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## Faculty of Science and Engineering – Programs of Study

### V. Programs of Study

#### Applied Biotechnology

The Department of Biology at York University and the School of Biological Sciences and Applied Chemistry at Seneca College offer a joint BSc (Tech) degree program in Applied Biotechnology. Students will enter the four year program by beginning their studies at Seneca College's School of Biological Sciences and Applied Chemistry. Following the successful completion of the first two and a half years of the curricula at the Biotechnology Technologist (Research) program at Seneca, students will transfer to the Department of Biology, Faculty of Science and Engineering where they will complete the last year and a half of the program at York. Upon completion of this program, students will receive a York University BSc (Tech) degree in applied biotechnology. This program will prepare students to enter the workforce in the biotechnology industry, government laboratories and university research laboratories.

For Seneca College course requirements, consult the Biotechnology Technologist (Research) program in the Seneca College Calendar.

The York University course requirements are as follows:

##### **BSc (Tech): 90 credits including:**

- i) 45 transfer credits for successful completion of the first two and a half years of the program at the approved joint program partner Seneca College.
- ii) All students must complete the following core: AS/ECON 1900 3.00, AS/PHIL 2070 3.00 or AS/PHIL 2075 3.00, SC/MATH 1505 6.00, SC/CSE 1520 3.00, SC/BIOL 2010 4.00, SC/BIOL 2030 4.00, SC/BIOL 2040 4.00, SC/BIOL 3010 3.00, SC/BIOL 3110 3.00, SC/BIOL 3130 3.00.
- iii) All students must complete a minimum of nine credits from the following list of courses: SC/BIOL 3160 4.00, SC/BIOL 4010 3.00, SC/BIOL 4020 3.00, SC/BIOL 4040 3.00, SC/BIOL 4050 3.00, SC/BIOL 4061 3.00, SC/BIOL 4150 3.00, SC/BIOL 4151 3.00, SC/BIOL 4160 3.00, SC/BIOL 4220 4.00, SC/BIOL 4270 3.00, SC/BIOL 4285 3.00, SC/BIOL 4320 3.00, SC/BIOL 4330 3.00, SC/BIOL 4350 4.00, SC/BIOL 4370 3.00, SC/BIOL 4450 4.00, SC/BIOL 4510 3.00, SC/CHEM 3051 3.00, SC/CHEM 3070 3.00, SC/CHEM 3071 3.00, SC/CHEM 4050 3.00.
- iv) Based on the requirements noted in ii) and iii) above, students must take a minimum of 45 credits of which 30 credits must be taken at York as a minimum residency requirement.

To graduate in this program, students must have a minimum overall York grade point average of 4.00 (C).

#### Applied Mathematics

See the *Mathematics and Statistics* section.

#### Atmospheric Chemistry (Applied Science Streams)

The Department of Chemistry and the Department of Earth and Space Science and Engineering offer degree program streams in atmospheric chemistry. Both programs of study are particularly demanding and will be of interest to students with academic performances of B grade or better.

- i) All BSc Honours degree candidates must complete the program core (normally before proceeding to 3000- or higher-level courses): SC/CHEM 1000 3.00; SC/CHEM 1001 3.00; SC/CHEM 2010 3.00; SC/CHEM 2011 3.00; SC/CHEM 2020 6.00; SC/CHEM 2030 3.00; SC/CHEM 2080 4.00; SC/EATS 2010 3.00; SC/MATH 2015 3.00; SC/MATH 2270 3.00.

- ii) All BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00 from the program core):

- SC/CSE 1540 3.00;
- SC/EATS 1011 3.00 (Honours Double Major stream only);
- SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00;
- SC/PHYS 1010 6.00\*;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

\*Note: SC/PHYS 1410 6.00 with a minimum grade of C may replace SC/PHYS 1010 6.00.

- iii) All BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

#### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

#### Specialized Honours Program in Chemistry: Atmospheric Chemistry Stream

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CHEM 3011 4.00; SC/CHEM 3020 4.00; SC/CHEM 3030 4.00; SC/CHEM 3060 3.00; SC/CHEM 3080 4.00;
- SC/EATS 3030 3.00;
- SC/CHEM 4060 4.00; SC/CHEM 4061 4.00; SC/CHEM 4000 8.00;
- four additional credits chosen from 3000- and 4000-level chemistry courses or from 3000- or 4000-level earth and atmospheric science courses chosen in consultation with the Department of Chemistry;
- additional elective credits, as required for an overall total of at least 120 credits.

#### Honours Double Major Program in Chemistry and Earth and Atmospheric Science: Atmospheric Chemistry Stream

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/EATS 2470 3.00;
- SC/CHEM 3011 4.00; SC/CHEM 3080 4.00;
- SC/CHEM 3060 3.00 or SC/EATS 3130 3.00;
- SC/EATS 3030 3.00; SC/EATS 3040 3.00;
- SC/CHEM 4060 4.00;
- SC/CHEM 4061 4.00;
- SC/CHEM 4000 4.00 or SC/EATS 4000 3.00;
- SC/EATS 4050 3.00; SC/EATS 4120 3.00;
- SC/MATH 3241 3.00;
- at least 12 additional credits (including at least three credits in earth and atmospheric science) from the following: SC/EATS 4051 3.00, SC/EATS 4130 3.00, SC/EATS 4140 3.00, SC/EATS 4150 3.00, SC/EATS 4160 3.00, SC/EATS 4230 3.00, SC/CHEM 3010 4.00, SC/CHEM 3020 4.00, SC/CHEM 3021 4.00, SC/CHEM 3030 4.00, SC/CHEM 3031 4.00, SC/PHYS 2020 3.00.

## Biochemistry

The Department of Biology and the Department of Chemistry offer jointly a Specialized Honours program in Biochemistry.

### Specialized Honours Program

- i) All BSc Honours degree candidates must complete the program core: SC/BIOL 1010 6.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00, SC/BCHM 2020 4.00, SC/BCHM 2021 4.00, SC/BIOL 2040 4.00, SC/CHEM 2011 3.00, SC/CHEM 2020 6.00, SC/CHEM 2030 3.00.
- ii) All BSc Honours biochemistry degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section (IV) of this calendar) by completing:
  - SC/MATH 1013 3.00 and SC/MATH 1014 3.00;
  - SC/CSE 1520 3.00, SC/CSE 1530 3.00, or SC/CSE 1540 3.00.
- iii) 12 general education credits.
- iv) All BSc Honours degree candidates must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section (IV) of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

### Honours Programs

To declare Honours requires successful completion of at least 24 credits, a minimum cumulative credit-weighted grade point average of 5.50 (B) over all science (SC) courses completed, and a minimum cumulative credit-weighted grade point average of 4.25 over all courses completed.

To proceed in each year of the Honours program requires a minimum cumulative credit-weighted grade point average of 5.50 (B) over all science (SC) courses completed, and a minimum cumulative credit-weighted overall grade point average as specified in the Academic Standards section of the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements (section (III) of this calendar).

To graduate in Specialized Honours biochemistry requires successful completion of all Faculty requirements and all required program courses, a minimum cumulative credit-weighted grade point average of 5.50 (B) over all science (SC) courses completed, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Specialized Honours Biochemistry Program

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level requirements, as specified in ii) above;
- SC/BCHM 3010 3.00, SC/BCHM 3110 3.00, SC/BCHM 3130 3.00, SC/BCHM 3140 4.00, SC/BCHM 3051 3.00, SC/CHEM 3020 4.00, SC/BCHM 4290 4.00, SC/BCHM 4000 8.00, SC/BCHM 4050 3.00, nine credits from any other 3000- or 4000-level biochemistry, biology or chemistry courses;
- additional elective credits, as required for an overall total of at least 120 credits.

## Biology

- i) All BSc and BSc Honours degree candidates (except those in Honours Double Major programs) must complete the program core: SC/BIOL 1010 6.00; and any five of SC/BIOL 2010 4.00, SC/BIOL 2020 4.00, SC/BIOL 2021 4.00, SC/BIOL 2030 4.00, SC/BIOL 2040 4.00, SC/BIOL 2050 4.00, SC/BIOL 2060 3.00, SC/CHEM 2020 6.00.
- ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/BIOL 1010 6.00 from the program core):
  - SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;

- SC/MATH 1505 6.00, or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00; (*Note: Students intending to combine biology with applied mathematics, chemistry, computer science, earth and atmospheric science, mathematics, physics and astronomy or statistics should not take SC/MATH 1505 6.00.*)
  - six credits from SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00 (prerequisites for SC/BIOL 2020 4.00 and SC/CHEM 2020 6.00), SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00;
  - a minimum of three additional credits from SC/BC 1800 3.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00, SC/EATS 1010 3.00, SC/EATS 1011 3.00, SC/MATH 1025 3.00, SC/MATH 1190 3.00, SC/PHYS 1070 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00; (*Note: HH/PSYC 1010 6.00 may be included in this section for Honours Double Major and Honours Major/Minor combinations of biology and psychology, or of biology and kinesiology.*)
  - 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).
- iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- additional credits from biology courses, as required for an overall total of at least 46 credits from biology courses;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses and at least 18 credits at the 3000 or higher level.

### Honours Programs

To declare Honours requires successful completion of at least 24 credits, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed, and a minimum cumulative credit-weighted grade point average of 4.25 over all courses completed, subject to the exception in the note below.

To proceed in each year of an Honours program requires a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed, and a minimum cumulative credit-weighted overall grade point average as specified in the Academic Standards section of the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section (III) of this calendar, subject to the exception in the note below.

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: The minimum 6.00 (B) biology grade point average is not required where biology is the minor in an Honours Major/Minor program. Only the minimum 5.00 (C+) overall grade point average is required in that case.*

### Specialized Honours Program

Students may follow a stream in biology, biomedical science, biotechnology or conservation ecology.

**Biology Stream**

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/BIOL 3100 2.00; SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00;
- additional credits from biology courses, as required for an overall total of at least 68 credits from biology courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

**Biomedical Science Stream**

- the program core, as specified in i) above, including SC/BIOL 1010 6.00; SC/BIOL 2020 4.00; SC/BIOL 2021 4.00; SC/BIOL 2040 4.00 and SC/CHEM 2020 6.00; a minimum of one of SC/BIOL 2030 4.00 or SC/BIOL 2060 3.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above, including the following:
  - SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
  - SC/MATH 1505 6.00 or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
  - SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
  - SC/PHYS 1410 6.00 or HH/PSYC 1010 6.00;
- a minimum of nine credits chosen from the following courses: SC/BIOL 3060 4.00; SC/BIOL 3070 4.00; SC/BIOL 3110 3.00; SC/BIOL 3130 3.00; SC/BIOL 3150 3.00/SC/BIOL 3150 4.00; SC/BIOL 3155 3.00; SC/BIOL 4010 3.00;
- SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00;
- additional biology credits from the following courses: SC/BIOL 2030 4.00; SC/BIOL 2060 3.00; SC/BIOL 3010 3.00; SC/BIOL 3060 4.00; SC/BIOL 3070 4.00; SC/BIOL 3071 3.00; SC/BIOL 3100 2.00; SC/BIOL 3110 3.00; SC/BIOL 3120 3.00; SC/BIOL 3130 3.00; SC/BIOL 3140 4.00; SC/BIOL 3150 3.00/SC/BIOL 3150 4.00; SC/BIOL 3155 3.00; SC/BIOL 4010 3.00; SC/BIOL 4061 3.00; SC/BIOL 4110 4.00; SC/BIOL 4141 3.00; SC/BIOL 4150 3.00; SC/BIOL 4151 3.00; SC/BIOL 4200 3.00; SC/BIOL 4220 4.00; SC/BIOL 4270 3.00; SC/BIOL 4285 3.00; SC/BIOL 4290 4.00; SC/BIOL 4320 3.00; SC/BIOL 4350 4.00; SC/BIOL 4360 4.00; SC/BIOL 4370 3.00; SC/BIOL 4450 4.00; SC/BIOL 4510 3.00;
- a minimum of seven credits from 3000 or higher level biology courses with an associated laboratory component;
- additional credits from biology courses, as required for an overall total of at least 68 credits from biology courses;
- additional elective credits as required for an overall total of at least 120 credits, including at least 90 credits from science courses, and at least 42 credits from courses at the 3000 or higher level.

**Biotechnology Stream**

- the program core, as specified in i) above, including SC/BIOL 1010 6.00, SC/BIOL 2020 4.00, SC/BIOL 2021 4.00, SC/BIOL 2040 4.00, SC/BIOL 2060 3.00 and SC/CHEM 2020 6.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above, including the following:
  - 12 general education credits, including AS/ECON 1000 3.00, AS/ECON 1010 3.00 and one of the following: AS/PHIL 2070 3.00, or AS/PHIL 2075 3.00;
  - SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
  - SC/MATH 1505 6.00, or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
  - SC/CHEM 1000 3.00; SC/CHEM 1001 3.00; SC/PHYS 1410 6.00;
  - SC/CHEM 2080 4.00; SC/CHEM 3070 3.00 or SC/CHEM 3071 3.00; SC/CHEM 3080 4.00;
- SB/BFND 3100 3.00; SB/BFND 3200 3.00;
- SC/BIOL 3110 3.00; SC/BIOL 3130 3.00; SC/BIOL 3140 4.00; SC/BIOL 3150 3.00;
- SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00; SC/BIOL 4290 4.00;

- a minimum of 12 credits chosen from the following courses in lists A and B, with a minimum of six credits chosen from list A. List A: SC/BIOL 3010 3.00, SC/BIOL 3120 3.00, SC/BIOL 3155 3.00, SC/BIOL 4020 3.00, SC/BIOL 4061 3.00, SC/BIOL 4110 4.00, SC/BIOL 4285 3.00; List B: SC/BIOL 3160 4.00 (SC/BIOL 2010 4.00 is a prerequisite), SC/BIOL 4010 3.00, SC/BIOL 4040 3.00, SC/BIOL 4150 3.00, SC/BIOL 4151 3.00, SC/BIOL 4160 3.00, SC/BIOL 4270 3.00, SC/BIOL 4370 3.00, SC/BIOL 4510 3.00;
- additional elective credits as required for an overall total of at least 120 credits.

**Conservation Ecology Stream**

- the program core, as specified in i) above, including SC/BIOL 1010 6.00, SC/BIOL 2010 4.00, SC/BIOL 2030 4.00, SC/BIOL 2040 4.00, SC/BIOL 2050 4.00 and SC/BIOL 2060 3.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above, including the following:
  - 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar); (AS/PHIL 2075 3.00 and ES/ENVS 1000 6.00 are recommended.)
  - SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
  - SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
  - SC/MATH 1505 6.00, or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
  - SC/EATS 1010 3.00, SC/EATS 1011 3.00;
- SC/BIOL 3001 2.00 or SC/BIOL 3001 3.00; SC/BIOL 3170 3.00; SC/BIOL 3200 3.00;
- SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00; SC/BIOL 4095 3.00; SC/BIOL 4245 3.00; SC/BIOL 4255 3.00; SC/BIOL 4265 3.00; at least seven additional credits from biology courses at the 4000 level, chosen in consultation with the department;
- additional credits from biology courses, as required for an overall total of at least 68 credits from biology courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits from courses at the 3000 or higher level.

**Honours Major Program**

- the program core, as specified in i) above;
- additional credits from biology courses, as required, for an overall total of at least 51 credits from biology courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

*Note: both SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00 are required as prerequisites for SC/BIOL 2020 4.00 and SC/CHEM 2020 6.00 in the program core.*

Students may follow a stream within the Honours Major program in Biomedical Science.

**Biomedical Science Stream**

- the program core, as specified in i) above, including SC/BIOL 1010 6.00, SC/BIOL 2020 4.00, SC/BIOL 2021 4.00, SC/BIOL 2040 4.00, and SC/CHEM 2020 6.00; a minimum of one of SC/BIOL 2030 4.00 or SC/BIOL 2060 3.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above, including the following:
  - SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
  - SC/MATH 1505 6.00 or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
  - SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
  - SC/PHYS 1410 6.00 or HH/PSYC 1010 6.00;
- a minimum of nine credits chosen from the following courses: SC/BIOL 3060 4.00; SC/BIOL 3070 4.00; SC/BIOL 3100 2.00; SC/BIOL 3110 3.00; SC/BIOL 3130 3.00; SC/BIOL 3150 3.00/SC/BIOL 3150 4.00; SC/BIOL 3155 3.00; SC/BIOL 4010 3.00;

- SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00;
- additional biology credits chosen from the following courses for a minimum of 51 biology credits: SC/BIOL 2030 4.00; SC/BIOL 2060 3.00; SC/BIOL 3010 3.00; SC/BIOL 3060 4.00; SC/BIOL 3070 4.00; SC/BIOL 3071 3.00; SC/BIOL 3100 2.00; SC/BIOL 3110 3.00; SC/BIOL 3120 3.00; SC/BIOL 3130 3.00; SC/BIOL 3140 4.00; SC/BIOL 3150 3.00/SC/BIOL 3150 4.00; SC/BIOL 3155 3.00; SC/BIOL 4010 3.00; SC/BIOL 4061 3.00; SC/BIOL 4110 4.00; SC/BIOL 4141 3.00; SC/BIOL 4150 3.00; SC/BIOL 4151 3.00; SC/BIOL 4200 3.00; SC/BIOL 4220 4.00; SC/BIOL 4270 3.00; SC/BIOL 4285 3.00; SC/BIOL 4290 4.00; SC/BIOL 4320 3.00; SC/BIOL 4350 4.00; SC/BIOL 4360 4.00; SC/BIOL 4370 3.00; SC/BIOL 4450 4.00; SC/BIOL 4510 3.00;
- a minimum of seven credits from 3000 or higher level biology courses with an associated laboratory component;
- additional elective credits as required for an overall total of at least 120 credits including at least 90 credits from science (SC) courses and at least 42 credits from courses at the 3000 or higher level.

### Honours Double Major Program

All BSc Honours degree candidates should consult departmental advisers as early as possible concerning course requirements for particular Honours Double Major programs. The following are the normal minimum requirements, but some subject combinations require more than the minimum number of biology credits and/or specific biology courses (consult the departmental undergraduate handbook for details). Possible subject combinations for BSc Honours Double Major degree programs are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- SC/BIOL 1010 6.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major;
- at least 12 credits from 2000-level biology courses in the program core (see i) above);
- at least 12 credits from biology courses at the 3000 or higher level;
- additional credits from biology courses, as required for an overall total of at least 36 credits from biology courses;
- the course requirements for the second major;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

### Honours Major/Minor Program

An Honours Major in biology may be combined with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the minor;
- the biology Honours Major requirements above;
- the course requirements for the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

Students may follow a stream within the Honours Major/Minor program in Biomedical Science (stream requirements are listed under the Biology Honours Major program). This stream may be combined with other approved science minors.

### Honours Minor

- SC/BIOL 1010 6.00;
- at least 12 credits from biology courses at the 2000 level;
- at least nine credits from biology courses at the 3000 or higher level;
- additional credits from biology courses at the 2000 or higher level, as required for an overall total of at least 30 credits from biology courses.

*Note: It is recommended that students interested in cell biology, genetics, molecular biology and biochemistry take the following courses: SC/BIOL 1010 6.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00, SC/BIOL 2020 4.00, SC/BIOL 2021 4.00, SC/BIOL 2040 4.00 and SC/CHEM 2020 6.00, plus a minimum of nine additional credits from biology courses at the 3000 or higher level. For other areas of interest, students are advised to choose their 2000-level biology courses wisely, based on the prerequisites for the courses they wish to take at the 3000 or higher level. Check the course outlines in this calendar for course prerequisites.*

## Biophysics

This is an interdisciplinary Specialized Honours program requiring coursework and practical experience in physics, biology, chemistry, mathematics and computer science. The focus of the program is on applying laws and methods of physics to understand biological processes.

i) All BSc Honours degree candidates must complete the program core:

- SC/BIOL 1010 6.00; SC/BIOL 2020 4.00; SC/BIOL 2021 4.00; SC/BIOL 2040 4.00;
- SC/BPHS 2090 3.00; SC/BPHS 3090 3.00; SC/BPHS 4090 4.00;
- SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
- SC/MATH 2015 3.00; SC/MATH 2271 3.00;
- SC/PHYS 1010 6.00 or SC/PHYS 1410 6.00; SC/PHYS 2010 3.00; SC/PHYS 2020 3.00; SC/PHYS 2060 3.00; SC/PHYS 2213 3.00; SC/PHYS 3030 3.00; SC/PHYS 3040 6.00; SC/PHYS 4061 3.00.

ii) All BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following, in addition to the courses from the program core:

- SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00;
- SC/CSE 1520 3.00 or SC/CSE 1540 3.00;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements of this calendar).

iii) All BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements of this calendar), and in so doing must satisfy the course, credit and standing requirements. To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Specialized Honours Biophysics Program

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level requirements, as specified in ii) above;
- six credits from: SC/BIOL 3051 3.00, SC/CHEM 2020 6.00, SC/PHYS 3020 3.00, SC/PHYS 3050 3.00, SC/PHYS 3320 3.00;
- six credits from: SC/PHYS 3150 3.00, SC/PHYS 3220 3.00, SC/PHYS 4010 3.00, SC/PHYS 4011 3.00, SC/PHYS 4040 3.00, SC/PHYS 4050 3.00, SC/PHYS 4120 3.00;
- at least 12 credits from: SC/BIOL 3010 3.00, SC/BIOL 3110 3.00, SC/BIOL 3130 3.00, SC/BIOL 3150 3.00/SC/BIOL 3150 4.00, SC/BIOL 4061 3.00, SC/BIOL 4141 3.00, SC/BIOL 4150 3.00, SC/BIOL 4151 3.00, SC/BIOL 4160 3.00, SC/CHEM 4093 3.00;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, and at least 42 credits at the 3000 or higher level.

## Chemistry

i) All BSc and BSc Honours degree candidates (exception noted below) must complete the program core (normally before proceeding to 3000- or higher-level courses): SC/CHEM 1000 3.00; SC/CHEM 1001 3.00; SC/CHEM 2010 3.00; SC/CHEM 2011 3.00; SC/CHEM 2020 6.00; SC/CHEM 2030 3.00.

ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00 from the program core):

- SC/CSE 1540 3.00 or SC/CSE 1020 3.00 or SC/CSE 1520 3.00 or SC/CSE 1530 3.00;
- SC/MATH 1013 3.00; SC/MATH 1014 3.00;
- SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00 (not necessarily in year one);
- for Specialized Honours stream in pharmaceutical and biological chemistry: SC/BIOL 1010 6.00; or for Honours Double Major and Honours Major/Minor programs: at least three credits from SC/BIOL 1010 6.00 (strongly recommended for students lacking OAC or 12U biology), SC/EATS 1010 3.00, SC/EATS 1011 3.00, SC/MATH 1025 3.00, or from other 1000-level science courses required for the second major or the minor;
- additional 1000-level science credits (excluding SC/CHEM 1500 4.00, SC/MATH 1510 6.00, SC/MATH 1515 3.00, SC/PHYS 1510 4.00 and all natural science courses), if required, for an overall total of at least 24 credits from 1000-level science courses; (SC/BIOL 1010 6.00 is strongly recommended for students lacking OAC or 12U biology.)
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CHEM 2080 4.00; *Note: SC/CHEM 2050 4.00 or equivalent is also strongly advised.*
- at least 21 credits from chemistry courses at the 3000 level, for an overall total of at least 46 credits from chemistry courses; (*Note: SC/CHEM 3080 4.00 is strongly advised.*)
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses.

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed is required to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 (B) biology grade point average is not required where biology is the minor.)*

### Specialized Honours Program

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CHEM 2050 4.00 or SC/BCHM 2020 4.00 or SC/BIOL 2020 4.00; SC/CHEM 2080 4.00;
- SC/CHEM 3010 4.00 or SC/CHEM 3011 4.00; SC/CHEM 3020 4.00; SC/CHEM 3030 4.00; SC/CHEM 3080 4.00;
- SC/CHEM 4000 8.00;
- a minimum of 18 additional credits from chemistry courses at the 3000 or 4000 level, of which at least nine must be at the 4000 level, for an overall total of at least 71 credits from chemistry courses;
- additional science credits, as required for an overall total of at least 90 credits from science courses;
- additional elective credits, as required for an overall total of at least 120 credits.

In the applied chemistry area, the Department of Chemistry offers a Specialized Honours program stream in atmospheric chemistry (see separate entry in the Faculty of Science and Engineering Programs of Study section of this calendar) and a Specialized Honours program stream in pharmaceutical and biological chemistry.

In addition, students may develop a concentration in analytical chemistry, or materials chemistry, for which they should consult the Department of Chemistry on course selection.

### Specialized Honours Program Stream in Pharmaceutical and Biological Chemistry

A degree program stream of interest as an entry into the field of pharmaceutical (medicinal) chemistry, or for those wishing to explore biologically relevant topics and issues from a chemical perspective. It is suitable for employment in the pharmaceutical and related industries, and in government laboratories, as well as for graduate work in areas of biological chemistry, including medicinal chemistry and structural biology.

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above (SC/MATH 1013 3.00 and SC/MATH 1014 3.00 may be replaced by SC/MATH 1505 6.00 with a minimum grade of B);
- SC/CHEM 2050 4.00 or SC/BCHM 2020 4.00 or SC/BIOL 2020 4.00; SC/BIOL 2021 4.00; SC/BIOL 2040 4.00; SC/CHEM 2080 4.00;
- SC/CHEM 3011 4.00; SC/CHEM 3020 4.00; SC/CHEM 3030 4.00; SC/CHEM 3050 3.00; SC/CHEM 3051 3.00; SC/CHEM 3071 3.00; SC/CHEM 3080 4.00;
- SC/CHEM 4000 8.00; SC/CHEM 4050 3.00; SC/CHEM 4051 3.00 or SC/CHEM 4021 3.00;
- at least three additional credits chosen from SC/CHEM 3021 3.00, SC/CHEM 4051 3.00, SC/BIOL 3110 3.00, SC/BIOL 4151 3.00;
- additional elective credits, as required, for an overall total of at least 120 credits including at least 90 credits from science courses.

### Honours Major Program

- the program core as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CHEM 2050 4.00 or SC/BCHM 2020 4.00 or SC/BIOL 2020 4.00; SC/CHEM 2080 4.00;
- SC/CHEM 4000 4.00 or SC/CHEM 4000 8.00;
- a minimum of 18 credits from chemistry courses at the 3000 or 4000 level, to include:
  - SC/CHEM 3030 4.00 or SC/CHEM 3050 3.00 or SC/CHEM 3080 4.00 (SC/CHEM 3080 4.00 is recommended to facilitate employment in industry);
  - at least two four credit 3000-level courses;
  - at least six credits at the 4000 level (being mindful of 3000-level prerequisites for 4000-level courses; some 4000-level courses can be taken in year 3);
- additional elective credits, as required, for an overall total of at least 120 credits, including at least 90 credits in science courses and at least 42 credits at the 3000 or 4000 levels.

## Honours Double Major Program

Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

Students should consult the departmental undergraduate handbook or a departmental adviser to plan their studies in order to meet the requirements for both majors and their prerequisites. The following are minimum chemistry requirements:

- SC/CHEM 1000 3.00, SC/CHEM 1001 3.00;
- any four of SC/CHEM 2010 3.00, SC/CHEM 2011 3.00, SC/CHEM 2020 6.00, SC/CHEM 2030 3.00 and SC/CHEM 2080 4.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- 18 chemistry credits at the 3000 and 4000 levels, including at least two four-credit 3000-level courses and including at least six credits at the 4000 level;
- SC/CHEM 4000 4.00 or SC/CHEM 4000 8.00 or an equivalent research project course in second major;
- the course requirements for the second major;
- additional elective credits, as required, for an overall total of at least 120 credits, including at least 90 credits in science courses and at least 42 science credits at the 3000 or 4000 levels.

Honours Double Major programs are necessarily highly demanding and should not be considered by any student without an average academic performance of B grade or better.

In the applied chemistry area, the Department of Chemistry and the Department of Earth and Space Science and Engineering offer an Honours Double Major program stream in atmospheric chemistry (see separate entry in the Faculty of Science and Engineering Programs of Study section of this calendar).

## Honours Major/Minor Program

An Honours Major in chemistry may be combined with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the program core as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the minor;
- SC/CHEM 2080 4.00;
- a minimum of 22 credits from chemistry courses at the 3000 or 4000 level, including a minimum of 16 credits from the following: SC/CHEM 3010 4.00, SC/CHEM 3011 4.00, SC/CHEM 3020 4.00, SC/CHEM 3021 4.00, SC/CHEM 3030 4.00, SC/CHEM 3031 4.00, SC/CHEM 3080 4.00;
- a minimum of nine additional credits from chemistry courses at the 4000 level, for an overall total of at least 56 credits from chemistry courses;
- the course requirements for the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

*Note: The following courses are required as prerequisites or corequisites for the chemistry courses above: SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00.*

## Honours Minor

- SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
- at least 24 additional credits from chemistry courses at the 2000 or higher level, for an overall total of at least 30 credits from chemistry courses.

*Note: Some 2000-level chemistry courses require mathematics and physics courses as prerequisites or corequisites. Careful planning is required to ensure that prerequisites for the 2000- and higher-level chemistry courses in which the student is interested are completed.*

## Computer Science

i) All BSc and BSc Honours degree candidates must complete the program core: SC/CSE 1019 3.00; SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/CSE 2001 3.00; SC/CSE 2011 3.00; SC/CSE 2021 4.00; SC/CSE 2031 3.00; SC/CSE 3101 3.00; SC/CSE 3221 3.00; SC/CSE 3311 3.00; SC/MATH 1090 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00; (see Note 2 below).

ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the computer science and mathematics courses from the program core):

- six credits from SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00; (*Note: In this context, SC/CSE 1020 3.00 and SC/CSE 1030 3.00 satisfy the other half of the 1000-level science requirement for courses with laboratories.*)
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

iv) All BSc Honours degree candidates with a major in computer science must complete at least 30 credits which are neither computer science nor mathematics.

*Note 1: See the general prerequisites for 2000-, 3000- and 4000-level computer science courses (under Courses of Instruction section of this calendar) for information about cumulative grade point average requirements in completed computer science courses.*

*Note 2: To satisfy computer science degree requirements, SC/MATH 1000 3.00 or SC/MATH 1013 3.00 may be taken in lieu of SC/MATH 1300 3.00; SC/MATH 1010 3.00 or SC/MATH 1014 3.00 may be taken in lieu of SC/MATH 1310 3.00; SC/MATH 1021 3.00 or SC/MATH 2221 3.00 may be taken in lieu of SC/MATH 1025 3.00.*

## Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- at least nine additional credits from computer science courses at the 3000 level, including at least three credits from courses with second digit 4 (i.e. applications area), for an overall total of at least 40 credits from computer science courses;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses.

## Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed is required to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 (B) biology grade point average is not required where biology is the minor.)*

### Specialized Honours Program

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00, SC/CSE 3401 3.00; at least three additional credits from computer science courses at the 3000 level;
- at least 12 credits from computer science courses at the 4000 level, including SC/CSE 4101 3.00 or SC/CSE 4111 3.00 or SC/CSE 4115 3.00;
- at least six additional credits from computer science courses at the 3000 or 4000 level, for an overall total of at least 58 credits from computer science courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

### Specialized Honours Program (Communication Networks Stream)

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00, SC/CSE 3401 3.00; SC/CSE 3213 3.00; SC/CSE 3451 4.00;
- at least 15 credits from computer science courses at the 4000 level, including SC/CSE 4101 3.00 or SC/CSE 4111 3.00 or SC/CSE 4115 3.00; SC/CSE 4084 6.00; SC/CSE 4213 3.00; SC/CSE 4214 3.00 for an overall total of at least 59 credits from computer science courses;
- additional elective credits, as required from an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

### Specialized Honours Program (Intelligent Systems Stream)

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00, SC/CSE 3401 3.00; SC/CSE 3402 3.00;
- at least 15 credits from computer science courses at the 4000 level, including SC/CSE 4101 3.00 or SC/CSE 4111 3.00 or SC/CSE 4115 3.00; SC/CSE 4081 6.00; SC/CSE 4401 3.00 or SC/CSE 4402 3.00; SC/CSC 4421 3.00 or SC/CSE 4422 3.00;
- at least three additional credits from computer science courses at the 3000 or 4000 level, for an overall total of at least 58 credits from computer science courses;
- additional elective courses, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

*Note: SC/CSE 3215 3.00 and SC/CSE 3451 4.00 are also recommended as complementing the stream.*

### Specialized Honours Program (Interactive Systems Stream)

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3401 3.00; SC/CSE 3431 3.00; SC/CSE 3461 3.00;
- at least 15 credits from computer science courses at the 4000 level, including SC/CSE 4101 3.00 or SC/CSE 4111 3.00 or SC/CSE 4115 3.00; SC/CSE 4082 6.00; two of: SC/CSE 4431 3.00; SC/CSE 4441 3.00; SC/CSE 4461 3.00; SC/CSE 4471 3.00; for an overall total of at least 58 credits from computer science courses;

- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

### Specialized Honours Program (Software Development Stream)

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3341 3.00; SC/CSE 3401 3.00; SC/CSE 3421 3.00; SC/CSE 3461 3.00;
- one of SC/CSE 4101 3.00 or SC/CSE 4111 3.00 or SC/CSE 4115 3.00; SC/CSE 4090 6.00; SC/CSE 4312 3.00; SC/CSE 4313 3.00;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

### Honours Major, Honours Double Major and Honours Major/Minor Programs

An Honours Major in computer science may be taken standalone in a BSc Honours Major degree program or combined with an Honours Major in another subject area in a BSc Honours Double Major degree program, or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including choices appropriate for the possible second major or the minor;
- the computer science Honours Major requirements below;
- the course requirements for the possible second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90\* credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

*\*or at least 66 credits from science courses if the minor is in a fine arts subject area.*

### Honours Major

- the program core, as specified in i) above;
- SC/MATH 2030 3.00;
- SC/CSE 3000 3.00, SC/CSE 3401 3.00;
- at least 12 credits from computer science courses at the 4000 level, for an overall total of at least 49 credits from computer science courses.

### Honours Major (Communication Networks Stream)

- the program core, as specified in i) above;
- SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3401 3.00; SC/CSE 3213 3.00; SC/CSE 3451 4.00;
- at least 12 credits from computer science courses at the 4000 level, including SC/CSE 4084 6.00; SC/CSE 4213 3.00; SC/CSE 4214 3.00; for an overall total of at least 56 credits from computer science courses;
- the course requirements for the second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90\* credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

*\*or at least 66 credits from science courses if the minor is in a fine arts subject area.*

## Honours Major (Intelligent Systems Stream)

- the program core, as specified in i) above;
- SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3401 3.00; SC/CSE 3402 3.00;
- at least 12 credits from computer science courses at the 4000 level, including SC/CSE 4081 6.00; SC/CSE 4401 3.00 or SC/CSE 4402 3.00; SC/CSE 4421 3.00 or SC/CSE 4422 3.00; for an overall total of at least 52 credits from computer science courses;
- the course requirements for the second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90\* credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

\*or at least 66 credits from science courses if the minor is in a fine arts subject area.

## Honours Major (Interactive Systems Stream)

- the program core, as specified in i) above;
- SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3401 3.00; SC/CSE 3431 3.00; SC/CSE 3461 3.00;
- at least 12 credits from computer science courses at the 4000 level, including SC/CSE 4082 6.00; two of SC/CSE 4431 3.00; SC/CSE 4441 3.00; SC/CSE 4461 3.00; SC/CSE 4471 3.00; for an overall total of at least 55 credits from computer science courses;
- the course requirements for the second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90\* credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are neither computer science nor mathematics.

\*or at least 66 credits from science courses if the minor is in a fine arts subject area.

## Honours Minor

- SC/CSE 1019 3.00; SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/CSE 2001 3.00; SC/CSE 2011 3.00; SC/CSE 2021 4.00; SC/CSE 2031 3.00;
- at least nine more credits at the 3000 or 4000 level for an overall total of at least 31 credits from computer science courses.

It is recommended that students in the Honours Major, Honours Double Major or Honours Major/Minor programs, where computer science is the major, take a linear algebra course such as SC/MATH 1025 3.00 among their electives.

## Computer Security

This is a specialized honours program that focuses on understanding threats to computer security and the techniques for combating those threats. The program requires in-depth study of computer networks, operating systems, cryptography, database systems and software engineering techniques. In addition, practical ethics and the study of law as it relates to privacy, intellectual property and theft in our digital world are important complementary topics.

i) All BSc Honours degree candidates must complete the program core:

- SC/CSE 1019 3.00; SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/CSE 2001 3.00; SC/CSE 2011 3.00; SC/CSE 2021 4.00; SC/CSE 2031 3.00; SC/CSE 3000 3.00; SC/CSE 3101 3.00; SC/CSE 3221 3.00; SC/CSE 3213 3.00; SC/CSE 3311 3.00; SC/CSE 3421 3.00; SC/CSE 3481 3.00; SC/CSE 4161 3.00; SC/CSE 4213 3.00; SC/CSE 4413 3.00; SC/CSE 4481 4.00; SC/CSE 4482 3.00; SC/MATH 1025 3.00; SC/MATH 1090 3.00; SC/MATH 1131 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00; SC/MATH 2030 3.00;
- AK/AS/PHIL 2075 3.00 or SC/STS 3500 3.00.

Note 1: SC/MATH 1190 3.00 must be taken if the student has not passed 12U Geometry and Discrete Math.

Note 2: AS/SOSC 2312 9.00 or AS/SOSC 2340 9.00 are highly recommended as fulfilling, in part, the General Education requirements.

Note 3: To satisfy computer science degree requirements, SC/MATH 1000 3.00 or SC/MATH 1013 3.00 may be taken in lieu of SC/MATH 1300 3.00; SC/MATH 1010 3.00 or SC/MATH 1014 3.00 may be taken in lieu of SC/MATH 1310 3.00; SC/MATH 1021 3.00 or SC/MATH 2221 3.00 may be taken in lieu of SC/MATH 1025 3.00.

ii) All BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the computer science and mathematics courses from the program core):

- six credits from: SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1010 6.00 or SC/PHYS 1410 6.00; (Note: In this context, SC/CSE 1020 3.00 and SC/CSE 1030 3.00 satisfy the other half of the 1000-level science requirement for courses with laboratories).
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar. Note: AK/AS/PHIL 2075 3.00 would count towards this requirement.).

iii) All BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the following, course, credit and standing requirements.

- Additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, at least 42 credits at the 3000 or higher level, and at least 30 credits which are not in computer science, or mathematics, or information technology (ITEC).

To graduate in Specialized Honours Computer Security requires successful completion of all Faculty requirements and all required program courses, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

## Digital Media

### Specialized Honours BA Program

All BA Honours degree candidates must complete the following:

- SC/CSE 1019 3.00; SC/CSE 1710 3.00; SC/CSE 1720 3.00; SC/CSE 1030 3.00; FA/FACS 1900 6.00; SC/MATH 1025 3.00; AS/SOSC 1310 9.00 or AS/SOSC 1731 9.00;
- SC/CSE 2011 3.00; SC/CSE 2031 3.00; FA/FACS 2930 6.00; FA/FACS 2935 3.00; FA/FACS 2936 3.00; SC/MATH 2565 3.00 or SC/MATH 1131 3.00;
- FA/FACS 3930 3.00; FA/FACS 3931 3.00 or FA/VISA 2057 3.00; FA/FACS 3935 3.00; FA/FACS 3936 3.00;
- nine credits chosen from: SC/CSE 3213 3.00, SC/CSE 3421 3.00, SC/CSE 3431 3.00, SC/CSE 3461 3.00;
- AS/CSE/FA/FACS 4700 6.00;
- six credits chosen from: FA/FACS 4930 3.00, FA/FACS 4931 3.00, FA/FACS 4932 3.00 or FA/FACS 4935 3.00;
- six credits chosen from: SC/CSE 4413 3.00, SC/CSE 4431 3.00, SC/CSE 4441 3.00, SC/CSE 4461 3.00, SC/CSE 4471 3.00 or SC/CSE 4491 3.00;
- six credits chosen from: AS/SOSC 4300 6.00, AS/SOSC 4301 6.00, AS/SOSC 4302 6.00, AS/SOSC 4305 6.00, AS/SOSC 4314 6.00, AS/SOSC 4319 6.00, AS/SOSC 4320 6.00, AS/SOSC 4330 6.00 or AS/SOSC 4801 6.00;
- six additional credits chosen from the FA/FACS or SC/CSE courses listed above;
- a 2000 level nine credit humanities course and a six credit natural science course to satisfy the General Education requirement;
- additional elective credits, as required for an overall total of at least 120 credits.

Note: SC/MATH 1190 3.00 must be taken if the student has not passed 12U Geometry and Discrete Math.

## Honours Programs

To graduate in an Honours program requires successful completion of all degree requirements and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed. Students must obtain a minimum of 36 credits at the 3000 or 4000 level, including at least 18 credits at the 4000 level. Of these, 12 credits at the 4000 level must be in the major.

## Earth and Atmospheric Science

*Note: The following BSc and BSc Honours degree requirements do not apply to students in the space science stream of Specialized Honours in earth and atmospheric science (see Space Science in the Faculty of Science and Engineering Programs of Study section of this calendar) or the atmospheric chemistry stream of Honours Double Major in earth and atmospheric science and chemistry (see Atmospheric Chemistry in the Faculty of Science and Engineering Programs of Study section of this calendar).*

- i) With the exceptions noted above, all BSc and BSc Honours degree candidates must complete the EATS program core: SC/CSE 1540 3.00; SC/EATS 2030 3.00; SC/EATS 2470 3.00; SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00; SC/MATH 2015 3.00; SC/MATH 2271 3.00; SC/PHYS 1010 6.00; SC/PHYS 2020 3.00; SC/PHYS 2211 1.00.
- ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the EATS program core):
  - 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).
- iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the EATS program core, as specified in i) above;
- the Faculty of Science and Engineering general education requirements, as specified in ii) above;
- SC/EATS 1010 3.00, SC/EATS 1011 3.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00; SC/EATS 2010 3.00 (for those wishing to emphasize Atmospheric Science) or SC/EATS 2050 4.00 (for those wishing to emphasize Earth Science); SC/MATH 2560 3.00 or SC/GEOG 2420 3.00, SC/EATS 3300 3.00;
- nine credits from SC/EATS 3010 2.00 and SC/EATS 3011 1.00, SC/EATS 3020 3.00, SC/EATS 3030 3.00, SC/EATS 3040 3.00, SC/EATS 3180 3.00, SC/MATH 3241 3.00, SC/PHYS 3050 3.00;
- nine additional credits from earth and atmospheric science courses at the 3000 or higher level;
- additional elective credits, approved by the Department of Earth and Space Science and Engineering, as required for an overall total of at least 90 credits, including at least 66 credits from science courses.

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed is required*

*to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 (B) biology grade point average is not required where biology is the minor.)*

### Honours Cores

The atmospheric science Honours core requires the following in addition to the EATS program core: SC/EATS 1011 3.00; SC/EATS 2010 3.00; SC/EATS 3030 3.00; SC/EATS 3040 3.00; SC/EATS 4050 3.00; SC/EATS 4051 3.00; SC/EATS 4120 3.00; SC/EATS 4130 3.00; SC/EATS 4140 3.00; SC/EATS 4230 3.00; SC/MATH 3241 3.00.

The earth science Honours core requires the following in addition to the EATS program core: SC/EATS 1010 3.00; SC/EATS 3020 3.00; SC/EATS 3300 3.00; SC/EATS 4020 3.00; SC/EATS 4220 3.00; SC/MATH 2560 3.00 or SC/GEOG 2420 3.00. Plus either: a) SC/EATS 2050 4.00; SC/EATS 3010 2.00; SC/EATS 3011 1.00; SC/EATS 3180 3.00; SC/EATS 4010 6.00 (for applied geophysics emphasis) or b) SC/EATS 3610 4.00; SC/EATS 3620 4.00; SC/EATS 3650 4.00; SC/EATS 4610 3.00 (for geomatics emphasis).

### Specialized Honours Program

- the EATS program core, as specified in i) above;
- the Faculty of Science and Engineering general education requirements, as specified in ii) above;
- all obligatory courses in one of the following streams:

#### Atmospheric Science Stream

- the atmospheric science Honours core;
- SC/EATS 1010 3.00; SC/EATS 3020 3.00; SC/EATS 3280 3.00; SC/EATS 3300 3.00; SC/EATS 4160 3.00; SC/MATH 2560 3.00 or SC/GEOG 2420 3.00; SC/CHEM 1000 3.00 or SC/CHEM 1001 3.00;
- at least three science credits chosen from SC/CHEM 2011 3.00, SC/CHEM 2030 3.00, SC/MATH 2222 3.00;
- 15 credits (to include at least three credits from earth and atmospheric science courses), chosen from the following: SC/EATS 3130 3.00, SC/EATS 4000 3.00, SC/EATS 4000 6.00, SC/EATS 4020 3.00, SC/EATS 4220 3.00, SC/EATS 4240 3.00, SC/GEOG 2400 6.00, SC/GEOG 4210 3.00, SC/GEOG 4310 3.00, SC/MATH 3242 3.00, SC/MATH 3271.30, SC/MATH 4141 3.00, SC/MATH 4142 3.00, SC/PHYS 2060 3.00, SC/PHYS 3050 3.00;
- additional elective credits, approved by the department, as required for an overall total of at least 120 credits.

#### Earth Science Stream

- the earth science Honours core;
- SC/EATS 1011 3.00; SC/EATS 2010 3.00;
- SC/CHEM 1000 3.00; SC/CHEM 1001 3.00; SC/EATS 2610 2.00;
- SC/EATS 3280 3.00; SC/MATH 3241 3.00;
- SC/EATS 4230 3.00; SC/EATS 4400 3.00;
- either SC/EATS 2060 3.00 and SC/EATS 3140 4.00 (for applied geophysics emphasis) or SC/EATS 2620 4.00 and SC/EATS 2630 3.00 (for geomatics emphasis);
- at least seven credits from SC/EATS 2620 4.00, SC/EATS 2630 3.00, SC/EATS 3610 4.00, SC/EATS 3620 4.00, SC/EATS 3630 4.00, SC/EATS 3640 4.00, SC/EATS 3650 4.00, SC/EATS 3660 3.00, SC/EATS 4000 3.00, SC/EATS 4000 6.00, SC/EATS 4610 3.00, SC/EATS 4620 3.00, SC/EATS 4630 3.00, SC/EATS 4640 3.00, SC/EATS 4650 3.00, SC/EATS 4660 3.00, SC/MATH 3242 3.00, SC/MATH 3271 3.00, SC/MATH 3410 3.00; SC/PHYS 3020 3.00; SC/PHYS 3050 3.00; SC/PHYS 3150 3.00, for an overall total of at least 42 credits from earth and atmospheric science courses;
- additional elective credits, approved by the department, as required for an overall total of at least 120 credits.

*Note: Entry by current earth science students into any courses in the applied geophysics emphasis is restricted, requiring written permission of the Chair of the Department of Earth and Space Science and Engineering.*

The Department of Earth and Space Science and Engineering also offers a BSc Specialized Honours degree stream in space science whose degree requirements are specified in a separate entry in the Faculty of Science and Engineering Programs of Study section of this calendar.

## Honours Double Major Program and Honours Major/Minor Programs

An Honours Major in earth and atmospheric science may be combined with an Honours Major in another subject area in a BSc Honours Double Major degree program, or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar. Further information on course selection for various Honours Double Major programs is detailed in the departmental handbook.

All degree candidates should contact departmental advisers as early as possible regarding course requirements for particular Honours Double Major and Honours Major/Minor programs. Early planning of courses is strongly advised so that the necessary prerequisites for courses in both departments are met.

- the Faculty of Science and Engineering general education requirement, as specified in ii) above;
- the earth and atmospheric science Honours Major requirements below;
- the course requirements for the second major or the minor;
- additional elective credits, approved by the department, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

In cooperation with the Department of Chemistry, the department offers an Honours Double Major program stream in the applied science area of atmospheric chemistry - see separate entry in the Faculty of Science and Engineering Programs of Study section of this calendar.

### Honours Major

An Honours Major in earth and atmospheric science may be taken in either the atmospheric science stream or the earth science stream.

#### Atmospheric Science Stream

- the atmospheric science Honours core, including the EATS program core, as specified above;

#### Earth Science Stream

- the earth science Honours core, including the EATS program core, as specified above.

### Honours Minor

- SC/EATS 1010 3.00; SC/EATS 1011 3.00;
- SC/EATS 2010 3.00; SC/EATS 2030 3.00; SC/EATS 2050 4.00;
- at least 14 credits from the following courses: SC/EATS 2470 3.00, SC/EATS 3010 2.00, SC/EATS 3011 1.00, SC/EATS 3020 3.00, SC/EATS 3030 3.00, SC/EATS 3040 3.00, SC/EATS 3140 3.00, SC/EATS 3180 3.00, SC/EATS 3300 3.00.

*Note: The following courses are required as prerequisites or corequisites for the courses listed above: SC/CSE 1540 3.00; SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00; SC/MATH 2015 3.00; SC/MATH 2270 3.00; SC/MATH 2560 3.00 or SC/GEOG 2420 3.00; SC/PHYS 1010 6.00; SC/PHYS 2010 3.00; SC/PHYS 2020 3.00.*

### Concurrent Certificate in Geographic Information Systems (GIS) and Remote Sensing

See Certificate Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

### Concurrent Certificate in Meteorology

See Certificate Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

## Engineering

The School of Engineering within the Faculty of Science and Engineering offers an Honours bachelor of applied science (BASc Honours) degree in engineering. After completion of a common first-year program, students will choose one of three available programs: computer engineering, geomatics engineering or space engineering.

i) All BASc Honours degree candidates must complete the engineering program core: SC/CHEM 1000 3.00; SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/EATS 1010 3.00; SC/ENG 1000 6.00; SC/ENG 2000 6.00; SC/ENG 3000 3.00; SC/ENG 4000 6.00; ES/ENVS 2150 3.00; SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1019 3.00; SC/MATH 1025 3.00; SC/MATH 2015 3.00; SC/PHYS 1010 6.00; SC/PHYS 2020 3.00; SC/PHYS 3050 3.00.

ii) All BASc Honours degree candidates must complete 12 non-science general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

iii) All BASc Honours degree candidates, in accordance with their declared stream, must satisfy the academic standing and course requirements below.

To graduate in the BASc Honours program requires successful completion of all Faculty requirements and program and stream required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Computer Engineering Stream

- the engineering program core;
- SC/CSE 2001 3.00; SC/CSE 2011 3.00; SC/CSE 2021 4.00; SC/CSE 2031 3.00;
- SC/MATH 1090 3.00; SC/MATH 2030 3.00;
- at least six additional credits from SC/BIOL 1010 6.00, SC/CHEM 1001 3.00, SC/CHEM 2011 3.00, SC/EATS 1011 3.00, SC/PHYS 1070 3.00, SC/PHYS 2010 3.00, SC/PHYS 2040 3.00, SC/PHYS 2060 3.00;
- SC/CSE 3101 3.00; SC/CSE 3201 4.00; SC/CSE 3213 3.00; SC/CSE 3215 4.00; SC/CSE 3221 3.00; SC/CSE 3311 3.00; SC/CSE 3451 4.00;
- three additional credits from computer science courses at the 3000 or 4000 level;
- SC/PHYS 3150 3.00;
- SC/CSE 4201 3.00; SC/CSE 4214 3.00; SC/CSE 4312 3.00;
- 12 credits from: SC/CSE 4210 3.00; SC/CSE 4211 3.00; SC/CSE 4215 3.00; SC/CSE 4313 3.00; SC/CSE 4352 3.00; SC/CSE 4421 3.00; SC/CSE 4422 3.00; SC/CSE 4431 3.00; SC/CSE 4441 3.00; SC/CSE 4452 3.00; SC/CSE 4471 3.00; SC/ENG 3320 3.00.

A non-credit, four to 16 month internship program (registered as SC/ENG 3900 0.00) is highly recommended for all engineering students, but is not a degree requirement.

### Engineering Physics Stream

- the engineering program core;
- SC/CSE 2011 3.00; SC/CSE 2021 4.00;
- SC/CHEM 2011 3.00 SC/EATS 2470 3.00; SC/PHYS 2040 3.00; SC/PHYS 2211 1.00;
- SC/MATH 2271 3.00; SC/MATH 3271 3.00;
- SC/PHYS 3010 3.00; SC/PHYS 3020 3.00; SC/PHYS 3030 3.00; SC/PHYS 3040 6.00; SC/PHYS 3150 3.00; SC/PHYS 3210 6.00;
- SC/PHYS 4010 3.00; SC/PHYS 4020 3.00; SC/PHYS 4050 3.00; SC/PHYS 4060 3.00; SC/PHYS 4211 3.00;
- six additional credits from courses in engineering design; six additional credits from engineering courses.

*Note: The Faculty of Science and Engineering will not be accepting applicants for the engineering physics stream in 2008-2009.*

### Space Engineering Stream

- the engineering program core;
- SC/CSE 2011 3.00; SC/CSE 2031 3.00; SC/CSE 2501 1.00;
- SC/MATH 2271 3.00;

- SC/EATS 2030 3.00; SC/EATS 2470 3.00; SC/ENG 2110 2.00; SC/ENG 2120 4.00;
- SC/PHYS 2030 3.00;
- SC/PHYS 3150 3.00; SC/PHYS 3250 3.00; SC/PHYS 3280 3.00; SC/ENG 3310 3.00; SC/ENG 3320 3.00; SC/ENG 3330 3.00;
- SC/EATS 3020 3.00; SC/ENG 3110 4.00;
- SC/CSE 4421 3.00; SC/ENG 4350 2.00; SC/ENG 4360 3.00; SC/PHYS 4110 3.00; SC/PHYS 4250 3.00;
- three of SC/EATS 4220 3.00, SC/EATS 4230 3.00, SC/ENG 4110 3.00, SC/ENG 4330 3.00, SC/ENG 4550 3.00, SC/PHYS 3070 3.00.

A non-credit, four to 16 month internship program (registered as SC/ENG 3900 0.00) is highly recommended for all engineering students, but is not a degree requirement.

#### Geomatics Engineering Stream

- the engineering program core;
- SC/CSE 2011 3.00; SC/CSE 2031 3.00; SC/CSE 2501 1.00;
- SC/EATS 2030 3.00; SC/EATS 2470 3.00; SC/ENG 2110 2.00; SC/ENG 2120 4.00; SC/ENG 2130 3.00; SC/GEOG 2420 3.00;
- SC/MATH 2271 3.00;
- SC/EATS 3020 3.00; SC/EATS 3300 3.00; SC/ENG 3110 4.00; SC/ENG 3120 4.00; SC/ENG 3130 4.00; SC/ENG 3140 4.00; SC/ENG 3150 4.00; SC/ENG 3160 3.00;
- SC/EATS 4020 3.00; SC/EATS 4220 3.00; SC/EATS 4400 3.00; SC/ENG 4110 3.00; SC/ENG 4120 3.00; SC/ENG 4130 3.00; SC/ENG 4140 3.00; SC/ENG 4150 3.00 or SC/ENG 4160 3.00.

A non-credit, four to 16 month internship program (registered as SC/ENG 3900 0.00) is highly recommended for all engineering students, but is not a degree requirement.

## Environmental Science

### Specialized Honours Program

i) All BSc Honours degree candidates must complete the program core: SC/GEOG 1400 6.00; SC/GEOG 2400 6.00; SC/GEOG 2500 3.00 or SC/GEOG 2600 3.00; six credits from SC/GEOG 2610 3.00; SC/GEOG 3200 3.00, SC/GEOG 3500 3.00, SC/GEOG 4180 4.00, SC/GEOG 4200 3.00, SC/GEOG 4500 3.00; six credits from SC/GEOG 4205 3.00, SC/GEOG 4210 3.00, SC/GEOG 4310 3.00, SC/GEOG 4400 3.00, SC/GEOG 4600 3.00; 12 additional credits from science geography courses (including three credits in statistics for students in the physical sciences stream).

ii) All BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/GEOG 1400 6.00 from the program core):

- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

#### Life Sciences Stream

- SC/CSE 1520 3.00 or SC/CSE 1540 3.00;
- SC/MATH 1505 6.00, or both SC/MATH 1013 3.00 and SC/MATH 1014 3.00;
- SC/BIOL 1010 6.00; SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, or SC/EATS 1010 3.00 and SC/EATS 1011 3.00;

#### Physical Sciences Stream

- SC/CSE 1540 3.00;
- SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00;
- SC/CHEM 1000 3.00; SC/CHEM 1001 3.00; SC/PHYS 1010 6.00 or SC/PHYS 1410 6.00.

iii) All BSc Honours degree candidates, in accordance with their declared program, must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below.

To graduate in an Honours program requires successful completion of all Faculty requirements and program required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Additional Course Requirements

All obligatory courses in one of the following streams:

#### Life Sciences Stream

- SC/BIOL 2010 4.00; SC/BIOL 2030 4.00; SC/BIOL 2050 4.00; SC/BIOL 2060 3.00;
- one ecology field course (SC/BIOL 3001 3.00 or SC/BIOL 3001 2.00);
- 15 additional credits chosen from the following: a second ecology field course (SC/BIOL 3002 3.00 or SC/BIOL 3002 2.00), SC/BIOL 3170 3.00, SC/BIOL 4000 8.00, SC/BIOL 4020 3.00, SC/BIOL 4070 3.00, SC/BIOL 4080 3.00, SC/BIOL 4090 4.00, SC/BIOL 4095 3.00, SC/BIOL 4100 3.00, SC/BIOL 4120 3.00, SC/BIOL 4130 3.00, SC/BIOL 4230 4.00, SC/BIOL 4240 4.00, SC/BIOL 4245 3.00, SC/BIOL 4250 3.00, SC/BIOL 4255 3.00, SC/BIOL 4260 3.00, SC/BIOL 4265 3.00, SC/BIOL 4340 3.00, SC/BIOL 4400 3.00, SC/BIOL 4420 3.00;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

#### Physical Sciences Stream

- SC/EATS 2010 3.00; SC/EATS 2470 3.00;
- SC/CHEM 2030 3.00; SC/PHYS 2020 3.00;
- SC/MATH 2015 3.00; SC/MATH 2270 3.00;
- SC/EATS 3030 3.00; SC/EATS 3130 3.00; SC/EATS 4220 3.00;
- six additional credits chosen from SC/EATS 3040 3.00, SC/EATS 4050 3.00, SC/EATS 4051 3.00, SC/EATS 4120 3.00, SC/EATS 4130 3.00, SC/EATS 4140 3.00, SC/EATS 4150 3.00, SC/EATS 4160 3.00, SC/EATS 4230 3.00, SC/EATS 4240 3.00, SC/EATS 4300 3.00 (atmospheric science topics), SC/MATH 3241 3.00;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

### Concurrent Certificate in Geographic Information Systems (GIS) and Remote Sensing

See Certificate Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

## Environmental Science Courses

The following list includes required and elective courses in the BSc Specialized Honours program in Environmental Science.

#### Geography

SC/GEOG 2400 6.00  
 SC/GEOG 2500 3.00  
 SC/GEOG 2600 3.00  
 SC/GEOG 2610 3.00  
 SC/GEOG 3200 3.00  
 SC/GEOG 3500 3.00 (cross-listed to: SC/BIOL 3500 3.00)  
 SC/GEOG 4180 4.00  
 SC/GEOG 4200 3.00  
 SC/GEOG 4205 3.00  
 SC/GEOG 4210 3.00  
 SC/GEOG 4310 3.00  
 SC/GEOG 4400 3.00  
 SC/GEOG 4500 3.00  
 SC/GEOG 4600 3.00

#### Biology

SC/BIOL 2010 4.00  
 SC/BIOL 2030 4.00  
 SC/BIOL 2050 4.00  
 SC/BIOL 2060 3.00  
 SC/BIOL 3001 3.00 (ecology sections)  
 SC/BIOL 3001 2.00 (ecology sections)  
 SC/BIOL 3002 3.00 (ecology sections)  
 SC/BIOL 3002 2.00 (ecology sections)  
 SC/BIOL 3170 3.00  
 SC/BIOL 4000 8.00

SC/BIOL 4070 3.00  
 SC/BIOL 4080 3.00  
 SC/BIOL 4090 4.00  
 SC/BIOL 4095 3.00  
 SC/BIOL 4100 3.00  
 SC/BIOL 4130 3.00  
 SC/BIOL 4230 4.00  
 SC/BIOL 4240 4.00  
 SC/BIOL 4245 3.00 (cross-listed to: ES/ENVS 4110 3.00)  
 SC/BIOL 4250 3.00  
 SC/BIOL 4255 3.00 (cross-listed to: ES/ENVS 4111 3.00)  
 SC/BIOL 4260 3.00  
 SC/BIOL 4265 3.00  
 SC/BIOL 4340 3.00  
 SC/BIOL 4400 3.00  
 SC/BIOL 4420 3.00

#### Earth and Atmospheric Science

SC/EATS 2010 3.00  
 SC/EATS 2470 3.00  
 SC/EATS 3030 3.00 (cross-listed to: SC/PHYS 3080 3.00)  
 SC/EATS 3040 3.00  
 SC/EATS 3130 3.00 (cross-listed to: SC/CHEM 3060 3.00)  
 SC/EATS 4050 3.00  
 SC/EATS 4051 3.00  
 SC/EATS 4120 3.00  
 SC/EATS 4130 3.00  
 SC/EATS 4140 3.00  
 SC/EATS 4160 3.00  
 SC/EATS 4220 3.00  
 SC/EATS 4230 3.00  
 SC/EATS 4240 3.00

## Geography

i) All BSc and BSc Honours degree candidates must complete the program core: SC/GEOG 1400 6.00; AS/GEOG 1410 6.00 or AS/GEOG 1000 6.00; SC/GEOG 2400 6.00; SC/GEOG 2420 3.00; SC/GEOG 2500 3.00 or SC/GEOG 2600 3.00 or both SC/GEOG 4205 3.00 and SC/GEOG 4210 3.00. (Note: Both SC/GEOG 2600 3.00 and SC/GEOG 2610 3.00 are required for Honours Double Major in geography and earth science; SC/GEOG 4205 3.00 and SC/GEOG 4210 3.00 are required for Honours Double Major in geography and atmospheric science.)

ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/GEOG 1400 6.00 from the program core):

- SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
- six credits from SC/MATH 1505 6.00, SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
- 12 credits from SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the program core, as specified in i) above;

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- at least six credits from science geography courses at the 3000 or 4000 level, for an overall total of at least 30 credits from geography courses;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses and at least 18 credits at the 3000 or higher level.

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

#### Specialized Honours Program

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/GEOG 4540 3.00;
- at least 33 additional credits from science geography courses at the 3000 or 4000 level, for an overall total of at least 54 credits from science geography courses (at least 60 from geography courses);
- at least six credits from non-geography science courses at the 2000 or higher level;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

#### Honours Double Major Programs

BSc Honours Double Major programs are offered in Geography and Earth and Atmospheric Science (in either the atmospheric science stream or the earth science stream).

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major;
- for the geography and atmospheric science stream: at least 36 credits from geography courses, including the program core (see i) above), SC/GEOG 4540 3.00, and at least three credits from the following courses: SC/GEOG 4000 6.00, SC/GEOG 4310 3.00; (Note: If only three credits are chosen from the list above, three additional credits from geography courses at the 3000- or 4000-level are required.)

or

- for the geography and earth science stream: at least 36 credits from geography courses, including the program core (see i) above), SC/GEOG 4540 3.00, and at least nine credits selected from the following courses: SC/GEOG 4000 6.00, SC/GEOG 4180 4.00, SC/GEOG 4200 3.00, SC/GEOG 4205 3.00, SC/GEOG 4210 3.00, SC/GEOG 4310 3.00, SC/GEOG 4400 3.00, SC/GEOG 4600 3.00;
- the course requirements for the second major;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

#### Honours Major/Minor Program

An Honours Major in geography may be combined with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the minor;
- the geography Honours Major requirements below;
- the course requirements for the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

### Honours Major (for Honours Major/Minor Programs)

- the program core, as specified in i) above;
- SC/GEOG 4540 3.00;
- at least 15 additional credits in science geography courses at the 3000 or 4000 level, for an overall total of at least 42 credits in geography courses.

### Honours Minor

- SC/GEOG 1400 6.00;
- AS/GEOG 1410 6.00;
- six credits in science geography courses at the 4000 level;
- at least 12 credits from science geography courses for an overall total of at least 30 credits from geography courses.

### Concurrent Certificate in Geographic Information Systems (GIS) and Remote Sensing

See *Certificate Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.*

### International Bachelor of Science

The degree builds on the established strengths of the Honours BSc programs, and combines them with general education requirements and other required courses outside the major, most of which will be taken in the Faculty of Arts, and a mandatory period of study abroad. The program requires students to acquire an international language and to gain international experience on exchange at one of York University's partner institutions abroad.

The principal components will be the following:

- a total of 120 credits;
- 90 credits in science courses;
- 30 required credits outside the science major, consisting of:
  - 12 credits of language study in one of the languages offered at York University;
  - 18 credits of non-science international content courses;
  - one or two exchange terms abroad as a full-time student at an institution with which York has a formal exchange agreement.

### Language Study

Each student will choose a modern language of study as an integral part of the program. The languages are those offered at York University. No prior knowledge of the language is necessary. All entering students will be given a placement test by the Department of Languages, Literature and Linguistics to determine their appropriate course entry level. All students must successfully complete at least the second university-level course in their chosen language. If entering students are placed in a course above the 1000-level, they must successfully complete 12 credits in that language; if students have a very high level of competence in the language, so that there are not 12 credits which they can do, i.e. the students are placed in the 4000 level, they must successfully complete the remaining six credits in that language and six credits of another language. If entering students already have a second-language competency in one of the designated program languages, they must select an additional language.

Students intending to study abroad in a language other than English should also get an assessment of their language ability from a member of the Department of Languages, Literature and Linguistics. Students whose language ability is deemed insufficient for exchange may do their exchange in an English-speaking country or take courses taught in English at a university where English is not the principal language of instruction.

### International Exchange (Mandatory)

Every student is required to spend at least one full term abroad at one of York University's exchange partners. While on exchange, students must carry a full-time course load. The exchange should take place during the student's second or third year, depending on the requirements of the specific science program, and/or the student's language capacity.

### International Content Courses

Sample list of relevant country, region and thematic courses:

#### East Asia

AS/GEOG 1000 6.00  
 AS/HIST 1030 6.00  
 AS/HIST 2710 6.00  
 AS/HIST 3760 6.00  
 AS/HUMA 1400 9.00  
 AS/HUMA 2420 9.00  
 AS/POLS 2920 6.00  
 AS/POLS 3510 3.00  
 AS/POLS 3515 3.00

#### Europe

AS/GER 3790 6.00  
 AS/HIST 2300 6.00  
 AS/HIST 3355 6.00  
 AS/HIST 3391 6.00  
 AS/HUMA 2195 9.00  
 AS/POLS 2920 6.00  
 AS/POLS 3530 3.00  
 AS/RU 3770 6.00

#### Latin America

AS/HIST 2720 6.00  
 AS/HIST 3731 6.00  
 AS/POLS 2920 6.00  
 AS/POLS 3553 6.00

#### Themes

Health:

AS/ANTH 3190 3.00  
 AS/ANTH 3200 3.00  
 AS/SOSC 2102 3.00

Cities:

AS/SOSC 1731 9.00  
 AS/SOSC 2730 6.00  
 AS/SOSC 3730 6.00

*Note 1: This list indicates types of courses that will fulfill the requirement for courses that focus on a particular country or region or a particular theme. Other relevant courses, including those offered at Glendon, Atkinson, Environmental Studies and Fine Arts, will also be acceptable.*

*Note 2: In order to also meet the general education requirement, courses must be chosen from two different disciplines, i.e. for a focus on Latin America, take at least one history course, and at least one political science course.*

### Specialized Honours in Biology (iBSc Honours)

Students may follow a stream in biology or conservation ecology.

i) All iBSc Honours degree candidates must complete the program core: SC/BIOL 1010 6.00; any five of SC/BIOL 2010 4.00, SC/BIOL 2020 4.00, SC/BIOL 2021 4.00, SC/BIOL 2040 4.00, SC/BIOL 2050 4.00, SC/BIOL 2060 3.00, SC/CHEM 2020 6.00; SC/BIOL 3100 3.00; SC/BIOL 4000 3.00 or SC/BIOL 4000 8.00.

### Honours Programs

To declare Honours requires successful completion of at least 24 credits, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed, and a minimum cumulative credit-weighted grade point average of 4.25 over all courses completed.

To proceed in each year of an Honours program requires a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed, and a minimum cumulative credit-weighted overall grade point average as specified in the Academic Standards section of the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section (III) of this calendar.

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses, requires a minimum cumulative credit-weighted grade point average of 6.00 (B) over

all biology (BIOL) courses completed, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Biology Stream

ii) All iBSc Honours degree candidates must comply with the Faculty of Science and Engineering general education and 1000-level science requirements by completing the following (in addition to SC/BIOL 1010 6.00 from the program core):

- SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
- SC/MATH 1505 6.00 or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
- six credits from SC/CHEM 1000 3.00 AND SC/CHEM 1001 3.00 (prerequisites for SC/BIOL 2020 4.00 AND SC/CHEM 2020 6.00), SC EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00;
- a minimum of three additional credits from SC/BC 1800 3.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00, SC/EATS 1010 3.00, SC/EATS 1011 3.00, SC/MATH 1025 3.00, SC/MATH 1190 3.00, SC/PHYS 1070 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00;
- 12 general education credits (see General Education Requirements in the Regulations Governing Undergraduate Degree Requirements section of this calendar, and item iii) below).

iii) International component:

- 12 credits of language study in one of the languages offered at York University;
- 18 credits of non-science courses with an international component (see sample list of courses above), which will also serve to meet the general education requirement;
- one to two exchange terms abroad as a full-time student at an institution with which York University has a formal exchange agreement.

iv) All iBSc Honours degree candidates must comply with general regulation 7 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below:

- students must complete additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science (SC) courses, at least 42 credits at the 3000 or higher level, and at least 54 credits in biology.

### Conservation Ecology Stream

- the program core, as specified in i) above, including SC/BIOL 1010 6.00, SC/BIOL 2010 4.00, SC/BIOL 2030 4.00, SC/BIOL2040 4.00, SC/BIOL 2050 4.00 and SC/BIOL 2060 3.00;
- SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00;
- SC/MATH 1505 6.00 or six credits from SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1025 3.00;
- SC/CHEM 1000 3.00; SC/CHEM 1001 3.00;
- SC/EATS 1010 3.00; SC/EATS 1011 3.00;
- SC/BIOL 3001 2.00 or SC/BIOL 3001 3.00; SC/BIOL 3170 3.00; SC/BIOL 3200 3.00;
- SC/BIOL 4000 8.00 or SC/BIOL 4000 3.00; SC/BIOL 4095 3.00; SC/BIOL 4245 3.00; SC/BIOL 4255 3.00; SC/BIOL 4265 3.00; at least seven credits from biology courses at the 4000 level, chosen in consultation with the department;
- additional credits from biology courses as required for an overall total of at least 68 credits from biology courses;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar, and item iii) above);
- international component (see item iii) above).

v) All iBSc Honours degree candidates must comply with general regulation 7 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below:

- students must complete additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science (SC) courses, at least 42 credits at the 3000 or higher level, and at least 68 credits in biology.

### Computer Science – Honours Major (iBSc Honours)

i) All iBSc degree candidates must complete the program core: SC/CSE 1019 3.00; SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/CSE 2001 3.00; SC/CSE 2011 3.00; SC/CSE 2021 4.00; SC/CSE 2031 3.00; SC/CSE 3101 3.00; SC/CSE 3221 3.00; SC/CSE 3311 3.00; SC/MATH 1090 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00 (See Note 2 below).

ii) All iBSc degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Requirements Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the computer science and mathematics courses from the program core):

- six credits from SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00; (Note: In this context SC/CSE 1020 3.00 and SC/CSE 1030 3.00 satisfy the other half of the 1000-level science requirement for courses with laboratories;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar, and item iii) below);

iii) International component:

- 12 credits of language study in one of the languages offered at York University;
- 18 credits of non-science courses with an international component (see sample list of courses above), which will also serve to meet the general education requirement;
- one to two exchange terms abroad as a full-time student at an institution with which York has a formal exchange agreement.

iv) All iBSc degree candidates must comply with general regulation 7 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below.

*Note 1: See the general prerequisites for 2000-, 3000- and 4000-level computer science courses (under the Courses of Instruction section of this calendar) for information about cumulative grade point average requirements in completed computer science courses.*

*Note 2: To satisfy computer science degree requirements, SC/MATH 1000 3.00 or SC/MATH 1013 3.00 may be taken in lieu of SC/MATH 1300 3.00; SC/MATH 1010 3.00 or SC/MATH 1014 3.00 may be taken in lieu of SC/MATH 1310 3.00; SC/MATH 1021 3.00 or SC/MATH 2221 3.00 may be taken in lieu of SC/MATH 1025 3.00.*

### iBSc Honours Program

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### iBSc Honours Program

- the program core, as specified in i) above;
- SC/MATH 1025 3.00; SC/MATH 2030 3.00;
- SC/CSE 3000 3.00; SC/CSE 3401 3.00;
- at least 12 credits from computer science courses at the 4000 level, for an overall total of at least 49 credits from computer science courses;
- international component (see item iii) above);
- additional elective credits, as required, for an overall total of at least 120 credits, including at least 90 credits from science (SC) courses, at least 42 credits at the 3000 or higher level, at least 18 credits in courses designated to have an international content.

## Mathematics and Statistics

The Department of Mathematics and Statistics offers BSc and BSc Honours degree programs in six subject areas:

- applied mathematics
- computational mathematics (BSc Honours only)
- mathematics
- mathematics for education
- statistics
- international dual degree program (mathematics and statistics)

The BSc and BSc Honours degree programs in each subject area are listed separately below. A student should choose one of these subject areas based on interest and employment goals, but it is possible to change subject areas provided the requirements of the desired subject area can be met.

i) All BSc and BSc Honours degree candidates must complete the mathematics/statistics core: SC/MATH 1021 3.00; SC/MATH 1131 3.00; SC/MATH 1200 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00; SC/MATH 2022 3.00; SC/MATH 2030 3.00; SC/MATH 2310 3.00 (see program specifications below).

ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the 1000-level CSE and MATH requirements specified for their program):

- 12 credits from SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/MATH 2041 3.00 and SC/MATH 2042 3.00, SC/PHYS 1410 6.00 or SC/PHYS 1010 6.00;
- additional 1000-level science credits (excluding SC/CHEM 1500 4.00, SC/MATH 1510 6.00, SC/MATH 1515 3.00, SC/MATH 1520 3.00, SC/PHYS 1510 4.00 and all natural science courses) - as required for a total of at least 24 1000-level science credits;
- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

*Note: Special regulations apply for the international dual degree program in Mathematics and Statistics.*

iii) All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must satisfy the course, credit and standing requirements specified below.

### Bachelor Programs

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed is required to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 (B) biology grade point average is not required where biology is the minor.)*

*Additional Note: For BA and BA Honours degree programs in mathematics and statistics, see the Faculty of Arts Programs of Study section of this calendar.*

## I. Applied Mathematics Programs

### Bachelor Program

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- SC/MATH 1021 3.00; SC/MATH 1131 3.00; SC/MATH 1200 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00;
- SC/MATH 2022 3.00; SC/MATH 2030 3.00; SC/MATH 2041 3.00; SC/MATH 2270 3.00; SC/MATH 2310 3.00;
- SC/MATH 3241 3.00; SC/MATH 3260 3.00 or SC/MATH 3170 6.00;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses and at least 18 credits at the 3000 or higher level.

### Specialized Honours Program

- the mathematics/statistics core;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- SC/MATH 2001 3.00; SC/MATH 2041 3.00; SC/MATH 2270 3.00;
- SC/MATH 3001 3.00; SC/MATH 3241 3.00; SC/MATH 3242 3.00; SC/MATH 3260 3.00 or SC/MATH 3170 6.00; SC/MATH 3410 3.00;
- at least 12 additional credits selected from science mathematics courses without second digit 5 at the 4000 level, for an overall total of at least 60 credits from major science mathematics courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

### Honours Major, Honours Double Major and Honours Major/Minor Programs

An Honours Major in applied mathematics may be taken stand-alone or combined with an Honours Major in another subject area in a BSc Honours Double Major degree program or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major or the minor;
- the applied mathematics Honours Major requirements below;
- the course requirements for the second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

### Honours Major

- the mathematics/statistics core;
- SC/CSE 1560 3.00;
- SC/MATH 2041 3.00; SC/MATH 2270 3.00;
- SC/MATH 3241 3.00; one of SC/MATH 3242 3.00, SC/MATH 3260 3.00 or SC/MATH 3170 6.00;
- 12 credits at the 4000 level, selected from science mathematics courses without second digit 5, for an overall total of at least 48 credits from major science mathematics courses.

### Honours Minor

- SC/CSE 1560 3.00;
- SC/MATH 1021 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00;
- SC/MATH 2310 3.00; two of SC/MATH 2041 3.00, SC/MATH 2022 3.00 (or SC/MATH 2222 3.00), SC/MATH 2270 3.00 (six credits);
- at least 12 more credits, including at least one of SC/MATH 3170 6.00 or SC/MATH 3241 3.00 or SC/MATH 3260 3.00, and the remaining credits from science mathematics courses without second digit 5 at the 3000 level or higher, for an overall total of at least 30 credits from major science mathematics courses.

## II. Computational Mathematics Program

### Specialized Honours Program

- SC/CSE 1020 3.00; SC/CSE 1030 3.00; SC/CSE 2031 3.00; SC/MATH 2041 3.00;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- the mathematics/statistics core;
- SC/MATH 3090 3.00; SC/MATH 4090 3.00;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

In addition, students must choose from one of three areas of concentration, and in each case complete the courses listed:

### Applied and Industrial Mathematics

- SC/MATH 2042 3.00; SC/MATH 2270 3.00; SC/MATH 3241 3.00; SC/MATH 3242 3.00; SC/MATH 4141 3.00;
- additional credits, selected from science mathematics courses without second digit 5, for an overall total of at least 54 credits from major science mathematics courses.

### Financial Mathematics

- SC/MATH 2280 3.00; SC/MATH 3170 6.00;
- AS/ECON 1000 3.00; AS/ECON 1010 3.00;
- SC/MATH 4143 3.00;
- additional credits, selected from science mathematics courses without second digit 5, for an overall total of at least 54 credits from major science mathematics courses.

### Actuarial Mathematics

- SC/MATH 2280 3.00; SC/MATH 3280 6.00; SC/MATH 3033 3.00 or SC/MATH 3330 3.00; SC/MATH 4280 3.00; SC/MATH 4430 3.00 or SC/MATH 4431 3.00; SC/MATH 4143 3.00;
- additional credits, selected from science mathematics courses without second digit 5, for an overall total of at least 54 credits from major science mathematics courses.

## III. Mathematics Programs

### Bachelor Program

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- SC/MATH 1021 3.00 or equivalent; SC/MATH 1300 3.00 and SC/MATH 1310 3.00 or equivalents;
- one of SC/MATH 1019 3.00, SC/MATH 1090 3.00, SC/MATH 1190 3.00, SC/MATH 1200 3.00, SC/MATH 2030 3.00 or SC/MATH 2320 3.00;
- SC/MATH 2022 3.00 or equivalent; SC/MATH 2310 3.00;
- at least 12 credits from major (i.e. without second digit 5) science mathematics courses, or approved or equivalent courses, at the 3000 level or higher, for a total of at least 30 credits from major science mathematics courses;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses and at least 18 credits at the 3000 or higher level.

### Honours Programs

#### Specialized Honours Program

- the mathematics/statistics core;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- SC/MATH 2001 3.00;
- SC/MATH 3001 3.00; SC/MATH 3010 3.00; either SC/MATH 3020 6.00 or both SC/MATH 3131 3.00 and SC/MATH 3132 3.00;
- six credits from: SC/MATH 4000 3.00/SC/MATH 4000 6.00 (projects in pure mathematics), SC/MATH 4001 6.00, SC/MATH 4020 6.00,

SC/MATH 4030 3.00, SC/MATH 4080 6.00, SC/MATH 4110 3.00, SC/MATH 4120 3.00, SC/MATH 4130 3.00, SC/MATH 4140 3.00, SC/MATH 4150 3.00, SC/MATH 4160 3.00, SC/MATH 4170 6.00, SC/MATH 4210 3.00, SC/MATH 4230 3.00, SC/MATH 4250 6.00, SC/MATH 4280 3.00, SC/MATH 4290 3.00, SC/MATH 4300 3.00, SC/MATH 4300 6.00, SC/MATH 4430 3.00, SC/MATH 4431 3.00, SC/MATH 4630 3.00, SC/MATH 4730 3.00;

- at least six additional credits from major science mathematics courses at the 4000 level (these must include either SC/MATH 4001 6.00 or SC/MATH 4020 6.00 if neither was taken above);
- at least 15 additional credits from major (i.e. without second digit 5) science mathematics courses, or approved or equivalent courses, for a total of at least 66 credits from major science mathematics courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

### Honours Major, Honours Double Major and Honours Major/Minor Programs

An Honours Major in mathematics may be taken stand-alone or combined with an Honours Major in another subject area in a BSc Honours Double Major degree program or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major or the minor;
- the mathematics Honours Major requirements below;
- the course requirements for the second major or the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90\* credits from science courses and at least 42 credits at the 3000 or higher level.

*\*or at least 66 credits from science courses if the minor is in a fine arts subject area.*

### Honours Major

- SC/CSE 1560 3.00;
- the mathematics/statistics core;
- SC/MATH 2001 3.00;
- SC/MATH 3001 3.00; SC/MATH 3010 3.00; either SC/MATH 3020 6.00 or both SC/MATH 3131 3.00 and SC/MATH 3132 3.00;
- six credits from: SC/MATH 4000 3.00/SC/MATH 4000 6.00 (projects in pure mathematics), SC/MATH 4001 6.00, SC/MATH 4020 6.00, SC/MATH 4030 3.00, SC/MATH 4080 6.00, SC/MATH 4110 3.00, SC/MATH 4120 3.00, SC/MATH 4130 3.00, SC/MATH 4140 3.00, SC/MATH 4150 3.00, SC/MATH 4160 3.00, SC/MATH 4170 6.00, SC/MATH 4210 3.00, SC/MATH 4230 3.00, SC/MATH 4250 6.00, SC/MATH 4280 3.00, SC/MATH 4290 3.00, SC/MATH 4300 3.00, SC/MATH 4300 6.00, SC/MATH 4430 3.00, SC/MATH 4431 3.00, SC/MATH 4630 3.00, SC/MATH 4730 3.00;
- at least six additional major (i.e. without second digit 5) science mathematics credits at the 4000 level, for a total of at least 51 credits from major science mathematics courses.

### Honours Minor

- SC/MATH 1021 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00;
- one of SC/MATH 1019 3.00, SC/MATH 1090 3.00, SC/MATH 1190 3.00, SC/MATH 1200 3.00, SC/MATH 2030 3.00 or SC/MATH 2320 3.00;
- SC/MATH 2022 3.00; SC/MATH 2310 3.00;
- at least 12 credits from major (i.e. without second digit 5) science mathematics courses, or approved or equivalent courses, at the 3000 or higher level, for an overall total of at least 30 science mathematics credits.

*Note: In all Mathematics Honours programs, SC/MATH 1021 3.00 and/or SC/MATH 2022 3.00 may be replaced by other linear algebra courses, but if the grade obtained in any such replacement course is below A then one of the following courses must be taken above and beyond the normal*

Honours requirements: SC/MATH 1019 3.00, SC/MATH 1090 3.00, SC/MATH 1190 3.00, SC/MATH 2320 3.00.

#### IV. Mathematics for Education Programs

This is a mathematics program focusing on the needs of students interested in concurrent education or consecutive education with mathematics as a teachable subject.

All Honours BSc degree candidates (except Honours Minor) must complete the mathematics/statistics core and SC/CSE 1560 3.00, SC/MATH 4100 3.00.

##### Specialized Honours Program

- one of SC/MATH 2131 3.00, SC/MATH 2280 3.00, or SC/MATH 2270 3.00;
- SC/MATH 3050 6.00; SC/MATH 3090 3.00;
- one of SC/MATH 3020 6.00; SC/MATH 3140 6.00; SC/MATH 2001 3.00 and SC/MATH 3001 3.00; (two of SC/MATH 3260 3.00, SC/MATH 4160 3.00, SC/MATH 4161 3.00) (six credits);
- SC/MATH 4400 6.00;
- three additional credits from science mathematics courses (i.e. without second digit 5) at the 3000 or higher level.

##### Honours Major, Honours Double Major and Honours Major/Minor Programs

An Honours Major in mathematics for education may be taken stand-alone or combined with an Honours Major in another subject area in a BSc Honours Double Major degree program or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

##### Honours Major

- two of SC/MATH 4400 6.00; SC/MATH 3020 6.00; SC/MATH 3050 6.00; SC/MATH 3140 6.00; SC/MATH 2001 3.00 and SC/MATH 3001 3.00, (two of SC/MATH 3260 3.00, SC/MATH 4160 3.00, SC/MATH 4161 3.00) (12 credits);
- six additional credits from science mathematics courses (i.e. without second digit 5) at the 3000 or higher level.

##### Honours Minor

- SC/MATH 1021 3.00; SC/MATH 1131 3.00; SC/MATH 1200 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00;
- SC/MATH 2022 3.00; SC/MATH 2030 3.00;
- at least nine credits from major (i.e. without second digit 5) science mathematics courses at the 3000 or higher level including: (SC/MATH 4100 3.00 or SC/MATH 4400 6.00) and at least three additional credits from proof-based courses approved by the director (such as SC/MATH 3020 6.00, SC/MATH 3050 6.00, SC/MATH 3140 6.00, SC/MATH 3260 3.00).

#### V. Statistics Programs

##### Bachelor Program

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- SC/MATH 1021 3.00; SC/MATH 1131 3.00; SC/MATH 1200 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00
- SC/MATH 2022 3.00\*; SC/MATH 2030 3.00; SC/MATH 2131 3.00; SC/MATH 2310 3.00;
- SC/MATH 3033 3.00 or SC/MATH 3330 3.00; SC/MATH 3131 3.00;
- at least three additional credits from 3000- or 4000-level science mathematics courses with third digit 3 for a total of at least 36 credits from major science mathematics courses;
- additional elective credits, as required for an overall total of at least 90 credits, including at least 66 credits from science courses and at least 18 credits at the 3000 or higher level.

\*Note: SC/MATH 2222 3.00 will be accepted in lieu of SC/MATH 2022 3.00 in this program, but is not recommended.

##### Specialized Honours Program

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/CSE 1560 3.00;
- the mathematics/statistics core;
- SC/MATH 2001 3.00; SC/MATH 2131 3.00;
- SC/MATH 3001 3.00; SC/MATH 3033 3.00 or SC/MATH 3330 3.00; SC/MATH 3034 3.00; SC/MATH 3131 3.00; SC/MATH 3132 3.00; SC/MATH 3430 3.00;
- 12 credits from 4000-level science mathematics courses with third digit 3;
- six additional credits from major (second digit not 5) science mathematics courses, for a total of at least 66 credits from major science mathematics courses;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

##### Honours Double Major Program

An Honours Major in statistics may be combined with an Honours Major in another subject area in a BSc Honours Double Major degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major;
- the statistics Honours Major requirements (for BSc Honours Double Major programs) below;
- the course requirements for the second major;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

##### Honours Major (BSc Honours Double Major Programs)

- SC/CSE 1560 3.00;
- the mathematics/statistics core;
- SC/MATH 2131 3.00;
- SC/MATH 3033 3.00 or SC/MATH 3330 3.00; SC/MATH 3131 3.00; SC/MATH 3132 3.00;
- six additional credits from 3000- or 4000-level science mathematics courses with third digit 3 for an overall total of at least 42 credits from major science mathematics courses.

\*Note: SC/MATH 2222 3.00 will be accepted in lieu of SC/MATH 2022 3.00 in this program, but it is not recommended.

##### Honours Major and Honours Major/Minor Programs

An Honours Major in statistics may be taken stand-alone or combined with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the minor;
- the statistics Honours Major requirements (for BSc Honours Major/Minor programs) below;
- the course requirements for the minor;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses and at least 42 credits at the 3000 or higher level.

### Honours Major (for BSc Honours Major and Major/Minor Programs)

- SC/CSE 1560 3.00;
- the mathematics/statistics core;
- SC/MATH 2131 3.00;
- SC/MATH 3033 3.00 or SC/MATH 3330 3.00; one of SC/MATH 3034 3.00 or SC/MATH 3430 3.00;
- SC/MATH 3131 3.00; SC/MATH 3132 3.00;
- 12 credits from 4000-level science mathematics courses with third digit 3, for an overall total of at least 51 credits from major science mathematics courses.

\*Note: The course SC/MATH 2222 3.00 will be accepted in lieu of SC/MATH 2022 3.00 in this program, but it is not recommended.

### Honours Minor

- first-year calculus (six credits at the 1000 level without second digit 5);
- SC/MATH 1021 3.00\*; SC/MATH 2022 3.00\*;
- SC/MATH 1131 3.00; SC/MATH 2030 3.00; SC/MATH 2131 3.00;
- nine additional credits from 2000- or higher-level science mathematics courses with third digit 3, for an overall total of at least 30 science mathematics credits.

\*Note: SC/MATH 1025 3.00, SC/MATH 2221 3.00 and SC/MATH 2222 3.00 will be accepted in this program, but are not recommended.

## VI. International Dual Degree in Mathematics and Statistics

In collaboration with the Dipartimento di Matematica Pura ed Applicata at the University of L'Aquila (Italy), the Department of Mathematics and Statistics offers an International Dual Degree program Mathematics and Statistics (BSc and Specialized Honours BSc only). This program is particularly demanding and will be of interest to students with academic performances of B average and better. Students in the program, after two years of study at York, but before the completion of the York degree requirements, will be eligible to study as York international exchange students for up to one year at the University of L'Aquila, earn York credits for specified courses taken at L'Aquila towards their York degree program, and at the same time fulfill the degree requirements for the Laurea di primo livello at L'Aquila, the Italian equivalent of a 90-credit BSc. All exchanges under this program are administered by York International in collaboration with the Ufficio Internazionale at the University of L'Aquila.

Upon completion of the York degree requirements, students of the University of L'Aquila studying as exchange students at York are eligible to earn a York degree in this program.

All BSc and BSc Honours degree candidates must satisfy a specified general education requirement in lieu of the general education requirements of the Faculty of Science and Engineering, as follows. For students whose home university is York, the specified general education requirement consists of: AS/IT 1000 6.00 or equivalent; the course *Lingua e Cultura Italiana* offered by the University of L'Aquila (three York credits) or equivalent; three more credits, in accordance with the general education requirements of the Faculty of Science and Engineering. (Note in particular that for York students in the program, AS/IT 1000 6.00 is exempted from Restriction 2 in the general education requirements of the Faculty of Science and Engineering). For students whose home university is the University of L'Aquila, the specified general education requirement consists of: *Lingua Inglese 1, 2* offered by the University of L'Aquila (six York credits) or equivalent; AS/HUMA 1220 9.00 or equivalent.

### Bachelor Program

- the specified general education requirement;
- SC/CSE 1530 3.00; SC/CSE 1560 3.00;
- SC/PHYS 1410 6.00;
- SC/MATH 1021 3.00; SC/MATH 1131 3.00; SC/MATH 1200 3.00; SC/MATH 1300 3.00; SC/MATH 1310 3.00;
- SC/MATH 2001 3.00; SC/MATH 2022 3.00; SC/MATH 2030 3.00; SC/MATH 2270 3.00; SC/MATH 2310 3.00; SC/MATH 2320 3.00;

- SC/MATH 3020 6.00; SC/MATH 3170 6.00; SC/MATH 3241 3.00; SC/MATH 3271 3.00; SC/MATH 3410 3.00;
- additional elective credits for an overall total of at least 90 credits.

### Specialized Honours Program

- the specified general education requirement;
- SC/CSE 1530 3.00; SC/CSE 1560 3.00;
- SC/PHYS 1410 6.00;
- the mathematics/statistics core;
- SC/MATH 2001 3.00; SC/MATH 2270 3.00; SC/MATH 2320 3.00;
- SC/MATH 3020 6.00; SC/MATH 3170 6.00; SC/MATH 3241 3.00; SC/MATH 3271 3.00; SC/MATH 3410 3.00;
- at least nine additional credits from SC/MATH courses at the 4000 level;
- additional elective credits, as required for an overall total of at least 120 credits, including at least 90 credits from science courses, and at least 42 credits at the 3000 or higher level.

Note: For an up-to-date list of equivalent courses offered at the University of L'Aquila, contact the Department of Mathematics and Statistics.

## Physics and Astronomy

Note: The following BSc and BSc Honours degree requirements do not apply to students in the space science stream of Specialized Honours physics and astronomy - for requirements for that stream, see *Space Science in the Faculty of Science and Engineering Programs of Study section of this calendar*.

- With the exception noted above, all BSc and BSc Honours degree candidates must complete the program core: SC/PHYS 1010 6.00; SC/PHYS 2010 3.00; SC/PHYS 2020 3.00; SC/PHYS 2040 3.00; SC/PHYS 2060 3.00; SC/PHYS 3040 6.00. (Note: All program core courses require mathematics prerequisites or corequisites.)
- All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to SC/PHYS 1010 6.00 from the program core):
  - SC/CSE 1540 3.00 or SC/CSE 1020 3.00;
  - SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00;
  - SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00 (or six credits from course(s) with laboratories required for the second major or the minor in BSc Honours Double Major or Honours Major/Minor programs - see departmental mini-calendars or Faculty checklists);
  - 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).
- All BSc and BSc Honours degree candidates, in accordance with their declared programs, must comply with general regulation 5 or 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

Students may follow a stream emphasizing physics or astronomy.

Students in both streams must take the following courses:

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/MATH 2015 3.00; SC/MATH 2271 3.00;
- six credits from SC/PHYS 3010 3.00, SC/PHYS 3020 3.00, SC/PHYS 3030 3.00.

In addition, there are the following stream-dependent course requirements:

#### Physics Stream

- SC/PHYS 2213 3.00; SC/PHYS 3220 3.00; SC/PHYS 4061 3.00;
- SC/PHYS 2030 3.00;
- at least three additional credits from 3000- or 4000-level science courses;
- additional elective credits, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 90 credits.

#### Astronomy Stream

- SC/PHYS 1070 3.00; SC/PHYS 2070 3.00; SC/PHYS 2213 3.00, SC/PHYS 4270 4.00;
- SC/PHYS 3220 3.00;
- additional elective credits, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 90 credits.

#### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed, subject to the exception in the note below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 (B) over all biology (BIOL) courses completed is required to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 (B) biology grade point average is not required where biology is the minor.)*

#### Specialized Honours Program

Students may follow a stream emphasizing physics, applied physics or astronomy.

Students in all three streams must take the following courses:

- the program core, as specified in i) above;
- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above;
- SC/PHYS 2030 3.00; SC/MATH 2015 3.00; SC/MATH 2271 3.00; SC/PHYS 2213 3.00;
- SC/MATH 3410 3.00; SC/PHYS 3010 3.00; SC/PHYS 3020 3.00; SC/PHYS 3030 3.00; SC/PHYS 3220 3.00; SC/PHYS 4010 3.00; SC/PHYS 4020 3.00; SC/PHYS 4061 3.00.

In addition, there are the following stream-dependent course requirements:

#### Physics Stream

- two of SC/PHYS 4011 3.00, SC/PHYS 4040 3.00, SC/PHYS 4050 3.00;
- either SC/PHYS 4210 3.00 or SC/PHYS 4062 3.00; and SC/PHYS 4211 3.00;
- three additional credits in PHYS courses at the 3000 level or higher;
- additional elective credits, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 120 credits.

#### Applied Physics Stream

- SC/PHYS 3050 3.00; SC/PHYS 3150 3.00; SC/PHYS 4050 3.00; either SC/PHYS 4210 3.00 or SC/PHYS 4062 3.00; SC/PHYS 4211 3.00; SC/PHYS 4310 3.00;
- six credits from SC/MATH 3241 3.00, SC/PHYS 3250 3.00, SC/PHYS 3280 3.00, SC/PHYS 4120 3.00, SC/PHYS 4250 3.00;
- additional credits from 3000- and 4000-level science courses, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 120 credits.

#### Astronomy Stream

- SC/PHYS 1070 3.00; SC/PHYS 2070 3.00; SC/PHYS 3070 3.00; SC/PHYS 4070 3.00; SC/PHYS 4270 4.00;
- SC/PHYS 4210 3.00 or SC/PHYS 4211 3.00; one of SC/PHYS 4011 3.00, SC/PHYS 4040 3.00, SC/PHYS 4050 3.00 or SC/PHYS 4120 3.00;
- one of SC/PHYS 3280 3.00, SC/PHYS 4060 3.00, SC/PHYS 4110 3.00, SC/PHYS 4330 3.00 or SC/EATS 4630 3.00;
- three additional credits from PHYS, EATS or MATH courses at the 3000 level or higher;
- additional elective credits, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 120 credits.

The Department of Physics and Astronomy also offers a BSc Specialized Honours degree stream in space science whose degree requirements are specified in a separate entry in the Faculty of Science and Engineering Programs of Study section of this calendar.

#### Honours Major, Honours Double Major and Honours Major/Minor Programs

An Honours Major in physics and astronomy may be taken stand-alone or combined with an Honours Major in another subject area in a BSc Honours Double Major degree program, or with an Honours Minor in another subject area in a BSc Honours Major/Minor degree program. Possible subject combinations are listed under Undergraduate Degree Programs in the Faculty of Science and Engineering Undergraduate Degree and Certificate Programs section of this calendar.

Early planning of courses in all combined programs is strongly advised so that the necessary prerequisites for courses in both departments are met.

- the Faculty of Science and Engineering general education and 1000-level science requirements, as specified in ii) above and including courses appropriate for the second major or the minor;
- the physics and astronomy Honours Major requirements below;
- the course requirements for the second major or the minor;
- additional elective credits, chosen in consultation with the Department of Physics and Astronomy, as required for an overall total of at least 120 credits, including at least 42 credits at the 3000 or higher level.

#### Honours Major

Students may follow a stream emphasizing physics or astronomy.

Students in both streams must take the following courses:

- the program core, as specified in i) above;
- six credits from SC/PHYS 3010 3.00, SC/PHYS 3020 3.00, SC/PHYS 3030 3.00.

*Note: The following courses are required as prerequisites or corequisites for the courses above: SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00; SC/MATH 2015 3.00; SC/MATH 2271 3.00.*

In addition, there are the following stream-dependent course requirements:

#### Physics Stream

- SC/PHYS 2213 3.00; SC/PHYS 3220 3.00; SC/PHYS 4061 3.00;
- at least six credits from PHYS courses at the 4000 level, for an overall total of at least 45 credits from PHYS courses;

#### Astronomy Stream

- SC/PHYS 1070 3.00; SC/PHYS 2070 3.00; SC/PHYS 2213 3.00; SC/PHYS 3220 3.00; SC/PHYS 4270 4.00; for an overall total of at least 46 credits from PHYS courses.

#### Honours Minor

Students may follow a stream in physics or a stream in astronomy in the minor subject area.

Students in both streams must take the following courses:

- the program core, as specified in i) above;

- three credits from SC/PHYS 3010 3.00, SC/PHYS 3020 3.00, SC/PHYS 3030 3.00.

*Note: The following courses are required as prerequisites or corequisites for the courses above: SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00; SC/MATH 2015 3.00; SC/MATH 2271 3.00.*

In addition, there are the following stream-dependent course requirements:

#### Physics Stream

- SC/PHYS 2213 3.00; SC/PHYS 3220 3.00; for an overall total of 33 credits from PHYS courses;

#### Astronomy Stream

- SC/PHYS 1070 3.00; SC/PHYS 2070 3.00; SC/PHYS 2213 3.00; SC/PHYS 3070 3.00 or SC/PHYS 4270 4.00; for an overall total of at least 39 credits from PHYS courses.

## BSc Honours Science and BSc Science

The BSc Honours Science and the BSc Science programs have no declared major. These programs are appropriate for a student who wishes to enrol in a broader range of courses at the 3000 and 4000 levels than can normally be undertaken in Honours or BSc programs.

To declare Honours science or BSc science requires successful completion of at least 24 credits and permission of the Faculty honours and BSc science adviser. The candidate is expected to provide a rationale for this choice of program and a study plan. The study plan must conform to Faculty of Science and Engineering general regulations.

To graduate in the Honours Science program requires successful completion of the Faculty 1000-level requirements (see general regulation 4 in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and the Faculty Honours requirements (see general regulation 6 in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) excluding the major requirement, and a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed. Further, a minimum of 42 credits must be earned in science courses at the 3000 or higher level.

To graduate in the BSc Science program requires successful completion of the Faculty 1000-level requirements (see general regulation 4 in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and the Faculty bachelor program requirements (see general regulation 5 in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) excluding the major requirement, and a minimum cumulative credit-weighted grade point average of 4.00 (C) over all courses completed. Further, a minimum of 18 credits must be earned in science courses at the 3000 or higher level.

## Science and Technology Studies

i) All BSc and BSc Honours degree candidates must complete the program core:

- 12 credits: SC/STS 2411 6.00, SC/STS 4501 6.00.

ii) All BSc and BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following:

- three credits from: SC/CSE 1520 3.00 or SC/CSE 1530 3.00 or SC/CSE 1540 3.00 or SC/CSE 1020 3.00;
- six credits from: SC/MATH 1505 6.00, SC/MATH 1013 3.00, SC/MATH 1014 3.00, SC/MATH 1300 3.00, SC/MATH 1310 3.00, SC/MATH 1021 3.00, SC/MATH 1025 3.00; (note that MATH 1013 3.00 and 1300 3.00 are course credit exclusions, as are MATH 1014 3.00 and 1310 3.00).

- 12 credits from: SC/BIOL 1010 6.00, SC/CHEM 1000 3.00 and SC/CHEM 1001 3.00, SC/EATS 1010 3.00 and SC/EATS 1011 3.00, SC/PHYS 1010 6.00 or SC/PHYS 1410 6.00;
- three credits from: SC/BC 1800 3.00, SC/BIOL 1010 6.00, SC/CHEM 1000 3.00, SC/CHEM 1001 3.00, SC/CSE 1030 3.00 (if SC/CSE 1020 3.00 is completed above), SC/EATS 1010 3.00, SC/EATS 1011 3.00, SC/PHYS 1010 6.00, SC/PHYS 1410 6.00, HH/PSYC 1010 6.00.

iii) 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements).

iv) All degree candidates must comply with general regulation 5 or 6 (Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and in so doing, must also satisfy the course, credit and standing requirements specified below.

v) All BSc and BSc Honours degree candidates must complete at least 18 science credits at the 2000 level or higher non-science and technology studies major courses.

### Bachelor Program

**To graduate in a bachelor program.** A minimum overall grade point average of 4.00 (C) is required in order to be eligible to graduate with a BSc degree (bachelor program).

- the program core as specified in (i) above;
- the Faculty of Science and Engineering general education and 1000 level science requirements as in (ii) and (iii) above;
- an additional 18 science and technology studies credits from the STS curriculum courses for a total of a minimum of 30 credits from science and technology studies major courses;
- at least 18 science credits at the 2000 level or higher non-science and technology studies major courses as in (v) above;
- additional elective credits as required for a total of at least 90 credits, including at least 66 credits from science courses and of these, at least 18 credits at the 3000 level or higher.

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses and a minimum cumulative credit-weighted grade point average of 5.00 over all courses completed, subject to the exceptions in the notes below.

*Note: In addition, a minimum cumulative credit-weighted grade point average of 6.00 over all biology (BIOL) courses completed is required to declare, proceed and graduate in (i) the Honours Double Major program where biology is the other major, and (ii) the Honours Major/Minor program where biology is the major. (The minimum 6.00 biology grade point average is not required where biology is the minor.)*

### Specialized Honours Program

- the program core as specified in (i) above;
- the Faculty of Science and Engineering general education and 1000 level science requirements as in (ii) and (iii) above;
- an additional 42 credits from the approved science and technology studies major courses (for a total of 54 science and technology studies credits);
- at least 18 science credits at the 2000 level or higher non-science and technology studies courses as in (v) above;
- additional elective credits as required for a total of at least 120 credits, including at least 90 credits from science courses and of these, at least 42 credits at the 3000 level or higher.

### Honours Double Major Program

Possible subject combinations are listed under Undergraduate Degree Programs in Science Section 1.

Students should consult a program adviser to plan their studies in order to meet the program requirements of both majors and their prerequisites. Such programs are highly demanding and should be carefully considered by any student wishing to undertake this course of study.

- the program core as specified in (i) above;
- the Faculty of Science and Engineering general education and 1000 level science requirements as in (ii) and (iii) above;
- an additional 30 credits from the approved science and technology studies major courses (for a total of 42 science and technology studies credits);
- at least 18 science credits at the 2000 level or higher level non-science and technology studies courses as in (v) above;
- the course requirements for the second major;
- additional elective credits as required for a total of at least 120 credits, including at least 90 credits from science courses\* and of these, at least 42 credits at the 3000 level or higher.

\*Note: At least 66 credits in science courses if the second major is in arts.

### Honours Major/Minor Program

- the program core as specified in (i) above;
- the Faculty of Science and Engineering general education and 1000 level science requirements as in (ii) above;
- an additional 30 credits from the approved science and technology studies major courses (for a total of 42 science and technology studies credits);
- at least 18 science credits at the 2000 level or higher non-science and technology studies courses as in (v) above;
- the course requirements for the minor;
- additional elective credits as required for a total of at least 120 credits, including at least 90\* credits from science courses and of these, at least 42 credits at the 3000 level or higher.

\*Note: At least 66 credits in science courses if the minor is in arts, fine arts, or environmental studies.

### Honours Minor

- the program core as specified in (i) above;
- an additional 18 credits from the approved science and technology studies major courses (for a total of 30 science and technology studies credits).

### List of Science and Technology Studies Courses

The following courses are cross-listed between the Faculty of Science and Engineering and the Faculty of Arts to form the core courses selections for the Science and Technology Studies BSc degree options.

#### Mandatory for all science and technology studies majors:

SC/STS 2411 6.00  
SC/STS 4501 6.00

#### Options for all science and technology studies majors (number of credits varies for degree type):

SC/STS 2010 6.00  
SC/STS 3500 3.00  
SC/STS 3561 3.00  
SC/STS 3600 6.00  
SC/STS 3700 6.00  
SC/STS 3725 6.00  
SC/STS 3726 3.00  
SC/STS 3730 6.00  
SC/STS 3740 3.00  
SC/STS 3750 6.00  
SC/STS 3755 3.00  
SC/STS 3760 6.00  
SC/STS 3765 3.00  
SC/STS 3770 6.00  
SC/STS 3775 3.00  
SC/STS 3780 6.00  
SC/STS 3790 6.00  
SC/STS 3925 6.00  
SC/STS 3970 6.00  
SC/STS 3975 3.00  
SC/STS 4700 3.00  
SC/STS 4700 6.00  
SC/STS 4710 6.00

## Space Science

The Department of Earth and Space Science and Engineering offers a Specialized Honours degree stream in space science. After completing a two-year foundational curriculum, space science students may choose one of two options: the first, which focuses upon the observation of the earth and atmosphere from space, is provided by the Department of Earth and Space Science and Engineering, through the Earth and Atmospheric Science program; the second, which focuses upon space astronomy and space exploration, is provided by the Department of Physics and Astronomy, through the Physics and Astronomy program. Students in the second option would transfer to physics and astronomy. Courses for the third and fourth years for each option are noted below.

i) All BSc Honours degree candidates must complete the space science foundational core at 1000 and 2000 levels:

- SC/CHEM 1000 3.00 or SC/CHEM 1001 3.00; SC/CSE 1020 3.00; SC/EATS 1010 3.00; SC/EATS 1011 3.00; SC/MATH 1013 3.00; SC/MATH 1014 3.00; SC/MATH 1025 3.00; SC/PHYS 1010 6.00; SC/PHYS 1070 3.00; *Note: Alternatively the first year engineering core would be an acceptable substitute.*
- SC/CSE 2501 1.00; SC/EATS 2030 3.00; SC/EATS 2470 3.00; SC/MATH 2015 3.00; SC/MATH 2271 3.00; SC/PHYS 2010 3.00; SC/PHYS 2020 3.00; SC/PHYS 2030 3.00; SC/PHYS 2040 3.00; SC/PHYS 2060 3.00; SC/PHYS 2213 3.00.

ii) All BSc Honours degree candidates must comply with general regulation 4 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) by completing the following (in addition to the 1000-level courses specified in the program core):

- 12 general education credits (see General Education Requirements in the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar).

iii) All BSc Honours degree candidates, in accordance with their declared program, must comply with general regulation 6 (see the Faculty of Science and Engineering Regulations Governing Undergraduate Degree Requirements section of this calendar) and, in so doing, must also satisfy the course, credit and standing requirements specified below.

iv) All BSc Honours degree candidates are encouraged to complete a non-credit industrial internship (normally salaried). This provides experience in a four-month to 12-month placement, normally after the third year of study.

### Honours Programs

To graduate in an Honours program requires successful completion of all Faculty requirements and departmental required courses, a minimum cumulative credit-weighted grade point average of 5.00 (C+) over all courses completed.

### Specialized Honours in Earth and Atmospheric Science

- the space science foundational core, as specified in i) above;
- the Faculty of Science and Engineering general education requirements, as specified in ii) above;
- SC/EATS 3030 3.00 (cross-listed to: SC/PHYS 3080 3.00); SC/EATS 3040 3.00 SC/EATS 3280 3.00 (cross-listed to: SC/PHYS 3280 3.00); SC/EATS 3300 3.00; SC/EATS 3610 4.00 (cross-listed to: SC/ENG 3110 4.00); SC/MATH 3241 3.00; SC/MATH 3271 3.00; SC/PHYS 3310 3.00;
- SC/EATS 4020 3.00 (cross-listed to: SC/PHYS 4060 3.00) or SC/PHYS 4250 3.00; SC/EATS 4220 3.00; SC/EATS 4230 3.00; SC/EATS 4630 3.00; (cross-listed to: SC/ENG 4130 3.00);
- at least 12 credits from: SC/EATS 4000 3.00, SC/EATS 4130 3.00, SC/EATS 4140 3.00, SC/EATS 4160 3.00, SC/EATS 4610 3.00 (cross-listed to: SC/ENG 4110 3.00), SC/PHYS 4110 3.00, SC/PHYS 4330 3.00, SC/PHYS 4360 3.00 (cross-listed to: SC/ENG 4360 3.00);
- additional elective credits, approved by the Department of Earth and Space Science and Engineering, as required for an overall total of at least 120 credits.

### Specialized Honours in Physics and Astronomy

- the space science foundational core, as specified in i) above;
- the Faculty of Science and Engineering general education requirements, as specified in ii) above;
- SC/PHYS 3020 3.00; SC/PHYS 3040 6.00; SC/PHYS 3070 3.00; SC/PHYS 3250 3.00; SC/PHYS 3280 3.00 (cross-listed to: SC/EATS 3280 3.00);
- at least three credits from: SC/PHYS 3050 3.00, SC/PHYS 3220 3.00
- three credits from: SC/PHYS 3010 3.00, SC/PHYS 3030 3.00, SC/PHYS 3050 3.00, SC/PHYS 3080 3.00 (cross-listed to: SC/EATS 3030 3.00), SC/PHYS 3150 3.00, SC/PHYS 3220 3.00, SC/PHYS 3310 3.00 (cross-listed to: SC/ENG 3310 3.00), other courses approved by the Department of Physics and Astronomy;
- SC/PHYS 4110 3.00; SC/PHYS 4330 3.00 (cross-listed to: SC/ENG 4330 3.00); SC/PHYS 4350 2.00 (cross-listed to: SC/ENG 4350 2.00);
- at least 15 credits from: SC/EATS 4610 3.00 (cross-listed to: SC/ENG 4110 3.00), SC/PHYS 4010 3.00, SC/PHYS 4020 3.00, SC/PHYS 4040 3.00, SC/PHYS 4050 3.00, SC/PHYS 4070 3.00, SC/PHYS 4120 3.00, SC/PHYS 4270 4.00, SC/PHYS 4310 3.00, SC/PHYS 4360 3.00 (cross-listed to: SC/ENG 4360 3.00), SC/PHYS 4410 3.00.

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### Statistics

*See the Mathematics and Statistics section.*

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