 1986 are eligible to continue or be readmitted to this after-degree program. All others, including those previously in a three-year program but who subsequently complete an undergraduate degree in another Faculty or another institution are eligible only for admission to a four-year degree. The deadline for completion of the three-year General degree is April 30, 1994.

172.1.7 Transfers Between Programs

A student may transfer from an Honors Program to either the corresponding Specialization Program or to the General Program, or from a Specialization Program to the General Program at any time in the program, by submitting a readmission form to the Faculty Office, subject to appropriate deadlines. Transfers from the General Program to a Specialization Program or an Honors Program or from one Specialization Program to another or to an Honors Program may be made according to the dates listed in §12. In addition, transfers to Honors and Specialization Programs require approval of the Department responsible for the new program.

172.1.8 Completion of a BSc Degree after Transfer to Another Faculty

Students who transfer to another Faculty after completing part of a BSc program may reapply to the Faculty of Science after completing the

degree from the other Faculty. A former student transferring to the Faculty of Science normally will be required to complete at least ★60 while registered in the Faculty of Science at the University of Alberta. Courses completed in the Faculty of Science prior to transfer may count toward the minimum ★60 required to be completed while registered in the Faculty of Science. Science or Arts courses taken while in another Faculty, which are clearly noted as "extra-to-degree" on the transcript, may be used to fulfil specific subject requirements of a degree program in science but will not be used to fulfil the minimum residence requirement of the program.

172.2 Biochemistry

172.2.1 Honors in Biochemistry

Continuation in the Honors Program in Biochemistry requires a GPA of at least 7.0 in each of the preceding Winter Sessions.

Graduation requires a minimum GPA of 7.0 on the last ★60 credited to the degree.

Year 1
CHEM 101/102 and 161/163
MATH 113 (or 114), and 115
BIOL 107/108
★6 in a junior Arts option (ENGL 101 recommended)

Year 2
BIOCH 203/205
CHEM 271/273
PHYS 100 and 101 or equivalent
★6 in an approved Science option
★6 in an Arts option

Year 3
BIOCH 401
★6 in Biochemistry (normally selected from BIOCH 410, 420, 430, or 441)
CHEM 211/213
★6 in approved Science options
★6 in Arts options

Year 4
★6 in Biochemistry (normally selected from BIOCH 410, 420, 430, or 441)
★3 in Biochemistry (selected from BIOCH 450, 455, or 460)
CHEM 361 and 363
★15 in approved Science options

Notes
(1) For information regarding new Biological Sciences courses, please consult your Department advisor.
(2) Recommended Science options for second year include MICRB 265; MATH 214 and 215; GENET 270 and 275 or other approved science courses.
(3) Recommended Science options for third and fourth year include BIOCH 450, 455, and 460; PHYS 201; MICRB 311 or 415; PHYSL 210.
(4) Students are urged to consult with the Department of Biochemistry regarding the selection of options throughout the course of the program.
(5) Students must receive a grade of not less than 6.0 in all Biochemistry courses credited toward the minimal number required for the degree.
(6) ★6 in a junior English is required as one of the ★18 in Arts options within the Honors in Biochemistry program.
(7) BIOCH 410, 420, 430, 441, 450, 455, and 460 are offered only in alternative years. Check the Registration Procedures Book for those courses offered in the current year.

172.2.2 Specialization in Biochemistry

Continuation in the Specialization Program in Biochemistry requires a minimum GPA of 6.0.

Graduation requires a minimum GPA of 6.0 on the last ★60 credited to the degree.

Year 1
CHEM 101/102 and 161/163
MATH 113 (or 114), 115
BIOL 107/108
★6 junior Arts option (ENGL 101 recommended).

Year 2
BIOCH 203/205
PHYS 100 and 101, or equivalent
★6 in an approved Mathematical Science or Physical Science option
★6 in an approved Science option
★6 in an Arts option

Year 3
BIOCH 401
★6 in Biochemistry (normally selected from BIOCH 410, 420, 430, or 441)
CHEM 211/213
★6 in an approved Science option
★6 in an Arts option

Year 4
★6 in a senior Biochemistry (normally selected from BIOCH 410, 420, 430, or 441)
★15 in approved Science options
★9 in an option

Notes
(1) For information regarding new Biological Sciences courses, please consult your Department advisor.
(2) Recommended Science options for second year include MICRB 265; GENET 270 and 275 or other approved Science courses.
(3) Recommended Mathematical or Physical Science options include MATH 214 and 215; CHEM 271 and 273; PHYS 201; or other approved Mathematical or Physical Science courses.
(4) Other recommended Science options for third and fourth year include BIOCH 450, 455, 460; PHYS 201; MICRB 311 or 415; PHYSL 210 or other approved Science courses.
(5) Students are urged to consult with the Department of Biochemistry regarding the selection of options throughout the course of the program.
(6) Students must receive a grade of not less than 6.0 in BIOCH 203 and 205 and 5.0 in all other Biochemistry courses credited toward the minimal number required for the degree.
(7) ★6 in a junior English is required as one of the ★18 in Arts options within the Specialization in Biochemistry program.
(8) BIOCH 410, 420, 430, 441, 450, 455, and 460 are offered only in alternative years. Check the Registration Procedures Book for those courses offered in the current year.

172.3 Biological Sciences

The Honors and Specialization programs formerly offered in the Biological Sciences Department were replaced with the programs below, effective Winter Session 1996/97. All students in Honors and Specialization programs in Biological Science now take a common core of courses in the first and second year. Thereafter they follow the course sequence of one of eight areas of concentration in either Honors or Specialization Biological Science which are identified in §172.3.4. Students must declare an area of concentration and follow the appropriate course sequence. The title of the area of concentration will appear on their degree.

The Department of Biological Science offered programs in Honors and Specialization in Botany, Cell Biotechnology, Entomology, Environmental Biology, Genetics, Microbiology, and Zoology until 1995/96. Effective September 1996, these programs were no longer available. Students who began the old programs prior to 1996 are allowed to complete the programs provided there has been no break in attendance. These students should consult the 1995/96 edition of the Calendar for program details. Students entering the Biological Sciences programs in September 1996 and thereafter are admitted to the new programs.

Students may receive block Transfer in the Biological Sciences at the University of Calgary or the University of Lethbridge provided the appropriate courses are completed. Interested students may contact the Department of Biological Sciences for details.

172.3.1 Honors in Biological Science

Admission to the BSc Honors in Biological Science program directly from high school requires a minimum average of 80% on the following required courses: English 30, Mathematics 30, Biology 30, Chemistry 30, and a subject from group A, B, or C (Physics 30 recommended). Admission on transfer requires a minimum GPA of 6.5 on a minimum of ★30 in the preceding Winter Session.

Continuation in the Honors Biological Science program requires a minimum GPA of 6.5 in the preceding Winter Session. Graduation requires a minimum GPA of 6.5 on the last ★60 credited to the degree. Students in Honors programs must take at least ★30 during the Winter Session of each year of the program. Exceptions to this requirement must be approved by the Department and the Faculty Office.

172.3.2 Specialization in Biological Science

Admission to the BSc Specialization in Biological Science program directly from high school requires a minimum average of 75% on the following required courses: English 30, Math 30, Biology 30, Chemistry 30, and a subject from group A, B, or C (Physics 30 recommended). Admission on transfer requires a minimum GPA of 5.5 in the preceding Winter Session.

Continuation in the Specialization program requires a GPA of 5.5 in the preceding Winter Session. Graduation requires a minimum GPA of 5.5 on all courses credited to the degree.

172.3.3 First Year Core for BSc Honors and Specialization Biological Science

First Year: BIOL 107, 108; CHEM 101,161; STAT 151; MATH 113 or 114 or 120; ★6 Arts option (English recommended); ★6 Science Option.

Notes
(1) Students should take CHEM 163 as a Science option in their first year if they are intending to complete their degree in the following areas of concentration: Cell Biotechnology, Microbiology, Molecular Genetics, or Physiology and Developmental Biology. See §172.3.4.
(2) The rest of the Biological Sciences program core consists of BIOL 207, 208, and BIOCH 203 or 220, which would be completed in the second year. See §172.3.4.

172.3.4 Course Sequence for Honors and Specialization in Biological Sciences

	Year 2	Years 3 and 4
Cell Biotechnology	BIOL 207, 208; CHEM 102; BIOCH 203, 205; MICRB 265; GENET 270; ★6 Arts Options; ★3 Science option.	GENET 301, 304, 390; MICRB 311, 313, 415, 450; MICRB 343 and 345 or GENET 420; ★6 Arts Options; ★24 Approved options.*
Environmental Biology	BIOL 207, 208; BIOCH 220; CHEM 163 or 263; BOT 201 or 210; EAS 102; ZOOL 224 or ENT 220; ZOOL 250 or ENT 220; ★3 Arts option; MATH 115 or 120.	STATS 337 or BIOL 430; BIOL 321, 380; ★9 from BIOL 331, BOT 332; FOR 322; SOILS 330; ZOOL 332, 371; ★6 from BOT 240, 250, 382, ENT 321, GENET 270, 275, MICRB 265, ZOOL 241, 242; ★9 Arts options, ★18 Approved options.* ★9 from List 1. **List 1:** Recommended options include, but are not restricted to: BIOL 361, 366, 430, 433, 435; BOT 305, 306, 333, 431, 433; EAS 250; ENT 308, 460; INT D 421; ZOOL 301, 405, 407, 408, 434, 464, 467, 468.
Invertebrate Biology	BIOL 207, 208; BIOCH 220; CHEM 163 or 263; ENT 220; MICRB 265; ZOOL 202, 250; GENET 275, ★3 Arts option.	ZOOL 370 or 371; ZOOL 351 or ENT 327, ZOOL 352, 355 or 302; BIOL 331 or ZOOL 332, 464; CMPUT 101 or 114; ENT 321; ENT 378 or ZOOL 354; ★6 from ENT 207, 280, 292; ★9 Arts options; ★18 Approved options*. **Note:** One of MA SC 410, 430 recommended; ZOOL 224 and other senior vertebrate Zoology or senior Botany courses recommended.
Microbiology	BIOL 201, 207; CHEM 102; BIOCH 203, 205; MICRB 265; GENET 270; ★3 Science option; ★6 Arts options.	BIOL 208; MICRB 311, 313; CHEM 211/213; ★6 Arts options; ★6 in MICRB options; ★15 Approved Science options; ★18 Approved options. **List 2:** Recommended options include, but are not restricted to the following: **Microbiology options:** MICRB 314, 343, 345, 391, 392, 410, 415, 420, 450, 452; INT D 224, 371, 372, 452. **Approved Science options:** BIOCH 410, 420, 430, 441, 450, 455, 460; BIOL 380; BOT 306, 380, 383, CHEM 271, 273, 303, 361, 363; COMPUT 101 or 114; GENET 275, 301, 302, 304, 390, 408, 471; EAS 201, 203; PHYS 100, 101; ZOOL 352, 452. **Approved options:** NU FS 361, 363, 402, MMID 350, 405, 415, 425, 427, PHARM 484, PHYSL 210, SOILS 210, 430. (Some of these approved options actually count as science courses, see §173).
Molecular Genetics	BIOL 207, 208; CHEM 102; BIOCH 203, 205; GENET 270, 275; MICRB 265; ★6 Arts options.	BIOL 201, 380; GENET 301, 302, 304, 390; ★12 from GENET 364, 408, 412, 418, 420; ★6 Arts options; ★12 Approved options; ★12 from List 3. **List 3:** Recommended options include, but are not restricted to CELL 300, 301; BIOCH 401, 410, 420, 430, 450; BIOL 315, 321, 420, 445; BOT 202, 250 306, 382; CHEM 271, 273; ENT 220, 321, MICRB 311, 313, 314, 343, 345, 401; PHYSL 210, 401; ZOOL 202, 241, 250, 303, 340, 342.
Physiology and Developmental Biology	BIOL 207, 208; BIOCH 203, 205; ZOOL 202, 225, 242, 250; ★6 Science options.	ZOOL 302, 344 and one of 402 or 441 or 442; ★12 Arts options; ★15 Approved Options*; ★24 from List 4. **List 4:** Recommended options include, but are not restricted to ANAT 415; BIOL 445, BOT 240, 306, 340, 431; CELL 300, 301; ENT 321; GENET 301, 302, 304, 412; INT D 371, 452, 543, 544; MICRB 265, 311, 313; PHYSL 372, 401, 402; PMCOL 371; ZOOL 340, 341, 342, 343, 352, 355, 370, 402, 441, 442, 452.
Plant Biology	BIOL 207, 208; BIOCH 220; CHEM 102; CHEM 163 or 263; BOT 201, 202, 210; ★3 Science option; ★3 Arts option.	BIOL 201; BOT 240, 250, 309, 320, 332; ★3 GENET; MICRB 265; ★9 Arts options; ★9 Approved options*; ★18 Senior Botany Courses.
Systematics and Evolution	BIOL 207, 208; BIOL 380; BIOCH 220; ★6 from BOT 201, 210; ZOOL 224, 225, 250; ENT 220; ★3 from BOT 240, ZOOL 241, 242, ENT 321; ★3 Arts option; ★6 Approved option.	BIOL 321, 335, 420, 435; ★3 from BOT 411, PALEO 318, 319; ★3 from BOIL 331, BOT 332, ZOOL 332; ★6 from BOT 302, 305, 306, 320, ZOOL 224, 225, 405, 407, 408, ENT 280, 327, MICRB 265; ★9 Arts options; ★12 from List #5; ★15 Approved options. **List 5:** Recommended options include, but are not restricted to BIOL 430, 433, 520; BOT 202, 250, 309, 409, 431, 504, 505, 506, 511; ENT 321, 378, EAS 101, 203, 230; MA SC 410, 412, 420, 430, 440, 445, PALEO 520, ZOOL 202, 302, 340, 352, 354, 355, 434, 472, PHYS 100 or 108. **Note:** Marine Science courses on this list are offered at Bamfield Marine Station.

*Students in Honors in Biological Science are required to successfully complete BIOL 499. It is recommended that students in Specialization in Biological Science take BIOL 498 or 499.

Science Chart 1

172.3.5 Industrial Internship Program

The Department of Biological Sciences offers a voluntary educational opportunity that allows students to augment their program of study with a period of paid, discipline-related work in cooperating organizations. An Industrial Internship Program is offered for students in the Specialization or Honors programs in Biological Sciences. Only students who are in good standing in the Specialization or Honors program, and who are Canadian citizens or hold landed immigrant status in Canada, are eligible to compete for places in these programs.

The Industrial Internship Stream extends a student's program of study by one academic year. Students approved to enter this stream, register for a continuous sequence of WKEXP courses 941 through 943. During this 12-month period, students are considered to be full-time students of the University of Alberta.

Note: The first four months of the internship are a trial period, after which the student or the employer may opt out of the program. WKEXP 941-943 are 0 credit courses, graded on a credit/no credit basis and recorded on the student's transcript. The graduation requirements for the Industrial Internship Program Stream designation include successful completion of WKEXP 941-943 plus BIOL 400 Industrial Internship Practicum. BIOL 400 must be taken in the first term immediately following WKEXP 943.

The table below illustrates the normal sequencing of courses for the Industrial Internship. Students registered in the Industrial Internship Program are assisted in the location of suitable Internship employment. Placements are based on the employer's selection. There is no guarantee that all qualified students can be placed. Interested students should see the Industrial Internship Program Coordinator in the Department of Biological Sciences for more information.

Industrial Internship Stream

Year 4	Course	Year 5	Course
Fall	WKEXP 401	Fall	Courses + BIOL 400
Winter	WKEXP 402	Winter	Courses
Summer	WKEXP 943		

172.3.6 General Program in Biological Sciences

A major or a minor area of concentration in the Biological Sciences is available in the BSc general program.

Courses which may be used toward a Biological Sciences major or minor include courses titled: BIOL; BOT; ENT; GENET; MICRB; ZOOL; CELL 300, 301; IMMUN 405, 451; INT D 224, 370, 421, 455, 464; LB AN 301; MMID 350; NU FS 363; PHYSL 210, 372, 401, 404, 410; PMCOL 305, 307 332, 335, 336, 371, 392, 403, 409, 412, 415;

Courses in Biochemistry, as listed in §173.2, may be used for a concentration in Biological Sciences or Physical Sciences but not both.

The following previously offered courses may be used for a concentration in Biological Sciences: BOT 199, ENT 120, GENET 197, MICRB 193, and ZOOL 120.

The following previously offered courses may not be used for a concentration in Biological Sciences: BIOL 110, BOT 130, GENET 165, and PMCOL 101.

Note: Effective September 1996, it will not be possible to combine a major or minor in the Biological Sciences with a minor or major in one of the specific subject disciplines in the Biological Science. For example, students may not select a major in the Biological Sciences and a minor in Microbiology. Students who choose Biological Sciences as a subject of concentration are advised to consult with the Department of Biological Sciences or the Faculty of Science Student Services Office.

172.4 Cell Biology

172.4.1 Honors in Cell Biology

Continuation in the Honors Cell Biology program requires a minimum GPA of 6.5 in the preceding Winter Session. Graduation requires a minimum GPA of 6.5 on the last ★60 credited to the degree.

Year 1
- CHEM 161/163
- CHEM 101/102
- MATH 113 or 114, and 115
- BIOL 107, 108
- ★6 in an Arts option (English 101 recommended)

Year 2
- BIOL 201
- BIOCH 203/205
- PHYS 100, 101
- GENET 270
- BIOL 207, 208
- MICRB 265
- ★3 in an Arts option

Year 3
- CELL 300, 301
- ★6 from Group A Cell Biology options
- ★9 from Group B Cell Biology options
- ★3 in an approved Science option
- ★6 in Arts options

Year 4
- BIOL 445
- CELL 490
- ★6 from Group A Cell Biology options
- ★6 from Group B Cell Biology options
- ★6 in approved Science options
- ★3 in an Arts option

Group A: Cell Biology Options
- BIOCH 420
- BIOCH 430 or GENET 304
- ZOOL 202 or BOT 202
- STAT 237

Group B: Cell Biology Options
- BIOCH 410, 441, 455
- BIOL 585
- BOT 250, 382
- CHEM 271 and 273
- GENET 275, 301, 364, 390
- INT D 224, 371, 372
- MICRB 265, 314
- PHYSL 401
- ZOOL 342, 445, 452

172.4.2 Specialization in Cell Biology

Continuation in the Specialization Cell Biology program requires a minimum GPA of 6.0 in the preceding Winter Session. Graduation requires a minimum GPA of 6.0 in all courses credited to the degree.

Year 1
- CHEM 161/163
- CHEM 101/102
- MATH 113 or 114, and 115
- BIOL 107, 108
- ★6 in an Arts option (English 101 recommended)

Year 2
- BIOL 201
- BIOCH 203/205
- PHYS 100, 101
- GENET 270
- BIOL 207, 208
- MICRB 265
- ★3 in an Arts option

Year 3
- CELL 300, 301
- ★6 from Group A Cell Biology options
- ★9 from Group B Cell Biology options
- ★3 in an approved Science option
- ★6 in Arts options

Year 4
- BIOL 445
- ★6 from Group A Cell Biology options
- ★6 from Group B Cell Biology options
- ★9 in an approved Science options
- ★3 in an Arts option
- ★3 in an approved option

Group A Cell Biology Options:
- BIOCH 420
- BIOCH 430 or GENET 304
- ZOOL 202 or BOT 202
- STAT 237

Group B Cell Biology Options:
- BIOCH 410, 441, 455
- BIOL 585
- BOT 250, 382
- CHEM 271 and 273
- GENET 275, 301, 364, 390
- INT D 224, 371, 372
- MICRB 265, 314
- PHYSL 401
- ZOOL 342, 445, 452

172.5 Chemistry

172.5.1 Honors in Chemistry

Honors students in Chemistry are required to take a core of Chemistry and auxiliary courses. The core consists of ★42 in Chemistry courses, ★12 in Mathematics courses, ★9 in Physics, and ★18 in Arts courses. In addition to the core courses, honors students are required to complete at least six ★3 in senior courses in Chemistry. Four of these must be selected from Group A and the other two from either Group A or Group B. Finally, the honors student must include seven ★3 in options in the third and fourth years of the program. These are normally chosen from offerings within the Faculty of Science. All options must be selected in consultation with the Department of Chemistry.

Continuation in the Honors Chemistry program requires a GPA of 6.5 in the preceding Winter Session. Graduation requires a minimum GPA of 6.0 on the last ★30.

Year 1
- CHEM 101, 102, 161, 163
- PHYS 100,102
- MATH 113 (or 114), 115
- a junior course in English or ★3 in English and ★3 in an Arts option

Year 2
- CHEM 211, 213, 241
- CHEM 271, 273
- PHYS 238
- MATH 214, 215
- ★6 in an Arts option

Years 3 and 4
- CHEM 341, 361, 363, 381, 383
- ★18 in senior chemistry courses
- ★21 in science options
- ★6 in Arts options

Group A
- CHEM 313, 437
- CHEM 461, 465
- CHEM 477, 479
- BIOCH 203

Group B
- CHEM 305, 401, 403, 407
- CHEM 413, 415, 417, 419, 421
- CHEM 433, 439
- CHEM 463, 467 469,
- CHEM 481, 483, 491, 493
- BIOCH 205

The Department of Chemistry may approve variations in the above program upon application.

172.5.2 Specialization in Chemistry

The complete Specialization program consists of ★120 and must include CHEM 101, 102, 161 (or 261), 163, (or 263), 211, 213, 241, 271, 273, 341, 361, 363, 381, 383; PHYS 100, 102, 238; MATH 113 (or 114), 115, 214, 215; ★6 in junior English or ★3 in English and ★3 in an Arts option, ★12 in Arts options, and ★39 in approved options. These options are normally chosen from offerings within the Faculty of Science. All options must be selected in consultation with the Department of Chemistry. The honors curriculum can be used as a guide in planning a specialization program.

Continuation in the Specialization in Chemistry program requires a GPA of 5.5 on all Chemistry courses and a GPA of 5.5 on all courses beyond the first ★30. Graduation requires a minimum GPA of 5.5 on the last ★90 credited to the degree.

172.5.3 Industrial Internship Program

The Department of Chemistry offers an Industrial Internship Program for students in the Honors or Specialization Programs. Eligible students must have good standing in their program and be Canadian citizens or permanent residents. Beginning in May, after completion of Year 3, students will spend one year in paid employment. The Department will make available to interested students approved job descriptions. Interviewing of students and final selection will be the responsibility of the company. At the end of the first three months of employment, the placement will be reviewed by the employer, the student, and the Program Advisor. If all parties are satisfied, the employment will continue for a further nine months and the Program Advisor will maintain contact at approximately three-month intervals with the student and the person designated by the employer to be responsible for the student's progress. This arrangement is designed to ensure satisfaction on all sides for the remainder of the work term. Although the student and employer may choose to keep the association for the four summer months following the internship, this stage will not be part of the formal Internship Program. If the review shows the situation is not satisfactory, the internship is terminated and the student may return to classes in September to complete Year 4. In this way the completion of the student's academic program is not delayed.

During the final eight months of the work experience, the students register in work experience (WKEXP) courses in each of the Fall and Winter terms and are considered as full-time students at the University of Alberta. The first four months of the work experience are considered as a 'trial period' and will not appear on the student's transcript. These courses have no weight and are graded credit or no credit. CHEM 400 (★3), graded on the normal 9-point grading scale, will comprise the academic component of the Internship Program. In the Fall term immediately following successful completion of the year-long internship, each student will submit a report to the Program Advisor describing the project(s) undertaken and make an oral presentation to the Program Committee. If required by the employer, the report and oral presentation may be classified as confidential. The employer will also assess the performance of the student during the work term. On the basis of these reports and the presentation, the Program committee will award the student a grade in CHEM 400.

A student must successfully complete WKEXP 401, 402, and CHEM 400, and the final year of their academic program to graduate with an Honors or Specialization Degree in Chemistry from the Industrial Internship Program Stream.

Students participation in the program is voluntary, but it will not be possible to guarantee that all students wishing to do an internship are able to do so. However, the Department will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the Department of Chemistry for further information.

Courses Related to the Industrial Internship Programs

Year 4	Course	Weight	Grade
Fall	WKEXP 401	0	CR/F
Winter	WKEXP 402	0	CR/F
Intersession			
(for 16 month option)	WKEXP 403	0	CR/F
Year 5			
Fall	CHEM 400	3	9-point

172.5.4 Concentration in Chemistry

Students in the BSc General program with a major in Chemistry should complete CHEM 100, 102, 161 (or 261), 163 (or 263); MATH 113 (or 114), 115, and ★6 of junior physics during the first two years of their programs. It is recommended that CHEM 101, 102, MATH 113 (or 114) and 115 be taken in the Year 1 since these provide maximum flexibility for course selection in Year 2 and subsequent years of the program. To complete a major in Chemistry, students should select from the following senior courses; CHEM 211, 213, 271, 273, 331, 332, 361, 363, 375 and 313. Students majoring in Chemistry should consult with the Chemistry Department Advisor before registering in second and later years of the program in order to plan a course of study and have their programs approved by the Advisor.

Students in the BSc General program with a minor in Chemistry should include CHEM 101, 102, 161 (or 261), and 163 (or 263) in their program. Other Chemistry courses to complete the minor may be selected from: CHEM 211, 213, 271, 273, 303, 313, 331, 332, 361, 363, and 375.

172.5.5 Certificate of Specialization After a BSc Degree from the Faculty of Science at the University of Alberta

All outstanding requirements of the Specialization Degree must be completed with an average of 5.5 or better in all chemistry courses taken after the general degree, see §172.1.3.

172.5.6 Diploma After a Previous Degree

Students who, after a period of professional employment, wish to update their qualifications may enrol in a special one-year program designed for this purpose. Those who possess at least the three-year general degree or its equivalent, and who complete satisfactorily an approved selection of 30 units of course weight, may be awarded a diploma which attests to this improvement in their qualification. All courses must be selected in consultation with the Department.

172.6 Computing Science

Admission requirements are set out in §15.16.

The Computing Science program has a quota in the second year.

Senior Computing Science courses (300- and 400-level) are restricted to third- and fourth-year Science Honors and Specialization students.

172.6.1 Honors in Computing Science

Continuation in the Honors program requires a GPA of at least 6.5 in the preceding Winter Session. Graduation requires a GPA of at least 6.5 on the last ★30 credited to the degree and at least 6.5 on the last ★60 credited to the degree.

Students must obtain departmental guidance in developing their program. All course selections and changes require approval by a departmental advisor.

It is recommended that students use the required Arts and approved options in Year 2 to build a foundation in disciplines related to Computing Science. Suggested programs of study in arts, business, electrical engineering, any applied mathematics are available from the Department.

Year 2	Year 3	Year 4
CMPUT 201, 204, 280, 285, 291	CMPUT 304, 325, 379, 391	CMPUT 401, 418 or 419, 451, 474, and at least ★3 in CMPUT at the 300-level or higher
MATH 120, 214 (or 217), 215 (or 317)	MATH 128 or 223	★6 in approved options
STAT 221	STAT 222	★6 in approved Science options
★3 in Arts options	★6 in Arts options	★3 in Arts options
	★6 in approved options	

Notes

(1) Honors students are encouraged to take the Honors version of the Mathematics courses beginning in the first year.

(2) Honors students are required to participate in CMPUT 495 (Honors Seminar) during their degree program.

172.6.2 Specialization in Computing Science

Continuation in the Specialization program requires a GPA of at least 6.0 in the preceding Winter Session. Graduation requires a GPA of at least 6.0 on the last ★90 credited to the degree.

The program gives students much freedom in pursuing specialized areas of interest in Computing Science and in other disciplines. It is recommended that students use the required Arts and approved option in Year 2 to build a foundation in disciplines related to Computing Science. Suggested programs of study in arts, business, electrical engineering, and applied mathematics are available from the Department. Coherent programs in these and other applications areas are to be developed by the student with the assistance of the departmental advisor. Course selections in other departments and Faculties may be subject to quotas and GPA requirements.

Year 2	Year 3	Year 4
CMPUT 280	★3 of CMPUT at the 200-level (must include one of CMPUT 201, 204, 285, 291)	CMPUT 401
★9 in CMPUT at the 200-level (must include three of CMPUT 201, 204, 285, 291)	CMPUT 325, 340, 379	6 in CMPUT at the 300-level or higher
MATH 120, 214 STAT 221	STAT 222	★15 in approved options
★6 in Arts options	★3 in Arts options	★3 in approved Science options
★3 in approved options	★9 in approved options	★3 in Arts options
	★3 in Science options	

Notes
(1) Students entering Year 2 of the program may register for no more than two Computing Science courses per term.
(2) At least ★9 in approved options must be at the 300-level or higher.

172.6.3 Specialization in Computing Science – Minor in Business

Note: All requirements for the BSc Specialization program as set out in §172.1.2 must be met.

Students who have been admitted to the Business minor and who maintain a minimum GPA of 6.0 in each Winter Session in the Specialization Computing program, may continue with the designation "pursuing a Business Minor within Specialization Computing Science." Students who drop out of the Specialization Computing Science program will lose their status as "pursuing a Business minor within Specialization Computing Science." Should such students be admitted to the BSc General program and wish to pursue a Business minor within the BSc General program, they must reapply to the Business-Science Quota Committee for admission to the Business minor.

The Business minor in Computing Science consists of the following courses:

(1) ECON 101, 102
(2) ACCTG 311
(3) ORG T 301
(4) Two of FIN 301, MARK 301, MGTSC 352, and ORG T 311
(5) a minimum of ★6 in courses offered by the Faculty of Business and approved by the student's advisor.

To graduate with the designation "Specialization in Computing Science with a Minor in Business," students must achieve a minimum GPA of 5.5 on all Business courses contributing to the minor. This calculation does not include the two economics courses.

172.6.4 Industrial Internship Programs

The Department of Computing Science offers a voluntary Industrial Internship Program (IIP) which allows students to augment their program of study with periods of paid, discipline-related work with approved, cooperating corporations. Only students who are in good standing in the Specialization or Honors program and who are Canadian citizens or hold landed immigrant status in Canada are eligible to compete for places in this program.

The IIP Stream extends a student's program of study by one academic year. During this 16-month IIP period, beginning annually in May; students are considered to be full-time, off-campus students of the University of Alberta. Students approved to enter this stream will be registered by the Department of Computing Science in WKEXP 921, 922, and 923 which are 0 credit courses. A grade of credit/fail will appear on the student's transcript for these courses. Students who have completed between four and eight months of the IIP may be given credit, if appropriate, for WKEXP 921. The graduation requirements for the IIP Stream designation include successful completion of WKEXP 921, 922, and 923 plus CMPUT 400 Industrial Internship Practicum. CMPUT 400 must be taken in the first term immediately following WKEXP 923.

The table below illustrates the normal sequencing of the required courses for the Industrial Internship Stream of the Specialization and Honors Programs.

Note: Students planning to enter the IIP stream are strongly encouraged to register in ORG T 311 in the third year of their program.

Students registered in the Industrial Internship Program are provided with some assistance in the location of suitable internship employment. Career and Placement Services (4th floor, Student's Union Building) will assist in the preparation and search for suitable industrial positions for these students. However, there is no guarantee that all qualified students can be placed. Interested students should see the Industrial Experience Programs Coordinator in the Department of Computing Science for more information.

Courses Related to the Industrial Internship Programs

	Normal	**Industrial Internship Program**
Year 2		
Fall	Courses	Courses
Winter	Courses	Courses
Year 3		
Fall	Courses	Courses
Winter	Courses	Courses
Summer	n/a	IIP (probationary)
Year 4		
Fall	Courses	IIP and WKEXP 921
Winter	Courses	IIP and WKEXP 922
Summer	n/a	IIP and WKEXP 923
Year 5		
Fall	n/a	Courses + CMPUT 400
Winter	n/a	Courses

172.6.5 BSc Program in Computer Engineering

A four-year program in Computer Engineering is offered jointly by the Faculty of Science and the Faculty of Engineering. For details see §82.5.

For administrative purposes, students in the program will be registered in the Faculty of Engineering.

Admission requirements are set out in §15.6.

Promotion and Graduation regulations are set out in §83.3(2).

172.7 Earth and Atmospheric Sciences

The Department of Earth and Atmospheric Sciences was established in 1995 from the merger of the Departments of Geography and Geology. Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers eight academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Science, Honors and Specialization in Geology, Honors in Paleontology, and BA Major in Human Geography.

172.7.1 Honors in Atmospheric Sciences

Atmospheric science is the study of atmospheric composition, state and motion, from the small scale (e.g. the environment of a single leaf) through medium scales (e.g. a Cumulus cloud) to the global scale (global pollution and warming). Most atmospheric scientists in Canada work for Environment Canada, providing weather forecasts or environmental information. Opportunities also arise with provincial governments, and in the private sector.

Continuation in the Honors in Atmospheric Sciences program requires a GPA of at least 6.5 on at least ★30 in the previous Winter Session. Graduation requires a GPA of at least 6.5 on the last ★60 credited to the degree.

A student enrolling in the Honors program should confer with the Atmospheric Sciences advisor before registration each year.

Year 1	**Year 2**
EAS 101, 102	EAS 220, 221, 270, 271, 327
ENGL 101	MATH 120, 214, 215
CHEM 101, 102	PHYS 244, 281
MATH 113/114, 115	
PHYS 100, 102	
Year 3	**Year 4**
EAS 290/291, 370, 371	EAS 426, 470, 471/472
★9 Arts options	★21 in approved Science options (see Note below)
★12 in approved Science options (see Note below)	

Note: Approved Science options should be chosen from the following list: EAS 208, 320, 324, 325, 326, 352, 427, 428, 451, 453, 454, 455, 457, 471, 472, CHEM 211, 213, 261, 263, 303, ENCS 203, 360, FOR 340, 372, GEOPH 221, 429, MATH 121, 280, 337, PHYS 211, 261, 264, 364, 285, 381, 383, SOILS 210, 330, 440. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.2 Specialization in Atmospheric Sciences

Continuation in the Specialization in Atmospheric Sciences program requires a GPA of at least 5.5 on at least ★27 in the previous Winter Session. Please note: In order to graduate in four years, a student needs to complete ★30 per year.

Graduation requires a GPA of at least 5.5 on the last ★60 credited to the degree.

A student enrolling in the Specialization program should confer with the Atmospheric Sciences Program student advisor before registration each year.

Year 1	**Year 2**
EAS 101, 102	EAS 220, 221, 270, 271
ENGL 101	MATH 120, 214, 215
CHEM 101, 102	PHYS 244, 281
MATH 113/114, 115	★3 Arts options
PHYS 100, 102	
Year 3	**Year 4**
EAS 290/291, 327, 370, 371	EAS 470, 471/472
★6 Arts options	★24 in approved Science options (see Note below)
★12 in approved Science options (see Note below)	

Note: Approved Science options should be chosen from the following list: EAS 208, 320, 324, 325, 326, 352, 427, 428, 451, 453, 454, 455, 457, 471, 472, CHEM 211, 213, 261, 263, 303, ENCS 203, 360, FOR 340, 372, GEOPH 221, 429, MATH 121, 280, 337, PHYS 211, 261, 264, 364, 285, 381, 383, SOILS 210, 330, 440. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.3 Honors in Environmental Earth Sciences

Environmental Earth Science is the study of interactions between humans and Earth's natural environment. It encompasses the influence of human activities on the local and global environment, as well as how our actions are shaped and controlled by the geologic and geomorphic processes occurring around us. Environmental Earth Scientists are typically employed by consulting companies, large resource and industrial firms, and government organizations.

Continuation in the Honors in Environmental Earth Sciences program requires a GPA of at least 6.5 on at least ★30 in the previous Winter Session.

Graduation requires a GPA of at least 6.5 on the last ★60 credited to the degree.

A student enrolling in the Honors program should confer with the Environmental Earth Sciences Program student advisor before registration each year.

Year 1
EAS 101, 102
ENGL 101
CHEM 101, 102
MATH 113/114, 115
PHYS 100, 101

Year 2
BIOL 108
EAS 220, 221, 222, 223, 224, 225, 250, 270/271, 290

Year 3
EAS 320, 324, 354
★21 Optional Elements (see below)

Year 4
EAS 426
★27 Optional Elements (see below)

Optional Elements
Students will be required to take additional courses from each of the six groups listed below:
Groups:
(1) At least ★3 (Field and Laboratory Methods) of the following: EAS 233, 327, 423, 424; GEOPH 229.
(2) At least ★3 (Geoprocessing) of the following: EAS 325, 351, 451.
(3) At least ★3 (Math, Statistics and Computing) of the following: EAS 326; CMPUT 101, 114; MATH 120, 214, 215, 280, 334.
(4) At least ★3 (Geology) of the following: EAS 207, 232, 321, 322, 330, 420, 421, 422, 425.
(5) At least ★6 (Surface Processes and Quaternary Geology) of the following: EAS 270, 271, 352, 370, 371, 453, 454, 455, 457; INT D 594.
(6) At least ★9 of the following Arts options: EAS 190, 191, 291, 292, 390, 391, 392, 491, 493.

An additional ★21 of the following approved options: ANTHR 488; BIOL 208, 381; CIV E 250, 355, 381; EAS 427, 428; ECON 101; ENCS 352, 475; INT D 369, 421; PHIL 265, 355, 465; POL S 222, 432; REN R 425; SOILS 210, 420, 430, 450; ZOOL 464 , or from Groups 1-6 listed above. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.4 Specialization in Environmental Earth Sciences

Continuation in the Specialization in Environmental Earth Sciences program requires a GPA of at least 5.5 on at least ★27 in the previous Winter Session. Please note: In order to graduate in four years, a student needs ★30 per year.

Graduation requires a GPA of at least 5.5 on the last ★60 credited to the degree.

A student enrolling in the Specialization program should confer with the Environmental Earth Sciences Program student advisor before registration.

Year 1
EAS 101, 102
ENGL 101
CHEM 101, 102
MATH 113/114, 115
PHYS 100, 101

Year 2
BIOL 108
EAS 220, 221, 222, 223, 224, 225, 250, 270/271, 290

Year 3
EAS 320, 324, 354
★21 of Optional Elements (see below)

Year 4
★30 Optional Elements (see below)

Optional Elements
Students will be required to take additional courses from each of the six groups listed below:
Groups:
(1) At least ★3 (Field and Laboratory Methods) of the following: EAS 233, 327, 423, 424; GEOPH 229.
(2) At least ★3 (Geoprocessing) of the following: EAS 325, 351, 451.
(3) At least ★3 (Math, Statistics and Computing) of the following: EAS 326; CMPUT 101, 114; MATH 120, 214, 215, 280, 334.
(4) At least ★3 (Geology) of the following: EAS 207, 232, 321, 322, 330, 420, 421, 422, 425.
(5) At least ★6 (Surface Processes and Quaternary Geology) of the following: EAS 270, 271, 352, 370, 371, 453, 454, 455, 457; INT D 594.
(6) At least ★9 of the following Arts options: EAS 190, 191, 291, 292, 390, 391, 392, 491, 493.

An additional ★24 of the following approved options: ANTHR 488; BIOL 208, 381; CIV E 250, 355, 381; EAS 427, 428; ECON 101; ENCS 352, 475; INT D 369, 421; PHIL 265, 355, 465; POL S 222, 432; REN R 425; SOILS 210, 420, 430, 450; ZOOL 464, or from Groups 1-6 listed above. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.5 Honors in Geology

Geology is the study of the planet Earth - the materials of which it is made, the processes which affect these materials, and the origin and evolution of life. Geologists are employed by companies engaged in exploration for and production of minerals and fuels, by government agencies, by companies engaged in engineering and environmental projects and by universities.

Continuation in the Honors in Geology program requires a GPA of 6.5 on at least ★30 in the previous Winter Session.

Graduation requires a minimum GPA of 6.5 on the last ★60 credited to the degree.

A student enrolling in the Honors program should confer with the Geology Program student advisor before registration each year.

EAS 101, 103
ENGL 101
CHEM 101, 102
MATH 113 or 114 and 115
PHYS 100, 101

EAS 220, 221, 223, 224, 225, 230, 231, 232, 233, 234

EAS 320, 321, 322, 330, 331, 332, 333
EAS 290 or 291
★6 in an Arts option listed below

EAS 426
GEOPH 223
★6 in approved EAS Science courses 250 or higher
★12 in approved Science options (including but not restricted to EAS courses)
★6 Arts options

Note: Recommended Arts options include: EAS 190, 191, 290, 291, 292, 390, 391, 392, 491, 493. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.6 Specialization in Geology

Continuation in the Specialization in Geology program requires a GPA of at least 5.5 on at least ★27 in the previous Winter Session. Please note: In order to graduate in four years, a student needs to complete ★30 per year.

Graduation requires a GPA of at least 5.5 on the last ★60 credited to the degree.

A student enrolling in the Specialization program should confer with the Geology Program student advisor before registration each year.

EAS 101, 103
ENGL 101
CHEM 101, 102
MATH 113/114, 115
PHYS 100, 101

EAS 220, 221, 223, 224, 225, 230, 231, 232, 233, 234

EAS 320, 321, 322, 330, 331, 332, 333
EAS 290/291
★6 Arts options

GEOPH 223
★9 in approved EAS Science courses 250 or higher
★15 in approved Science options (including but not restricted to EAS courses)
★3 in an Arts option listed below

Note: Recommended Arts options include: EAS 190, 191, 290, 291, 292, 390, 391, 392, 491, 493. For students in the Industrial Internship Program: EAS 401, WKEXP 401, WKEXP 402, WKEXP 403.

172.7.7 Professional Association

The practice of geology in Alberta is governed by provincial law and regulated by the Association of Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA). In the interest of public protection, the right to practice geology in Alberta and accept professional responsibility for geological work, as well as the right to use the title of Professional Geologist (PGeol) is limited to individuals who are registered by APEGGA.

Members of the PS Warren Society, the geology student society, are automatically student members of APEGGA, and as such are introduced to the professional association. In order to meet the requirements of full registration, acceptable academic training and four years of full-time experience as a geologist in-training following graduation are needed.

Students are advised to plan their course program to meet the requirements for professional registration. Attention is drawn in particular to the Science course requirements additional to calculus, introductory Physics, and introductory Chemistry. The Specialization in Geology and the Honors in Geology degrees can be accepted by APEGGA as satisfying the academic requirements if courses are chosen to cover the APEGGA syllabus. Holders of degrees that do not cover the APEGGA syllabus may

the APEGGA Board of Examiners, to meet additional academic requirements before being accepted for registration.

Current syllabus and registration information is available in the Departmental Office or from APEGGA.

172.7.8 Honors in Paleontology

See §172.14, Paleontology, for details on the Honors in Paleontology program.

172.7.9 Industrial Internship Program

Industrial Internship Program offers undergraduate students extended work experience in industry in addition to their academic courses. The work experience is normally undertaken after completion of the third year. The program will consist of a four month probationary appointment from May to August, after which a decision will be made by all parties involved as to whether to proceed with the additional 12 month program. Students will return to the department for their fourth year. Work during the internship period is full time for which the student is paid by the employer at competitive rates. Students in Honors and Specialization Programs in the Department of Earth and Atmospheric Sciences, who have completed three years of their program, have maintained good academic standing, and are Canadian citizens or permanent residents are eligible for the program. In the fall term of the student's third academic year, the IIP Advisor will make available approved position descriptions from companies wishing to employ IIP students. Interviewing and final selection of the students for the positions will be the responsibility of the companies. Student participation in the program is voluntary, but it will not be possible to guarantee that all students wishing to do an internship will be able to do so.

During the Fall, Winter, and Summer Intersession terms of the work experience, the student registers in WKEXP 401, WKEXP 402, and WKEXP 403 and is considered to be a full-time student at The University of Alberta. The work experience courses have no weight and are graded credit or no credit. In the Fall term immediately following the completion of the internship, each student submits a report to the Program Advisor and the program committee, describing the project(s) undertaken, and makes an oral presentation to the department. If required by the employer, the report and oral presentation may be classified as confidential and in that case, only the program committee will attend the presentation. A written report from the employer will also be used in assessing the performance of the student during the work period. On the basis of the reports and presentation, the Program committee will award the student a grade in EAS 401. A student must successfully complete WKEXP 401, WKEXP 402, WKEXP 403, EAS 401 and the final year of their academic program to graduate with an Honors or Specialization Degree in Earth and Atmospheric Sciences in the Industrial Internship Program.

Courses Related to the Industrial Internship Program

	Normal	Industrial Internship Program
Year 2		
Fall	Courses	Courses
Winter	Courses	Courses
Year 3		
Fall	Courses	Courses
Winter	Courses	Courses
Summer	n/a	IIP (Probationary)
Year 4		
Fall	Courses	IIP and WKEXP 401
Winter	Courses	IIP and WKEXP 402
Summer	n/a	IIP and WKEXP 403 (for 16-month IIP)
Year 5		
Fall	n/a	Courses + EAS 401
Winter	n/a	Courses

172.8 Environmental Physical Sciences

172.8.1 Specialization in Environmental Physical Sciences

Continuation in the Specialization in the Environmental Physical Sciences program requires a GPA of 5.5 on all Environmental Physical Sciences courses and a GPA of 5.5 on all courses beyond the first H30. Graduation requires a minimum of GPA of 5.5 on the last H90 credited to the degree.

Year 1
- CHEM 101/102;
- MATH 113 or 114
- MATH 115
- PHYS 100
- PHYS 101 or 102
- EAS 101 and 102
- ★6 in English (ENGL 101 recommended)

Year 2
- BIOL 108
- CHEM 261/263
- MATH 120
- PHYS 201
- EAS 220/221 (See Note 1) or PHYS 261/264
- ★9 in Arts options or approved Science or other options (See Notes 2 and 3)

Year 3
- CHEM 211/213
- EAS 220/221 (See Note 1) or PHYS 261/264, whichever were not previously taken.
- EAS 223/270
- PHYS 294
- PHYS 364 or approved Science option
- ★6 in Arts options or approved Science or other options. (See Notes 2 and 3)

Year 4
- CHEM 303
- CHEM 305 or EAS 351
- EAS 425
- PHYS 364 or approved Science option, whichever was not previously taken.
- ★18 in Arts options or approved Science or other options. (See Notes 2 and 3)

Notes

(1) In lieu of EAS 220, an approved course in computation, computing, or statistics may be taken.

(2) H6 to H12 must be taken in Arts option, in addition to the H6 in 100-level English. These may include EAS 290, 291, 390, 493; ECON 101; PHIL 355.

(3) Approved Science or other options must total H24 to H30, such that H36 of optional courses are taken altogether. These options include, but are not restricted to CHEM 271, 273, 313, 331, 332, 415, 417; EAS 224, 225, 250, 327, 352, 457; ENCS 203, 352; GEOPH 227, 229; INT D 369; MATH 214, 215, 270; SOILS 210.

172.8.2 Industrial Internship Program

The Environmental Physical Sciences Program in the Faculty of Science offers an Industrial Internship Component for students who have successfully completed three years in this Program. Eligible students must have good standing in the Program and be Canadian citizens or permanent residents Beginning in May, after completion of Year 3, students will spend one year in paid employment. The Industrial Internship Program (IIP) Advisor will make available to interested students approved job descriptions. Interviewing of students and final selection will be the responsibility of the company. At the end of the first three months of employment, the placement will be reviewed by the employer, the student and the IIP Advisor. If all parties are satisfied, the employment will continue for a further nine months and the IIP Advisor will maintain contact at approximately three-month intervals with the student and the person designated by the employer to be responsible for the students progress. This arrangement is designed to ensure satisfaction on all sides for the remainder of the work term. Although the student and employer may choose to keep the association for the four summer months following the internship, this stage will not be part of the formal Internship component. If the review shows the situation is not satisfactory, the internship is terminated and the student may return to classes in September to complete the Year 4. In this way the completion of the students academic program is not delayed. During the final eight months of the work experience, the students register in work experience (WKEXP) courses in each of the Fall and Winter terms and are considered as full-time students at the University of Alberta. The first four months of the work experience are considered as a trial period and will not appear on the student's transcript. These courses have no weight and are graded credit or no credit. ENVPS 403 (H3), graded on the normal 9-point grading scale, will comprise the academic component of the Internship Program. In the fall term immediately following successful completion of the year-long internship, each student will submit a report to the IIP Advisor describing the project(s) undertaken and make an oral presentation to the Advisory committee. If required by the employer, the report and oral presentation may be classified as confidential. The employer will also assess the performance of the student during the work term. On the basis of these reports and the presentation, the Advisory committee will award the student a grade in ENVPS 403.

A student must successfully complete WKEXP 401, 402, and ENVPS 403, and the final year of their academic program to graduate with a Degree from the Environmental Physical Sciences Program in the Industrial Internship Stream.

Students participation in the program is voluntary but it will not be possible to guarantee that all students wishing to do an internship are able to do so. However the IIP Advisor will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the IIP Advisor for further information.

Courses Related to the Industrial Internship Program

		Course	Weight	Grade
Year 4	Fall	WKEXP 401	0	CR/F
Year 4	Winter	WKEXP 402	0	CR/F
Year 5	Fall	WKEXP 403	3	9-point

172.8.3 Honors in Paleontology

See §172.16, Paleontology, for details on the Honors in Paleontology program.

172.9 Geophysics

The Department of Physics offers two programs dealing with solid earth physics and space physics. The Honors in Geophysics program is

designed to prepare students for careers in graduate work in geophysics and is described below. The Specialization in Geophysics program is designed to prepare students with the conceptual and laboratory background required for employment at the BSc level in industry, government and technical schools. Also see §172.16 (Physics).

172.9.1 Professional Association

The practice of geophysics in Alberta is regulated by the Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA).

The right to practise geophysics in Alberta and accept professional responsibility for such work as well as the right to use the geophysicist title is limited to those who are registered with APEGGA.

Members of the Geophysics Student Society are automatically student members of APEGGA. Graduates are encouraged to join APEGGA as Geophysicists-in-training. Two years of acceptable experience following graduation is necessary for registration as a Professional Geophysicist, the APEGGA membership category which confers the right to accept responsibility for geophysical work.

172.10 Marine Science

A marine station is established at Bamfield on Vancouver Island, BC, where there are excellent opportunities for the study of marine biology and related subjects. An academic program is in operation at the station, in which summer study will provide credit towards degrees in Science.

Prerequisite for all of the MA SC courses is consent of the Department of Biological Sciences.

Students will be expected to take a full course load of 15 credits during the fall term.

Courses will run from Monday to Saturday.

A refundable deposit of $100 payable at the time of application is required.

An extension fee of $1000 must be paid upon arrival at BMS to cover the cost of field trips, lab supplies and course materials.

There is a mandatory room and board charge of $1840 for the 13 weeks.

Information concerning course prerequisites and application procedures for Marine Science may be obtained from the Departments of Biological Sciences, or the Office of the Dean of Science. Permission to register in these courses may be obtained from the Director of the Bamfield Marine Station, to whom application should be made.

See §211 Course Listings for descriptions of Marine Science courses available.

172.11 Mathematics

172.11.1 Honors in Mathematics

Continuation in the Honors in Mathematics program requires a minimum GPA of 6.5 in the preceding Winter Session. Graduation requires a minimum GPA of 6.5 on ★30 in each Winter Session.

Year 1	Year 2	Years 3 and 4
MATH 117, 118, 127, 128	MATH 217, 227, 317, 336	★30 in Mathematics courses
★3 in a Computing Science option	★6 in an approved Science option	★6 in an approved Science option
★3 in an approved Science option	★6 in an approved Arts option	★6 an approved Arts option
★6 in approved Arts options	★6 in an approved option	★18 in approved option
★6 in approved options		

The program must include MATH 411, 417, 418, 426, 427, 447, 496, two of MATH 324, 347, 373, 412, 421, 486 and either MATH 446 or 448.

The Honors Seminar, MATH 496 should normally be taken in the fourth year. Note that several of the required courses are only given in alternate years.

Honors in Applied Mathematics

This program is the same as the above except for the courses required in the third and fourth years: MATH 337, 411, 417, 436, 486, 496, one of MATH 373 or 421, ★12 in approved options at the 300-level in the field of application, ★3 in an approved 300- or 400-level Mathematics and/or Mathematical Physics option, ★12 in approved Science options, ★6 in an approved Arts option, ★6 in an approved option.

Minor in Statistics

The degrees Honors in Mathematics and Honors in Applied Mathematics can each be obtained with a minor in Statistics provided the student's program included STAT 265, 266, 465, 466, 471, and two of STAT 377, 472, 475, 479, or a 400-level Statistics course.

Minor in Computing Science

The degrees Honors in Mathematics and Honors in Applied Mathematics can each be obtained with a Minor in Computing Science. The student's program must include CMPUT 114, 115, 201, 204, 272, 280, and at least ★15 in Computing Science at the 300- or 400-level chosen with approval of both the Computing Science Department Honors Advisor and the Mathematical Sciences Department Honors Advisor. CMPUT 304, 311, 313, and 474 are recommended.

The Department also offers a BA Honors in Mathematics (See §54.15.1).

Honors in Mathematical Physics

See §172.16.3 for details.

172.11.2 Specialization in Mathematics

Continuation in the program normally requires, in the previous winter session, successful completion of at least ★24 with a GPA of at least 5.5, and a GPA of at least 5.5 on all Mathematics courses taken in that session. Graduation requires a GPA of at least 5.5 of all courses credited toward the degree and a GPA of at least 5.5 on all Mathematics courses credited toward the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated as follows:

Year 1	Year 2
MATH 114, 115	MATH 214, 215
MATH 120, 121	MATH 223
★6 from CMPUT 101, 102, 114, 115	★3 in Mathematics
★6 in approved options	★6 in an approved Science option
★6 in a junior English	★6 in an Arts option
	★6 in an approved option
Year 3	**Year 4**
MATH 314/414	★12 in a 300- or 400-level Mathematics
★6 in Mathematics	★6 in approved Science options
★6 in an approved Science option	★12 in approved options
★6 in an Arts option	
★6 in an approved option	

Notes

(1) A student must take ★6 in a Mathematics course in each year of the program.

(2) A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example, MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

172.11.3 Mathematics and Economics

The Faculty of Science offers both an Honors degree and a Specialization degree in Mathematics and Economics.

Honors in Mathematics and Economics

Year 1	Year 2	Year 3 and 4
ECON 101, 102	ECON 281, 282	★24 in Economics
MATH 117, 118, 127, 128	MATH 217, 317, STAT 265, 266	★24 in Mathematics or Statistics courses
★6 in a junior English	★6 in a Science option	★6 in a Science option
★6 in a Science option	★6 in an option	★6 in an option

The program must contain MATH 227; ECON 481, 482, 407, 408; and four of MATH 336, 373, 411, 417, 421, 426, 486. MGTSC 352, 404, 424, 426, 427 are approved options, but are not substitutes for Economics courses. Credit will not be given for ECON 386, 387, or 399.

Specialization in Mathematics and Economics

Continuation in the program normally requires, in the previous winter session, successful completion of at least ★24 with a GPA of at least 5.5, and a GPA of at least 5.5 on the aggregate of all Mathematics and Economics courses taken in that session. Graduation requires a GPA of at least 5.5 on all courses credited towards the degree and a GPA of at least 5.5 on the aggregate of all Mathematics and Economics courses credited toward the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated as follows:

Year 1	Year 2	Years 3 and 4
ECON 101, 102	ECON 281, 282	★24 in Economics
MATH 113, 115	MATH 214, 215	★18 in Mathematics
MATH 120, 121	STAT 151 and 265 or STAT 265 and 266	★18 in options
★6 in a junior English	★6 in Science options	
★6 in Science options	★6 in options	

The program must contain at least ★36 in Economics, at least ★36 in Mathematics, and ★6 in Computing Science, chosen from CMPUT 101, 102, 114, 115. ★12 in Economics must be at the 400-level or above. ★12 in Mathematics must be at the 300-level or above. MGTSC 352, 404, 424, 426, 427 are approved options but are not substitutes for Economics courses. Credit will not normally be given for ECON 386, 387, or 399. Students who

are considering graduate work in Economics are advised to take ECON 407 and ECON 408.

Each program must have approval of the Departments of Mathematical Sciences and Economics and must contain a minimum of ★63 in Science.

Notes

(1) A student must take at least ★6 in Mathematics and/or Economics in each year of the program.
(2) A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

172.11.4 Specialization in Mathematics and Finance

Continuation in the program normally requires, in the previous winter session, successful completion of at least ★24 with a GPA of at least 5.5, and a GPA of at least 5.5 on the aggregate of all MATH, STATS, ACCTG. ECON, FIN, and MGTSC courses taken in that session. Graduation requires a GPA of at least 5.5 on all courses credited towards the degree and a GPA of at least 5.5 on the aggregate of all MATH, STATS, ACCTG, ECON, FIN, and MGTSC courses credited toward the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated as follows:

Year 1
MATH 114/115
MATH 120/121
★6 from CMPUT 101, 102, 114, 115, 252
ECON 101/102
★6 of junior English

Year 2
MATH 214/215
MATH 253
STAT 151/265 or 265/266
ACCTG 311
ECON 281
★9 of options

Year 3
MATH 254
MATH 314/414
MATH 373
FIN 301
FIN option
★3 of Science option
★9 of Science options

Year 4
★3 in MATH options
★6 in FIN options
★12 in Science options
★9 in options

Notes

(1) Approved ACCTG, ECON, FIN and MGTSC options include: ACCTG 413; ECON 282, 384, 385, 407, 408, 481, 482; FIN 412, 413, 414, 416, 422, 434, 442; MGTSC 352, 404, 405, 428, 456.
(2) Students are encouraged to choose some of their MATH and Science options from the following list of recommended courses: MATH 334, 337, 432, 470; MATH 280, 380; MATH 354; STAT 471, 472.
(3) Each program must have the approval of the Department of Mathematical Sciences and **must** include:
   a. ★18 in Arts Courses;
   b. ★63 in Science courses; including ★36 of MATH with at least ★12 of these at the 300-level or higher;
   c. ★36 in ECON, ACCTG, FIN, or MGTSC, including ★9 of 400-level FIN.
(4) A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example: MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

172.11.5 Specialization in Mathematics and Statistics for Actuarial Science

Continuation in the program normally requires, in the previous winter session, successful completion of at least ★24 with a GPA of at least 5.5, and a GPA of at least 5.5 on the aggregate of all Mathematics and Statistics courses taken in that session. Graduation requires a GPA of at least 5.5 on all courses credited towards the degree and a GPA of at least 5.5 on the aggregate of all Mathematics and Statistics courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated as follows:

Year 1
MATH 114/115
MATH 120/121
STAT 151
★6 from CMPUT 101, 102, 114, 115
★6 in a junior English
★3 in a junior Science

Year 2
MATH 214/215
MATH 253/254
STAT 265/266
★6 in Arts
★6 in Science

Years 3 and 4
MATH 354/STAT 331
MATH 280/380
MATH 373
STAT 332
STAT 378/368
STAT 471/466
STAT472
STAT 479
★6 in Arts
★18 in options

Notes

(1) The program **must** include
   ★36 in MATH
   ★33 in STAT
   ★6 in CMPUT
   ★9 in MATH at the 300-level or higher
   ★18 in Arts courses
   (It is recommended that students take Arts courses requiring essays)
(2) Students are encouraged to choose some of their options from the following list of recommended courses: MATH 220, 314/414, 334/432, 470; STAT 252, 361, 475.
(3) A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example: MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

172.11.6 Industrial Internship Program

The Industrial Internship Program provides students who have finished their third year of study in the Department of Mathematical Sciences an opportunity for extended work experience. The program lasts for 16 months, and after completing the reporting requirements, a student can receive university credit for the experience.

A student must successfully complete WKEXP 951, 952, 953, and MATH 400, and the final year of their academic program to graduate with the Industrial Internship designation.

This program should be of particular interest to Mathematics students studying Actuarial Science, Applied Mathematics, Economics, Finance, or Statistics.

It may not be possible to guarantee that all students wishing to do an internship are able to do so. However, the Department will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the Industrial Internship Program Coordinator in the Department of Mathematical Sciences for further information.

Courses Related to the Industrial Internship Program

			Weight	Grade
Year 4	Fall	WKEXP 951	0	CR/F
Year 4	Winter	WKEXP 952	0	CR/F
Year 4	Intersession	WKEXP 953	0	CR/F
Year 5	Fall	MATH 400 or STAT 400	3	9-point

Note: A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

172.12 Neuroscience

172.12.1 Honors in Neuroscience

The Honors program in Neuroscience is an interdisciplinary program coordinated by the Division of Neuroscience and administered by the Faculty of Science. This program is intended for students planning a career in Neuroscience.

Neuroscience is a broadly based discipline covering all aspects of brain function. Some of the major areas are brain development, nerve cells and synapses, sensation and perception, learning and memory, control of movement, animal behavior, cognitive psychology, and disorders of the nervous system.

The objective of the honors program is to introduce students to all the major areas of Neuroscience and to provide an opportunity for each student to explore topics of interest in their final year.

Continuation in the honors program requires a minimum GPA of 7.0 in the preceding Winter Session. Graduation requires a minimum GPA of 7.0 on ★120 contributing to the degree. Each program of study must be approved by the coordinator in the Division of Neuroscience.

Year 1
CHEM 101, 161
BIOL 107, 108
MATH 113 or 114
MATH 115 or STAT 151
PHYS 100, 101 or PHYS 108, 109
ENGL 101

Year 2
BIOCH 220
CHEM 263
BIOL 207
PHYSL 210
PSYCO 104, 275
★6 in Science options
★3 in an Arts option

Year 3
PMCOL 371
PHYSL 372
PSYCO 377
ZOOL 342
★12 in approved Science options
★6 in Arts options

Year 4
NEURO 450, 451
★12 chosen from ANAT 415, PMCOL 407, 412, 509, 512, PSYCI 511, PSYCO 475, 478, ZOOL 445
★9 in approved Science options (PHYSL 401 and 402 recommended)

Note: In the fourth year all students will be required to successfully complete an individual study program with members of the Division of Neuroscience. This program consists of two courses: a reading course, NEURO 450; and a laboratory course, NEURO 451. Students must consult the Division of Neuroscience prior to the beginning of their fourth year to arrange an individual study program.

172.13 Northern Studies

Students interested in Canada's North and especially students planning a career in northern Canada are encouraged to include within their curriculum some of the following courses: ANTHR 346, 350, 355, 445, and 446; GENET 197; BOT 199, 201, 202, 221, 422; EAS 101, 102; GEOG 333, 334, 424, 445, 446, 465, 468, 469; GEOL 201, 204, 492; INT D 416; METEO 230; POL S 100, 220 or 221, 432; ZOOL 120, 366. These courses may be taken within the framework of existing General, Specialization, or Honors programs in the Faculty of Science. Students interested in Northern Studies should mention this fact to their faculty advisor.

Note: More information about courses given may be obtained from the Canadian Circumpolar Institute Office.

172.14 Paleontology

The Honors in Paleontology program is designed for Honors students in Geology, Zoology, and Anthropology, having interests in vertebrate and invertebrate paleobiology, including evolution and systematics, historical biogeography, functional morphology and stratigraphic distribution. The program may be entered through the framework of existing programs in the Departments of Earth and Atmospheric Sciences, Biological Sciences, and Anthropology. Interested students should consult with their Honors advisor in preparing their programs.

Paleontology is a basic science; it is concerned with the evolutionary history of life and, hence, draws upon both biological and geological knowledge. Paleontologists usually work as research scientists and/or teachers in universities, museums, and government and industrial laboratories, in Canada and elsewhere. Paleontologists usually hold advanced research degrees.

The Honors Program in Paleontology

Paleontology is intended to provide an introduction at the undergraduate level to the fossil history of invertebrate and vertebrate animals, thereby enabling the student to secure a core of broad paleontological knowledge that will permit later entry into more specialized postgraduate studies in invertebrate and vertebrate paleontology. The program is also constructed to provide the student with background in those ancillary geological and biological sciences that are most relevant to studies in paleontology.

Continuation in the Honors in Paleontology program requires a GPA of 6.5 in the preceding Winter Session.

Graduation requires a GPA of 6.5 calculated over the last two years. For First Class Honors, an average of at least 7.5 is required. In addition, students are required to pass an oral examination, in their fourth year, on stratigraphic and biologic principles. The examining committee shall consist of three members of the academic staff of Earth and Atmospheric Sciences and/or Biological Sciences.

Year 1
- BIOL 107, 108
- CHEM 101, 161
- EAS 101, 103
- MATH 113 or 114 or 120
- STAT 151
- ★6 in an approved Arts options

Year 2
- BIOL 207, 208
- BOT 210
- EAS 222, 230, 231, 234
- ZOOL 224, 225, 250

Year 3
- ANTHR 390
- BIOL 321, 361
- EAS 224 or PALEO 414
- EAS 225, 330
- BIOL 335 or BOT 411
- ★6 in approved Arts options
- ★3 in approved option

Year 4
- EAS 224 or PALEO 414
- PALEO 318, 319
- BIOL 335 or BOT 411
- BIOL 499 or EAS 427 and 428
- ★12 in approved courses

Note: For information regarding new Biological Sciences and Earth and Atmospheric Sciences courses, please consult your Department advisor.

172.15 Pharmacology

172.15.1 Honors in Pharmacology

The program leading to an Honors degree in Pharmacology is intended to prepare students for advanced study leading to academic or research careers.

Continuation and graduation from the Honors Pharmacology program requires a minimum GPA of 7.0 in the preceding Winter Session and a minimum GPA of 7.0 in all science courses taken, and a grade of 7.0 in all courses taken in the Department of Pharmacology.

Year 1
- CHEM 101, 102
- CHEM 161, 163
- MATH 113 (or 114)
- BIOL 107, 108
- ★3 in an approved Science option
- ENGL 101

Year 2
- BIOCH 203, 205
- MICRB 265
- PHYSL 210
- PMCOL 201
- ★6 in Science options from BIOCH, BIOL, CHEM, GENET, MATH, MICRB, PHYS, PHYSL, PMCOL, or ZOOL
- ★6 in an approved Arts option

Year 3
- PMCOL 305
- PMCOL 332
- PMCOL 342
- STAT 237 or 141 or 151
- ★9 in Science options from areas as indicated for Year 2.
- ★6 in approved Arts option

Year 4
- PMCOL 335, 336, 392, 403, 407, 409, 412, 415, 498, 499
- ★3 in Science options from areas indicated for Year 2.

Note: Students **must** consult the Chair of the Department or designee for approval of the selection of options.

BSc Honors in Pharmacology is awarded to students who achieve a GPA of at least 6.5 in Year 4 and, in addition, a GPA of at least 7.0 for all courses taken in the Department of Pharmacology.

A student who fails to attain the GPAs necessary for an Honors degree in Pharmacology may be granted the Specialization degree, provided the standing attained is approved by the Department.

172.15.2 Specialization in Pharmacology

The program leading to a Specialization degree in Pharmacology is intended for students who wish to pursue further studies in the health sciences and those who wish to prepare for a career in the Pharmaceutical industry. Although not as rigorous as an Honors program, the Specialization program is a solid background for advanced study leading to a career in academia or research.

Continuation and graduation from the Specialization program in Pharmacology require a minimum GPA of 6.0 in the preceding Winter Session. In addition, a GPA of at least 6.0 is required in all science courses taken and a minimum GPA of 6.0 is required in all courses in the Department of Pharmacology.

Year 1
- CHEM 101, 102
- CHEM 161, 163
- MATH 113 (or 114)
- BIOL 107, 108
- ENGL 101
- ★3 in an approved Science option

Year 2
- BIOCH 203/205
- MICRB 265
- PHYSL 210
- PMCOL 201
- ★6 in Science options from: BIOCH, BIOL, CHEM, GENET, MATH, MICRB, PHYS, PHYSL, PMCOL, or ZOOL
- ★6 in an approved Arts option

Year 3
- PMCOL 305, 332, 342
- ★6 in Arts options
- STAT 237 or 141 or 151
- ★9 in Science options from areas as indicated for Year 2

Year 4
- PMCOL 335, 336, 392, 403, of the remaining ★18, at least ★9 shall be chosen from PMCOL 407, 409, 412, 415, and the remainder shall be Science options from areas as indicated for Year 2.

Note: Students **must** consult the Chair of the Department or designee for approval of the selection of options.

172.16 Physics

The Honors Programs offered by the Department of Physics are designed to provide a comprehensive education for students intending to pursue advanced degrees and a research or academic career.

Continuation in the Honors Physics programs requires a GPA of 6.5 in the preceding Winter Session. Graduation requires a GPA of 6.5 on the last ★90 credited to the degree.

The Specialization programs are designed to provide greater flexibility for students who want a four-year degree in Physics or Geophysics without the full comprehensive training of the Honors Programs. Continuation in the Specialization program normally requires a GPA of at least 5.5 in the preceding Winter Session. Graduation requires a GPA of 5.5 on the last ★90 credited to the degree.

Notes

(1) Students interested in the Engineering-Physics program should consult §82.7 of the Faculty of Engineering section of this Calendar.

(2) Honors and Specialization Physics students must consult an advisor in the Department of Physics regarding their programs. Third- and fourth-year students are advised that not all 300-level and 400-level Physics and Geophysics courses are offered every year.

172.16.1 Honors in Physics

Notes
(1) By the end of their programs, students must have taken ★18 of Arts options.
(2) Students must take ★27 from Pools A and B.
Pool A: PHYS 362, 395, 413, 415, 472, 481, 484, 485, 491, 499; MA PH 343, 451.
Pool B: All 300- and 400-level ASTRO, PHYS, MA PH, and GEOPH courses, unless otherwise indicated in the course descriptions, plus all 400-level MATH courses. With consent of the Department, other courses may be taken for credit.
(3) Students wishing to qualify for an Honors degree must take a minimum of ★18 from Pool A including PHYS 472 and 481.

Year 1	Year 2	Year 3 and 4
PHYS 100, 102 MATH 113 (or 114, or 117), 115 (or 118) MATH 120 (or 127) ★9 in Science options (★3 in Computing Science recommended; other suggested options are in Astronomy, Chemistry, or Earth and Atmospheric Sciences.) ★6 in Arts options (English recommended) (See Note 1 above.)	PHYS 211, 244, 271, 281, 295, 297 MATH 121 (or 227) MATH 214 (or 217), 215 (or 317) ★6 in Arts options (See Note 1 above)	PHYS 311, 351, 372, 381, 397, 472, 481 MATH 311 (or 411), 334 (or 336), 337 ★30 in other courses (See Notes 1, 2, and 3 above). In Year 4, students are also expected to take part in the weekly Physics Colloquium.

172.16.2 Honors in Geophysics

The Honors and Specialization (see §172.16.5) programs are identical except for the GPA requirements (see §172.18) and residency requirements (see §172.1).

Notes:
(1) Students must complete EAS 101 and CHEM 101 and 102 by the end of the second year.
(2) Students must take ★18 from Geophysics Core courses, and a minimum of ★9 from Geophysics Pool courses.
Core: GEOPH 221, 325, 326, 426, 438, 429.
Pool: GEOPH 421, 424, 437; MA PH 467; PHYS 372, 499; CMPUT 340; PET E 465; EAS 321.
Not all 300-level and 400-level courses are offered every year. Students must consult the Department of Physics for approval of third and fourth year programs.
(3) By the end of their programs, students must have taken ★15 in Science options (at least ★3 of which must be in Computing Science), and ★12 in Arts options.

Year 1	Year 2	Year 3 and 4
PHYS 100, 102 Math 113 (or 114 or 117), 115 (or 118), 120 (or 127) ★6 from: EAS 101, CHEM 101, CHEM 102, a three credit Arts option (see Note 1) ★3 in Computing Science (see Note 3) ★6 in Arts options (English recommended).	PHYS 211, 244, 271, 281, 295 MATH 214 (or 217), 215 (or 317) GEOPH 221 ★6 from: EAS 101, CHEM 101, CHEM 102, a three credit Arts option, whichever were not taken previously (see Note 1)	(see Notes 1, 2, and 3) PHYS 381, 481 MATH 311 (or 411), 334 (or 336), 337 EAS 233 EAS 222 (or 103 or 224) ★15 in approved Geophysics Core courses ★9 in approved Geophysics Pool courses ★12 in approved Science options ★3 in an Arts option

172.16.3 Honors in Mathematical Physics

Year 1	Year 2	Years 3 and 4
MATH 117, 118, 127 PHYS 100, 102 ★3 in Computing Science or MATH 128; ★6 in Science options (Chemistry recommended); ★6 in Arts options (English recommended)	MATH 217, 227, 317 PHYS 211, 244, 271, 281, 295 MATH 128 or ★3 in Computing Science, whichever was not take previously ★3 in an Arts option	MATH 311 (or 411), 334 (or 336), 337, 417; MA PH 343, 451 PHYS 311, 351, 372, 381, 472, 481; STAT 235 or 265 ★12 approved Science options ★9 Arts options

172.16.4 Specialization in Physics

Notes:
(1) By the end of their programs, students must have taken ★18 of Arts options.
(2) Students must take ★27 from Pools A and B.
Pool A: PHYS 362, 395, 413, 415, 472, 481, 484, 485, 491, 499, MA PH 343, 451.
Pool B: All 300- and 400-level ASTRO, PHYS, MA PH, and GEOPH courses unless otherwise indicated in the course descriptions, plus all 400-level MATH courses. Specialization students may take 200-level courses from Science departments other than Physics and Mathematical Sciences. With consent of the Department, other courses may be taken for credit.
(3) Students wishing to qualify for a Specialization degree must take a minimum of ★9 from Pool A.
(4) The courses listed below comprise a minimum program. Students may, in consultation with the Department, select more advanced courses in place of those listed. A suitably enriched program can be used for admission to graduate work in Physics provided satisfactory standing is obtained.

Year 1	Year 2	Years 3 and 4
PHYS 100, 102 MATH 113 (or 114 or 117), 115 (or 118), 120 (or 127) ★9 in Science options (★3 in Computing Science recommended) ★6 in Arts options (English recommended) (see Note 1 above)	PHYS 211, 244, 271, 281, 295, 297 MATH 121 (or 227), 214 (or 217), 215 (or 317) ★3 in an Arts option (see Note 1 above)	PHYS 311, 351, 372, 381, 397 MATH 311 (or 411), 334 (or 336), 337 ★36 in other courses (see Notes 1, 2 and 3 above)

172.16.5 Specialization in Geophysics

The Honors (see §172.16.2) and Specialization programs are identical except for the GPA requirements (see §172.16) and residency requirements (see §172.1).

Note:
(1) Students must complete EAS 101 and CHEM 101 and 102 by the end of the second year.
(2) Students must take ★18 from Geophysics Core courses, and a minimum of ★9 from Geophysics Pool courses.
Core: GEOPH 221, 325, 326, 426, 438, 429.
Pool: GEOPH 421, 424, 437; MA PH 467; PHYS 372, 499; CMPUT 340; PET E 465.
Not all 300-level and 400-level courses are offered every year. Students must consult the Department of Physics for approval of third and fourth year programs.
(3) By the end of their programs, students must have taken ★15 in Science options (at least ★3 of which must be in Computing Science), and ★12 in Arts options.

Year 1	Year 2	Years 3 and 4
PHYS 100, 102 MATH 113 (or 114 or 117), 115 (or 118), 120 (or 127) ★6 from: EAS 101, CHEM 101, CHEM 102 ★3 Arts option (see Note 1) ★3 in Computing Science (see Note 3) ★6 in Arts options (English recommended).	PHYS 211, 244, 271, 281, 295 MATH 214 (or 217), 215 (or 317) GEOPH 221 ★6 from: EAS 101, CHEM 101, CHEM 102, ★3 Arts option, whichever were not taken previously (see Note 1)	(see Notes 1, 2, and 3) PHYS 381, 481 MATH 311 (or 411), 334 (or 336), 337 EAS 233 EAS 222 (or 103 or 224) ★15 in approved Geophysics Core courses ★9 in approved Geophysics Pool courses ★12 in approved Science options ★3 in an Arts option

172.16.6 Industrial Internship Program

The Industrial Internship Program provides students who have finished their third year of study in the Department of Physics an opportunity for extended work experience. The program lasts for 16 months, and after completing the reporting requirements, a student can receive university credit for the experience.

A student must successfully complete WKEXP 401, WKEXP 402, WKEXP 403, and PHYS 400, and the final year of their academic program to graduate with the Industrial Internship designation.

Student participation in the program is voluntary, but it will not be possible to guarantee that all students wishing to do an internship are able to do so. However the Department will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the Industrial Internship Program Coordinator in the Department of Physics for further information.

Courses Related to the Industrial Internship Program

			Weight	Grade
Year 4	Fall	WKEXP 401	0	CR/F
Year 4	Winter	WKEXP 402	0	CR/F
Year 4	Intersession	WKEXP 403	0	CR/F
Year 5	Fall	PHYS 400	3	9-point

172.16.7 Concentration in Physics

Students considering Physics as their major subject of concentration in the four-year General BSc program are strongly advised to include PHYS 100, 101, 201 and 208 as early as possible in their program. To complete a major in Physics, PHYS 294 is strongly recommended. Students majoring in Physics should normally select from the following senior courses: PHYS 301, 302, 307, 309, 319, and 364. They must also consult with a Physics Department advisor before registering in second or later years of the program in order to have their programs approved, as not all 300-level PHYS courses are offered each year. Students wishing to combine a major in Physics with a minor in Arts or Business should consult a Physics Department advisor see §§172.1.2 and 172.1.3.

172.17 Physiology

172.17.1 Honors in Physiology

The program leading to the degree of BSc with Honors in Physiology is offered by the Department of Physiology in the Faculty of Medicine.

The Honors program is designed primarily to prepare students for advanced study leading to academic and research careers. A choice of courses is available for students with interest in particular branches of Biology. The current trend is towards quantitative aspects of Physiology and students are advised to acquire the best background in Mathematics, and in the chemical and physical sciences, consistent with their interests and abilities.

Continuation in the program requires a GPA of 7.0 in the year completed and a grade of at least 7.0 in PHYSL 210 (or equivalent course). Students must consult the Program Advisor in the Department prior to registration in each year of the program.

The course requirements in the program are:

Year 1
BIOL 107, 108
CHEM 101, 102, 161, 163;
ENGL 101
★6 in approved Science or Arts options (see Note 1)

Year 2
PHYSL 211
BIOL 201, 207
STAT 141, 151 or 237
BIOCH 203, 205
★9 in approved Science or Arts options (see Note 1)

Year 3
PMCOL 371, 332
PHYSL 372, 401, 402, 404
CELL 300, 301
★3 in an approved Science or Arts option (see Note 1)

Year 4
PHYSL 502 or 506
at least ★12 from: PHYSL 410, 501, 527,
PMCOL 509
INT D 543, 544, 545
BIOL 445
★12 in approved options (see Note 1)

Notes

(1) The program must consist of a minimum of ★90 in science, a minimum of ★18 in Arts, and up to ★12 in non-Arts/non-Science options.

(2) Approved Science options should be chosen from the following list: Junior Courses: PSYCO 104; PHYS 100, 101 or 102*; MATH 113 or 114, 115; CMPUT 114. Advanced Courses: BIOCH 410, 420, 430, 441, 450, 455, 460; BIOL 315, 585; CHEM 211, 213, 419; CMPUT 251, 252; ENT 292; GENET 270, 275, 301, 302, 304, 390, 418, 421, 471; LB AN 301; MATH 214, 215 262; MICRB 265, 370, 371; PH AS 221; PMCOL 305, 407, 412, 415 505, 506, 508; PSYCO 275, 281, 371, 377, 381, 459, 476, 478; STAT 252, 341, 368; ZOOL 202, 225, 226, 241, 242, 311, 340, 341, 342, 343, 412, 422, 445.

(3) Approved non-Science/non-Arts options must be chosen from the following list: AN SC 310, 311, 410, 374, 484; ASM 513, 563; IMMUN 370, 451, MMID 224; 350, 520; NU FS 225, 227, 301, 302, 452, 468; OCCTH 106, 107; PEDS 200; PSYCI 511

(4) Recommended Arts options may be chosen from the following list: CHRTC 352; ENGL 310; LING 321, 323, 499; PHIL 101, 250, 265, 412, 415, 417; POL S 212, PSYCO 105, 223, 258, 425; SOC 100, 300, 382, 462, 473, WRITE 298.

(5) Honors students are also encouraged to attend all department seminars.

*Recommended to be taken in the second year.

172.18 Psychology

172.18.1 Honors in Psychology

The Department offers courses leading to the degrees of BSc and BA with Honors in Psychology. Students wishing to emphasize the physical, biological, and mathematical sciences are advised to enroll in the BSc program; those wishing to emphasize the humanities and social sciences are advised to enroll in the BA program. Either program is appropriate for students considering postgraduate training in psychology or in other fields that require these research skills.

Continuation in and graduation from the Honors Psychology program requires a minimum GPA of 7.0 in the preceding Winter Session. Although admission into the Honors Psychology program is permitted only in the second or third year, students are expected to take at least ★30 during the Winter Session of each year of study, including the first and second years. Exceptions to this requirement must be approved by both the Department of Psychology and the Faculty of Science. A minimum of ★48 (but no more than ★60) must be taken in Psychology. A minimum of ★72 in science courses must be taken. A student's program of courses must be approved in advance each year by the Honors Psychology Adviser.

Note: the required courses noted in Year 1 and Year 2 below must be taken during the first two years of study.

Year 1
ENGL 100 or 101
PSYCO 104, 105
BIOL 107, 108
★6 from CMPUT 101, 102, 114, 115, MATH 113, 114, 115, 117, 118, 120, 121, STAT 252, 341, or other computing science, mathematics or statistics course approved by the Honors Advisor
★6 in approved Science options.

Year 2
STAT 151 and PSYCO 212
★6 (two of) from PSYCO 223, 233, 241, 258
★6 (two of) from PSYCO 267, 275, 281
★6 from approved courses offered by the Departments of Anthropology, Economics, Linguistics, Political Science and/or Sociology
★6 in approved Science options

Year 3
PSYCO 300, 390, 391
★3 (one of) PSYCO 356, 364, 410, 411, 431, 441, 475, 476, 482, 493, or other advanced research methods course approved by the Honors Advisor
★9-★12 in approved Science options
★6-★9 in approved options

Year 4
PSYCO 400, 490
★6 (two of) in a 400-level Psychology course other than 400, 410, 411, 431, 441, 475, 476, 482, 490, 493, 496, 497, 498, except as approved by the Honors Advisor
★9-★15 in approved Science options
★3-★9 in approved options

Notes:

(1) In addition to the courses specifically listed above, the program must include, among the student's optional courses, a minimum of ★12 in one or more disciplines relevant to Psychology, e.g., Antrhopology, Biologiy, Chemistry, Computing Science, Economics, Genetics, Linguistics, Mathematics, Neuroscience, Pharmacology, Philosophy, Physics, Physiology, Political Science, Sociology, Statistics, and applied Probability, and Zoology (this list is not exhaustive). These courses may not overlap with those used to fulfill the Computing/Mathematics/Statistics, Natrual Science and Social Science requirements listed above.

(2) Under the supervision of a faculty member in the Department of Psychology students undertake a year-long research apprenticeship (PSYCO 390) during the thrid year and conduct and write an emperiical thesis (PSYCO 490) during the fourth year. Third-year students present their thesis research proposals, and fourth-year students present the results of their thesis research at the annual Honors Psychology Conference in April.

172.18.2 Specialization in Psychology

Continuation in the Specialization in Psychology program requires a minimum GPA of 5.5 in the preceding Winter Session. Graduation requires a minimum GPA of 5.5 on all courses credited to the degree.

Year 1
PSYCO 104, 105
BIOL 107/108
★6 in an English course (ENGL 101 is recommended)
★6 from junior courses offered in the departments of Computing Science and Mathematics
★6 from junior courses offered in the departments of Chemistry and Physics

Year 2
STAT 151
★9 from PSYCO 258, 266 or 267, 275, 281
★3 in an approved Arts option
★6 in approved Science options
★9 in approved options

Year 3
★6 in approved Arts options
(a) for students meeting Year 2 requirements by taking PSYCO 258:
★15 in approved Science options
★9 in approved options or
(b) for students meeting Year 2 requirements by taking courses other than PSYCO 258:
★12 in approved Science options
★12 in approved options

Year 4
★21 in approved Science options
★9 in approved options

In order to fulfil the degree requirements the student is required to complete a minimum of ★36 in Science Psychology courses, or PSYCO 258 and a minimum of ★33 in Science Psychology courses. At least ★12 must be in Science Psychology courses at the 300-level or above. The student may take a maximum of ★48 from PSYCO courses listed in the Arts and Science Course Listing sections of the Calendar.

172.18.3 Industrial Internship Program

The Industrial Internship Program provides students who have finished their third year of study in the Department of Psychology an opportunity for extended work experience. The program lasts for 12 or 16 months, and

after completing the reporting requirements, a student can receive university credit for the experience.

A student must successfully complete WKEXP 931, 932, 933 (WKEXP 933 for the 16 month option), and PSYCO 410, and the final year of their academic program to graduate with the Industrial Internship designation.

Student participation in the program is voluntary, but it will not be possible to guarantee that all students wishing to do an internship are able to do so. However the Department will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the Coordinator, Industrial Internship Program in the Department of Psychology for further information.

Courses Related to the Industrial Internship Program

			Weight	Grade
Year 4	Fall	WKEXP 931	0	CR/F
Year 4	Winter	WKEXP 932	0	CR/F
Year 4	Intersession	WKEXP 933	0	CR/F
Year 5	Fall	PSYCO 410	3	9-point

172.19 Statistics and Applied Probability

172.19.1 Honors in Statistics

Continuation in the Honors in Statistics and Applied Probability program requires a GPA of 6.5 in the preceding Winter Session.

Graduation requires a GPA of 7.0 on all Statistics and Mathematics courses taken and a GPA of 6.0 on the last ★30 credited to the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated:

Year 1	Year 2	Years 3 and 4
STAT 151 MATH 114 (or 117), 115 (or 118) MATH 120 (or 127), 121 (or 128) Any two of CMPUT 101, 102, 114, 115 or 252 ★6 in an Arts option ★3 in an approved option	STAT 265, 266 MATH 214 (or 217), 215 (or 317) ★6 in an Arts option ★6 in an approved Science option ★6 in an approved option	STAT 368, 378, 466, 471, 472, 475 MATH 311 or 334 or 373 or 380 MATH 314 or 417 MATH 414 or 418 ★3 in a statistics option ★6 in an Arts option ★24 in approved options

Note: At least ★9 in approved options in one distinct field of application must be taken at the 300-level or higher. Examples of fields of applications are Biology, Business, Computing Science, Economics, Engineering, Pharmacology, Political Science, Psychology, and Sociology. The student should plan carefully so that the proper prerequisites are taken early in the program.

172.19.2 Specialization in Statistics

The Specialization program in Statistics is intended for students who are interested in applying Statistics to a second discipline. Students in this program must choose one distinct field of application. Recommended fields of application are Agriculture, Business, Chemical Engineering, Computing Science, Economics, Education, Genetics, Health Sciences Administration, Pharmacology, Political Science, Psychology, Sociology, and Zoology. Students may, in consultation with the Department of Mathematical Sciences, select a different field of application in place of those listed above.

Continuation in the program normally requires, in the previous winter session, successful completion of at least ★24 with a GPA of at least 5.5, and a GPA of at least 5.5 on the aggregate of all Statistics and Mathematics courses taken in that session. Graduation requires a GPA of at least 5.5 on all courses credited toward the degree and a GPA of at least 5.5 on the aggregate of all Statistics and Mathematics courses credited toward the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated:

Year 1	Year 2	Years 3 and 4
STAT 151 MATH 114, 115 MATH 120, 121 ★15 in approved options. See Note (1) below.	STAT 265, 266 MATH 214, 215 ★18 in approved options. See Note (1) below.	STAT 368, 378, 466, 471 ★6 300-level STAT ★42 in approved options

Notes

(1) The program must include ★6 in English and ★6 from CMPUT 101, 102, 114 and 115. It is recommended that these courses be taken in the first two years of the program.

(2) The program must include at least ★18 in a single field of applications. The student is advised to consult the Department of Mathematical Sciences regarding specific program recommendations for the field of applications.

(3) The program must meet the requirements of the Faculty of Science (see §172.1.2) and include ★18 in Arts courses.

(4) A corresponding Honors Mathematics course can be substituted for any Mathematics course listed. For example MATH 117 can be substituted for MATH 114, and MATH 127 can be substituted for MATH 120.

(5) Each program must be approved by the Department of Mathematical Sciences

172.19.3 Industrial Internship Program

The Industrial Internship Program provides students who have finished their third year of study in the Department of Mathematical Science an opportunity for extended work experience. The program lasts for 16 months, and after completing the reporting requirements, a student can receive university credit for the experience.

A student must successfully complete WKEXP 951, 952, 953, and STAT 400, and the final year of their academic program to graduate with the Industrial Internship designation.

This program should be of particular interest to Mathematics students studying Actuarial Science, Applied Mathematics, Economics, Finance, or Statistics.

It may not be possible to guarantee that all students wishing to do an internship are able to do so. However, the Department will make every effort to find suitable employment for those students wishing to take part in the program. Interested students should contact the Industrial Internship Program Coordinator in the Department of Mathematical Sciences for further information.

Courses Related to the Industrial Internship Program

			Weight	Grade
Year 4	Fall	WKEXP 951	0	CR/F
Year 4	Winter	WKEXP 952	0	CR/F
Year 4	Intersession	WKEXP 953	0	CR/F
Year 5	Fall	STAT 400	3	9-point

172.20 Preprofessional Programs

Students admitted to a Faculty of Science degree program who plan to transfer later to a professional program in another Faculty must satisfy Faculty of Science requirements while they are registered in this Faculty. Students planning to apply to a professional program should consult the relevant Calendar sections to ensure that they are satisfying preprofessional requirements as well as program requirements in the Faculty of Science.

172.20.1 Preprofessional Requirements for Medicine and Dentistry

The admission requirements for the DDS Degree program and the MD Degree program are given in §15.4 and §15.9, respectively. Students planning to apply for admission to one of these Degree programs, may take the required courses while registered in a degree program in the Faculty of Science. See §15.16.8 for Grade XII requirements for the preprofessional program.

172.20.2 Preprofessional Requirements for Veterinary Medicine

See §43.2.7 and §15.16. Students may take the required courses while registered in a BSc General program or one of the BSc Specialization or BSc Honors programs. Students should consult the Faculty Office regarding appropriate courses.

172.20.3 Preprofessional Requirements for Rehabilitation Medicine

See §15.14.3 and §15.16. Students may take the required courses while registered in a BSc General program or one of the BSc Specialization or BSc Honors programs.

172.20.4 Preprofessional Requirements for Optometry

Arrangements have been made whereby a maximum of seven students from Alberta wishing to enter the School of Optometry at the University of Waterloo may take one or two preprofessional years at the University of Alberta. Applicants must be Canadian Citizens or be residents of Canada who have held permanent resident (landed immigrant) status for at least twelve months prior to the registration day of the Fall Term.

The minimum requirement for admission consideration to the professional optometry program at the University of Waterloo is at least one year of university-level study in science.

Students planning to take a one-year, pre-optometry program should register in the following courses: BIOL 107, 108; CHEM 101, 102; MATH 113 or 114 and 115; PHYS 100/101 or 100/102; PSYCO 104; ★3 in an Arts option.

Students planning to take a two-year, pre-optometry program should register in the following courses:

Year 1	**Year 2**
BIOL 107, 108	BIOCH 203 or 220
CHEM 101, 102, 161, 163	MICRB 265
MATH 113 (or 114), 115	PSYCO 104
PHYS 100/101 or 100/102	one of STAT 141, 151
	★6 in a senior Science option
	★9 in Arts options

Note: Courses in human anatomy, histology, and embryology and physical optics, that are comparable to those at the University of Waterloo, are not available in this pre-optometry program.

For further information consult the Faculty of Science Office and/or the University of Waterloo Calendar.

172.20.5 Preprofessional Requirements for Medical Laboratory Science

The admission requirements for the BSc Medical Laboratory Science program are given in §15.9.1. Students planning to apply for admission to Medical Laboratory Science may take the required courses while registered in the Faculty of Science.

173 Details of Courses

173.1 Course Listings

Science courses can be found in §211, Course Listings, under the following subject headings:

- Astronomy (ASTRO)
- Biochemistry (taught by the Faculty of Medicine and Oral Health Sciences) (BIOCH)
- Biological Science - Biology (BIOL)
- Biological Science - Botany (BOT)
- Biological Science - Entomology (ENT)
- Biological Science - Genetics (GENET)
- Biological Science - Microbiology (MICRB)
- Biological Science - Zoology (ZOOL)
- Biologie (BIOLE) (Faculté Saint-Jean)
- Botanique (BOTQ) (Faculté Saint-Jean)
- Cell Biology (CELL)
- Chemistry (CHEM)
- Chimie (CHIM) (Faculté Saint-Jean)
- Computing Science (CMPUT)
- Earth and Atmospheric Sciences (formerly Geography and Geology (EAS))
- Geophysics (GEOPH)
- Interdisciplinary Studies (INT D)
- Laboratory Animal Management (LB AN)
- Marine Science (MA SC)
- Mathematical Physics (MA PH)
- Mathematics (MATH)
- Mathematique (MATHQ) (Faculté Saint-Jean)
- Paleontology (PALEO)
- Pharmacology (taught by the Faculty of Medicine and Oral Health Sciences) (PMCOL)
- Physiology (taught by the Faculty of Medicine and Oral Health Sciences) (PHYSL)
- Physics (PHYS)
- Physics/Applied Science in Medicine (PH AS)
- Physique (PHYSQ) (Faculté Saint-Jean)
- Psychology (PSYCO)
- Science (SCI)
- Statistics and Applied Probability (STAT)
- Statistique (STATQ) (Faculté Saint-Jean)

173.2 Prerequisites

Where a prerequisite is stated in a course description, it is understood that equivalent courses may be used to satisfy the requirement. In addition, the department offering a course with prerequisite requirements may waive the prerequisite in writing. (Prerequisite waiver forms are available from the Faculty of Science office and the Department offices.)

173.3 Biochemistry Courses

The following courses can be used by students in the Faculty of Science as science courses: BIOCH 203, 205, 220, 401, 410, 420, 430, 441, 450, 455, and 460.

173.4 Computing Science Courses

Introductory

The following courses are considered to be introductory. Specific course details may be found in Course Listings (§211): CMPUT 101, 102, 114, 115.

Specialization and Honors

All other courses, with the exception of those noted above, are restricted to students registered in various Specialization and Honors programs in the Faculty of Science, in the Computer Engineering program, and Computer Process Control Option in the Chemical Engineering program. Some senior Computing courses are available to students with a Computing Sceince minor in the BSc General program and to other students, subject to availability of space. Refer to Course Listings (§211) for detailed descriptions.

173.5 Food Science Courses

NU FS 363 may be used by students in the Faculty of Science as a science course in Microbiology.

173.6 Immunology Courses

The following courses may be used by students in the Faculty of Science as science courses in Microbiology: INT D 371, 372 and 452.

173.7 Medical Microbiology Courses

The following courses may be used by students in the Faculty of Science as science courses in Microbiology: INT D 224, MMID 350

173.8 Pharmacology Courses

The following courses can be used by students in the Faculty of Science as science courses: PMCOL 201, 292, 305, 332, 342, 336, 403, 407, 409, 412, and 415.

173.9 Physiology Courses

The following can be used by students in the Faculty of Science as science courses: PHYSL 210, 211, 401, 402, 404, 410, 465 and 466.

173.10 Graduate Courses

Courses numbered 500 and up are restricted to graduate students and normally may not be taken for credit by undergraduate science students.