

Geomatics

This section presents the requirements for programs in:

- Geomatics B.A. Honours
- Geomatics B.Sc. Honours
- Minor in Geomatics

Program Requirements

Course Categories for B.Sc. Geomatics

See Academic Regulations for the Bachelor of Science Degree for a list of courses in these categories.

- Science Continuation
- Experimental Science Electives
- Science Faculty Electives
- Approved Courses Outside the Faculties of Science and Engineering and Design
- Science Geography courses

Geomatics

B.A. Honours (20.0 credits)

A. Credits Included in the Major CGPA (10.0 credits)

1. 1.0 credit in: 1.0

GEOG 1010 [0.5]	Global Environmental Systems
GEOG 1020 [0.5]	People, Places and Environments

2. 2.5 credits in: 2.5

GEOM 1004 [0.5]	Maps, Satellites and the Geospatial Revolution
GEOM 2005 [0.5]	Introduction to Geospatial Programming
GEOG 2006 [0.5]	Introduction to Quantitative Research
or STAT 2507 [0.5]	Introduction to Statistical Modeling I
GEOM 2007 [0.5]	Points, Lines and Polygons
GEOM 2008 [0.5]	Pixels and Grids

3. 2.5 credits in: 2.5

GEOG 3000 [0.5]	Honours Field Course
or GEOG 3010 [0.5]	Field Methods in Physical Geography
GEOM 3002 [0.5]	Introduction to Remote Sensing
GEOG 3003 [0.5]	Quantitative Geography
GEOM 3005 [0.5]	Geospatial Analysis
GEOM 3007 [0.5]	Cartographic Theory and Design

4. 1.5 credits from: 1.5

GEOM 4001 [0.5]	Special Topics in Geomatics
GEOM 4003 [0.5]	Remote Sensing of the Environment
GEOM 4005 [0.5]	Directed Studies in Geomatics
GEOM 4008 [0.5]	Advanced Topics in Geographic Information Systems
GEOM 4009 [0.5]	Applications in Geographic Information Systems

5. 0.5 credit in: 0.5

a) Co-op students must complete:

0.5 cr in GEOG or GEOM at 4000-level, excluding GEOG 4406, GEOG 4408, GEOM 4406, GEOM 4408

b) All other students must complete:

GEOM 4406 [0.5] Practicum I (with placement in a Geomatics-related setting)

6. 1.0 credit in GEOG at the 2000-level or higher 1.0

7. 1.0 credit from: 1.0

a) Thesis pathway
GEOM 4909 [1.0] Honours Research Thesis

or

b) Course pathway
1.0 credit in GEOM or GEOG at the 4000-level

B. Credits not included in the Major CGPA (10.0 credits)

8. 8.0 credits in electives not in Geomatics 8.0

9. 2.0 credits in free electives. 2.0

Total Credits 20.0

Geomatics

B.Sc. Honours (20.0 credits)

A. Credits Included in the Major CGPA (10.5 credits)

1. 0.5 credit from: 0.5

GEOG 1010 [0.5]	Global Environmental Systems
ERTH 1006 [0.5]	Exploring Planet Earth

2. 3.5 credits in: 3.5

GEOM 1004 [0.5]	Maps, Satellites and the Geospatial Revolution
GEOG 2013 [0.5]	Weather and Water
GEOM 2005 [0.5]	Introduction to Geospatial Programming
GEOG 2006 [0.5]	Introduction to Quantitative Research
or STAT 2507 [0.5]	Introduction to Statistical Modeling I

GEOM 2007 [0.5]	Points, Lines and Polygons
GEOM 2008 [0.5]	Pixels and Grids
CIVE 2004 [0.5]	GIS, Surveying, CAD and BIM

3. 2.5 credits in: 2.5

GEOG 3000 [0.5]	Honours Field Course
or GEOG 3010 [0.5]	Field Methods in Physical Geography
GEOM 3002 [0.5]	Introduction to Remote Sensing
GEOG 3003 [0.5]	Quantitative Geography
GEOM 3005 [0.5]	Geospatial Analysis
GEOM 3007 [0.5]	Cartographic Theory and Design

4. 1.5 credits from: 1.5

GEOM 4001 [0.5]	Special Topics in Geomatics
GEOM 4003 [0.5]	Remote Sensing of the Environment
GEOM 4005 [0.5]	Directed Studies in Geomatics
GEOM 4008 [0.5]	Advanced Topics in Geographic Information Systems
GEOM 4009 [0.5]	Applications in Geographic Information Systems

5. 0.5 credit in: 0.5

a) Co-op students must complete:

0.5 cr in GEOM or GEOG at 4000-level, excluding GEOG 4406, GEOG 4408, GEOM 4406, GEOM 4408

b) All other students must complete:

GEOM 4406 [0.5] Practicum I

6. 1.0 credits in GEOG at the 2000-level or higher 1.0

7. 1.0 credit in: 1.0

GEOM 4906 [1.0] Honours Research Project

B. Credits Not Included in the Major CGPA (9.5 credits)

8. 1.0 credit in Experimental Science Electives 1.0

9. 1.0 credits in:		1.0
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1107 [0.5]	Linear Algebra I	
10. 1.0 approved credits in Computer Science		1.0
11. 2.0 credits in Science Continuation not in GEOM		2.0
12. 1.0 credit in Science Faculty Electives		1.0
13. 0.5 credit in:		0.5
NSCI 1000 [0.5]	Seminar in Science (or approved courses outside the faculties outside the faculties of Science and Engineering and Design)	
14. 1.5 credits in approved courses outside the faculties of Science and Engineering and Design		1.5
15. 1.5 credits in free electives		1.5
Total Credits		20.0

Minor in Geomatics (4.0 credits)

Only students pursuing undergraduate programs requiring at least 20.0 credits to graduate may be admitted to the minor in Geomatics.

Requirements

1. 0.5 credit in:		0.5
GEOM 1004 [0.5]	Maps, Satellites and the Geospatial Revolution	
2. 1.0 credit from:		1.0
GEOM 2005 [0.5]	Introduction to Geospatial Programming	
GEOM 2007 [0.5]	Points, Lines and Polygons	
GEOM 2008 [0.5]	Pixels and Grids	
3. 0.5 credit from:		0.5
GEOG 2006 [0.5]	Introduction to Quantitative Research	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
4. 1.5 credits from:		1.5
GEOM 3002 [0.5]	Introduction to Remote Sensing	
GEOG 3003 [0.5]	Quantitative Geography	
GEOM 3005 [0.5]	Geospatial Analysis	
GEOM 3007 [0.5]	Cartographic Theory and Design	
5. 0.5 credit from:		0.5
GEOM 4001 [0.5]	Special Topics in Geomatics	
GEOM 4003 [0.5]	Remote Sensing of the Environment	
GEOM 4005 [0.5]	Directed Studies in Geomatics	
GEOM 4008 [0.5]	Advanced Topics in Geographic Information Systems	
GEOM 4009 [0.5]	Applications in Geographic Information Systems	
6. The remaining requirements of the major discipline(s) and degree must be satisfied.		
Total Credits		4.0

Note: Familiarity with computers is assumed. Students with little computer experience may wish to take one of the following courses as part of their program of study:

BUSI 1402 [0.5]	Introduction to Business Information and Communication Technologies
-----------------	---

COMP 1001 [0.5]	Introduction to Computational Thinking for Arts and Social Science Students
-----------------	---

B.A. Regulations

The regulations presented below apply to all Bachelor of Arts programs. In addition to the requirements presented here, students must satisfy the University regulations common to all undergraduate students including the process of Academic Performance Evaluation (consult the Academic Regulations of the University section of this Calendar).

First-Year Seminars

B.A. degree students are strongly encouraged to include a First-Year Seminar (FYSM) during their first 4.0 credits of registration. Students are limited to 1.0 credit in FYSM and can only register in a FYSM while they have first-year standing in their B.A. program. Students who have completed the Enriched Support Program (ESP) or who are required to take a minimum of one English as a Second Language (ESLA) credit are not permitted to register in a FYSM.

Breadth Requirement

Among the credits presented at graduation, students in both the B.A. and the B.A. Honours degrees and B.Co.M.S. are required to include 3.0 breadth credits, including 1.0 credit from each of three of the four Breadth Areas identified below. Credits that fulfil requirements in the Major, Minor, Concentration or Specialization may be used to fulfil the Breadth Requirement.

Students admitted with a completed university degree are exempt from breadth requirements.

Students in the following interdisciplinary programs are exempt from the B.A. breadth requirement.

- African Studies
- Criminology and Criminal Justice
- Environmental Studies
- Human Rights
- Human Rights and Social Justice

Breadth Area 1: Culture and Communication

American Sign Language, Art History, Art and Culture, Communication and Media Studies, Comparative Literary Studies, Digital Humanities, English, Film Studies, French, Journalism, Media Production and Design, Music, Performance in Public Sphere, and Languages (Arabic, English as a Second Language, German, Greek, Hebrew, Indigenous Languages, Italian, Japanese, Korean, Latin, Mandarin, Portuguese, Russian, Spanish)

Subject codes: ARAB, ARTH, ASLA, CHIN, CLST, COMS, DIGH, ENGL, ESLA, FILM, FINS, FREN, GERM, GREK, HEBR, ITAL, JAPA, JOUR, KORE, LANG, LATN, MPAD, MUSI, PIPS, PORT, RUSS, SPAN

Breadth Area 2: Humanities

African Studies, Applied Linguistics and Discourse Studies, Archaeology, Canadian Studies, Child Studies, Classical Civilization, Critical Race Studies, Directed Interdisciplinary Studies, Disability Studies, Environmental

and Climate Humanities, European and Russian Studies, History, Human Rights, Humanities, Indigenous Studies, Latin American and Caribbean Studies, Linguistics, Medieval and Early Modern Studies, Philosophy, Religion, Sexuality Studies, South Asian Studies, and Women's and Gender Studies.

Subject codes: AFRI, ALDS, ARCY, CDNS, CHST, CLCV, CRST, DBST, DIST, EACH, EURR, HIST, HUMR, HUMS, INDG, LACS, LING, MEMS, PHIL, RELI, SAST, SXST, WGST

Breadth Area 3: Science, Engineering, and Design

Architecture, Biology, Chemistry, Computer Science, Earth Sciences, Engineering, Environmental Science, Food Science and Nutrition, Health Sciences, Industrial Design, Information Resource Management, Information Technology (BIT), Information Technology (ITEC), Interactive Multimedia and Design, Mathematics, Neuroscience, Network Technology, Optical Systems and Sensors, Photonics, Statistics, Physics, and Technology, Society, Environment.

Subject codes: AERO, ARCC, ARCH, ARCN, ARCS, ARCU, BIOC, BIOL, BIT, CHEM, CIVE, CMPS, COMP, ECOR, ELEC, ENSC, ENVE, ERTH, FOOD, HLTH, IDES, IMD, IRM, ISCI, ISCS, ISYS, ITEC, MAAE, MATH, MECH, NET, NEUR, NSCI, OSS, PHYS, PLT, SREE, STAT, SYSC, TSES

Breadth Area 4: Social Sciences

Anthropology, Business, Cognitive Science, Criminology and Criminal Justice, Economics, Environmental Studies, Geography, Geomatics, Global and International Studies, Global Politics, Interdisciplinary Public Affairs, International Affairs, Law, Migration and Diaspora Studies, Political Management, Political Science, Psychology, Public Administration, Public Affairs and Policy Management, Social Work, Sociology/Anthropology, Sociology

Subject codes: ANTH, BUSI, CGSC, CRCJ, ECON, ENST, GEOG, GEOM, GINS, GPOL, INAF, IPAF, LAWS, MGDS, PADM, PAMP, POLM, PSCI, PSYC, SOCI, SOWK

Declared and Undeclared Students

Degree students are considered "Undeclared" if they have been admitted to a degree but have not yet selected and been accepted into a program within that degree. The status "Undeclared" is available only in the B.A. and B.Sc. degrees. See the Open Studies program section of this Calendar for recommended registration information. Normally, Undeclared students are required to be eligible to enter a program within their degree before reaching second year standing. Undeclared students should consult Academic Advising Centre for guidance in planning their studies prior to registration.

Change of Program Within the B.A. Degree

Students may transfer to a program within the B.A. degree, if upon entry to the new program they would be in *Good Standing*. Other applications for change of program will be considered on their merits; students may be admitted to the new program in *Good Standing* or on Academic Warning. Students may apply to declare or change their program within the B.A. Degree at the

Registrar's Office according to the published deadlines. Acceptance into a program or into a program element or option is subject to any enrollment limitations, specific program, program element or option requirements, as published in the relevant Calendar entry.

Minors, Concentrations and Specializations

Students may apply to the Registrar's Office to be admitted to a minor, concentration or specialization during their first or subsequent years of study. Acceptance into a minor, concentration or specialization is subject to any specific requirements of the intended Minor, Concentration or Specialization as published in the relevant Calendar entry. Acceptance into a Concentration or Specialization requires that the student be in Good Standing.

Mention : Français

Students registered in certain B.A. programs may earn the notation *Mention : Français* by completing part of their requirements in French and by demonstrating a knowledge of the history and culture of French Canada. The general requirements are listed below. For more specific details consult the departmental program entries.

Students in a B.A. Honours program must present:

1. 1.0 credit in French language;
2. 1.0 credit devoted to the history and culture of French Canada;
3. 1.0 credit at the 2000- or 3000-level and 1.0 credit at the 4000-level in the Honours discipline taken in French.

Students in a B.A. program must present:

1. 1.0 credit in advanced French;
2. 1.0 credit devoted to the history and culture of French Canada;
3. 1.0 credit at the 2000- or 3000-level in the Major discipline taken in French.

Students in Combined Honours programs must fulfil the *Mention : Français* requirement in both disciplines.

Courses taught in French (Item 3, above) may be taken at Carleton, at the University of Ottawa on the Exchange Agreement, or at a francophone university on a Letter of Permission. Students planning to take courses on exchange or on a Letter of Permission should take careful note of the residence requirement for a minimum number of Carleton courses in their programs. Consult the *Academic Regulations of the University* section of this Calendar for information regarding study on Exchange or Letter of Permission.

B.Sc. Regulations

The regulations presented in this section apply to all Bachelor of Science programs. In addition to the requirements presented here, students must satisfy the University regulations common to all undergraduate students including the process of Academic Performance Evaluation (see the *Academic Regulations of the University* section of this Calendar).

Breadth Requirement for the B.Sc.

Students in a Bachelor of Science program must present the following credits at graduation:

1. 2.0 credits in Science Continuation courses not in the major discipline; **students completing a double major are considered to have completed this requirement providing they have 2.0 credits in science continuation courses in each of the two majors**
2. 2.0 credits in courses outside of the faculties of Science and Engineering and Design (but may include NSCI 1000)

In most cases, the requirements for individual B.Sc. programs, as stated in this Calendar, contain these requirements, explicitly or implicitly.

Students admitted to B.Sc. programs by transfer from another institution must present at graduation (whether taken at Carleton or elsewhere):

1. 2.0 credits in courses outside of the faculties of Science and Engineering and Design (but may include NSCI 1000) if, on transfer, the student received credit for fewer than 10.0 credits.
2. 1.0 credit in courses outside of the faculties of Science and Engineering and Design (but may include NSCI 1000) if, on transfer, the student received credit for 10.0 or more credits.

Declared and Undeclared Students

Students who are registered in a program within the degree are called Declared students. Most students designate a program of study when they first apply for admission and so begin their studies as Declared students. Students may also choose to begin their studies within the B.Sc. degree without being registered in a program. These students are referred to as Undeclared students. The recommended course pattern for Undeclared students is provided in the Undeclared entry of the Programs section of this Calendar. Undeclared students normally must apply to enter a program before beginning their second year of study. The Science Student Success Centre (SSSC) provides Undeclared students guidance to the appropriate support services in making this decision.

Change of Program within the B.Sc. Degree

Students may transfer to a program within the B.Sc. degree if upon entry to the new program they would be in good academic standing.

Other applications for change of program will be considered on their merits; students may be accepted in the new program in *Good Standing* or on *Academic Warning*.

Applications to declare or change their program within the B.Sc. Degree must be made online through Carleton Central by completing a Change of Program Elements (COPE) application form within the published deadlines. Acceptance into a program or into a program element or option is subject to any enrolment, and/or specific

program, program element or option requirements as published in the relevant Calendar entry.

Minors, Concentrations and Specializations

Students may add a minor, concentration or specialization by completing a Change of Program Elements (COPE) application form online through Carleton Central. Acceptance into a minor, concentration or specialization requires that the student be in *Good Standing* and is subject to any specific requirements of the intended Minor, Concentration or Specialization as published in the relevant Calendar entry.

Experimental Science Requirement

Students in a B.Sc. degree program must present at graduation at least two full credits of experimental science chosen from two different departments or institutes from the list below:

Approved Experimental Science Courses

Biochemistry	
BIOC 2200 [0.5]	Cellular Biochemistry
BIOC 4001 [0.5]	Methods in Biochemistry
BIOC 4201 [0.5]	Advanced Cell Culture and Tissue Engineering
Biology	
BIOL 1103 [0.5]	Foundations of Biology I
BIOL 1104 [0.5]	Foundations of Biology II
BIOL 2001 [0.5]	Animals: Form and Function
BIOL 2002 [0.5]	Plants: Form and Function
BIOL 2104 [0.5]	Introductory Genetics
BIOL 2200 [0.5]	Cellular Biochemistry
BIOL 2600 [0.5]	Ecology
Chemistry	
CHEM 1001 [0.5]	General Chemistry I
CHEM 1002 [0.5]	General Chemistry II
CHEM 1005 [0.5]	Elementary Chemistry I
CHEM 1006 [0.5]	Elementary Chemistry II
CHEM 2103 [0.5]	Physical Chemistry I
CHEM 2203 [0.5]	Organic Chemistry I
CHEM 2204 [0.5]	Organic Chemistry II
CHEM 2302 [0.5]	Analytical Chemistry I
CHEM 2303 [0.5]	Analytical Chemistry II
CHEM 2800 [0.5]	Foundations for Environmental Chemistry
Earth Sciences	
ERTH 1006 [0.5]	Exploring Planet Earth
ERTH 1009 [0.5]	The Earth System Through Time
ERTH 2102 [0.5]	Mineralogy to Petrology
ERTH 2404 [0.5]	Engineering Geoscience
ERTH 2802 [0.5]	Field Geology I
ERTH 3111 [0.5]	Vertebrate Evolution: Mammals, Reptiles, and Birds
ERTH 3112 [0.5]	Vertebrate Evolution: Fish and Amphibians
ERTH 3204 [0.5]	Mineral Deposits
ERTH 3205 [0.5]	Physical Hydrogeology
ERTH 3806 [0.5]	Structural Geology
Food Sciences	
FOOD 3001 [0.5]	Food Chemistry

FOOD 3002 [0.5]	Food Analysis
FOOD 3005 [0.5]	Food Microbiology
Geography	
GEOG 1010 [0.5]	Global Environmental Systems
GEOG 3108 [0.5]	Soil Properties
Neuroscience	
NEUR 3206 [0.5]	Sensory and Motor Neuroscience
NEUR 3207 [0.5]	Systems Neuroscience
NEUR 4600 [0.5]	Advanced Lab in Neuroanatomy
Physics	
PHYS 1001 [0.5]	Foundations of Physics I
PHYS 1002 [0.5]	Foundations of Physics II
PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics
PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion
PHYS 1007 [0.5]	Elementary University Physics I
PHYS 1008 [0.5]	Elementary University Physics II
PHYS 2202 [0.5]	Wave Motion and Optics
PHYS 2604 [0.5]	Modern Physics I
PHYS 3007 [0.5]	Third Year Physics Laboratory: Selected Experiments and Seminars
PHYS 3606 [0.5]	Modern Physics II
PHYS 3608 [0.5]	Modern Applied Physics

Course Categories for B.Sc. Programs

Science Geography Courses

GEOG 1010 [0.5]	Global Environmental Systems
GEOG 2006 [0.5]	Introduction to Quantitative Research
GEOG 2013 [0.5]	Weather and Water
GEOG 2014 [0.5]	The Earth's Surface
GEOG 3003 [0.5]	Quantitative Geography
GEOG 3010 [0.5]	Field Methods in Physical Geography
GEOG 3102 [0.5]	Geomorphology
GEOG 3103 [0.5]	Watershed Hydrology
GEOG 3104 [0.5]	Principles of Biogeography
GEOG 3105 [0.5]	Climate and Atmospheric Change
GEOG 3106 [0.5]	Aquatic Science and Management
GEOG 3108 [0.5]	Soil Properties
GEOG 4000 [0.5]	Field Studies
GEOG 4005 [0.5]	Directed Studies in Geography
GEOG 4013 [0.5]	Cold Region Hydrology
GEOG 4017 [0.5]	Global Biogeochemical Cycles
GEOG 4101 [0.5]	Two Million Years of Environmental Change
GEOG 4103 [0.5]	Water Resources Engineering
GEOG 4104 [0.5]	Microclimatology
GEOG 4108 [0.5]	Permafrost

Science Psychology Courses

PSYC 2001 [0.5]	Introduction to Research Methods in Psychology
PSYC 2002 [0.5]	Introduction to Statistics in Psychology
PSYC 2700 [0.5]	Introduction to Cognitive Psychology

PSYC 3000 [1.0]	Design and Analysis in Psychological Research
PSYC 3506 [0.5]	Cognitive Development
PSYC 3700 [1.0]	Cognition (Honours Seminar)
PSYC 3702 [0.5]	Perception
PSYC 2307 [0.5]	Human Neuropsychology I
PSYC 3307 [0.5]	Human Neuropsychology II

Science Continuation Courses

A course at the 2000 level or above may be used as a Science Continuation credit in a B.Sc. program if it is not in the student's major discipline, and is chosen from the following:

BIOC (Biochemistry)
BIOL (Biology)
CHEM (Chemistry)
COMP (Computer Science) A maximum of two half-credits at the 1000-level in COMP, excluding COMP 1001 may be used as Science Continuation credits.
ERTH (Earth Sciences), except EARTH 2415 which may be used only as a free elective for any B.Sc. program. Students in Earth Sciences programs may use EARTH 2401, EARTH 2402, and EARTH 2403 only as free electives.
Engineering. Students wishing to register in Engineering courses must obtain the permission of the Faculty of Engineering and Design.
ENSC (Environmental Science)
FOOD (Food Science and Nutrition)
GEOM (Geomatics)
HLTH (Health Sciences)
ISAP (Interdisciplinary Science Practice)
MATH (Mathematics)
NEUR (Neuroscience)
PHYS (Physics), except PHYS 2903
Science Geography Courses (see list above)
Science Psychology Courses (see list above)
STAT (Statistics)
TSES (Technology, Society, Environment) except TSES 2305. Biology students may use these courses only as free electives. Integrated Science and Environmental Science students may include these courses in their programs but may not count them as part of the Science Sequence.

Science Faculty Electives

Science Faculty Electives are courses at the 1000-4000 level chosen from:

BIOC (Biochemistry)
BIOL (Biology) Biology & Biochemistry students may use BIOL 1010 and BIOL 2005 only as free electives
CHEM (Chemistry) except CHEM 1003, CHEM 1004 and CHEM 1007
COMP (Computer Science) except COMP 1001
ERTH (Earth Sciences) except EARTH 1010, EARTH 1011 and EARTH 2415. Earth Sciences students may use EARTH 2401, EARTH 2402, and EARTH 2403 only as free electives.
Engineering
ENSC 2001
FOOD (Food Science and Nutrition)

GEOM (Geomatics)
 HLTH (Health Science)
 ISAP (Interdisciplinary Science Practice)
 MATH (Mathematics)
 NEUR (Neuroscience)
 PHYS (Physics) except PHYS 1901, PHYS 1902, PHYS 1905, PHYS 2903
 Science Geography (see list above)
 Science Psychology (see list above)
 STAT (Statistics)
 TSES (Technology, Society, Environment) Biology students may use these courses only as free electives.

Advanced Science Faculty Electives

Advanced Science Faculty Electives are courses at the 2000-4000 level chosen from the Science Faculty Electives list above.

Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)

All courses offered by the Faculty of Arts and Social Sciences, the Faculty of Public Affairs, and the Sprott School of Business are approved as Arts or Social Sciences courses EXCEPT FOR: All Science Geography courses (see list above), all Geomatics (GEOM) courses, all Science Psychology courses (see list above). NSCI 1000 may be used as an Approved Course Outside the Faculties of Science and Engineering and Design.

Free Electives

Any course is allowable as a Free Elective providing it is not prohibited (see below). Students are expected to comply with prerequisite requirements and enrolment restrictions for all courses as published in this Calendar.

Courses Allowable Only as Free Electives in any B.Sc. Program

BIOL 4810 [0.5]	Education Research in Biology
CHEM 1003 [0.5]	The Chemistry of Food, Health and Drugs
CHEM 1004 [0.5]	Drugs and the Human Body
CHEM 1007 [0.5]	Chemistry of Art and Artifacts
ERTH 1010 [0.5]	Our Dynamic Planet Earth
ERTH 1011 [0.5]	Evolution of the Earth
ERTH 2415 [0.5]	Natural Disasters
ISCI 1001 [0.5]	Introduction to the Environment
ISCI 2000 [0.5]	Natural Laws
ISCI 2002 [0.5]	Human Impacts on the Environment
MATH 0107 [0.5]	Algebra and Geometry
PHYS 1901 [0.5]	Planetary Astronomy
PHYS 1902 [0.5]	From our Star to the Cosmos
PHYS 1905 [0.5]	Physics Behind Everyday Life
PHYS 2903 [0.5]	Physics Towards the Future

Prohibited Courses

The following courses are not acceptable for credit in any B.Sc. program:

COMP 1001 [0.5]	Introduction to Computational Thinking for Arts and Social Science Students
MATH 0005 [0.5]	Precalculus: Functions and Graphs

MATH 0006 [0.5]	Precalculus: Trigonometric Functions and Complex Numbers
MATH 1009 [0.5]	Mathematics for Business
MATH 1119 [0.5]	Linear Algebra: with Applications to Business
MATH 1401 [0.5]	Elementary Mathematics for Economics I
MATH 1402 [0.5]	Elementary Mathematics for Economics II

Co-operative Education

For more information about how to apply for the Co-op program and how the Co-op program works please visit the Co-op website.

All students participating in the Co-op program are governed by the Undergraduate Co-operative Education Policy.

Undergraduate Co-operative Education Policy Admission Requirements

Students can apply to co-op in one of two ways; directly from high school or after beginning a degree program at Carleton.

If a student is admitted to co-op from high school, their grades will be reviewed two terms to one year prior to their first work term to ensure they continue to meet the academic requirements after their 1st or 2nd year of study. The time at which evaluation takes place depends on the program of study. Students will automatically be notified via their Carleton email account if they are permitted to continue.

Students not admitted to Carleton University with the co-op option on their degree can apply for admission via the co-operative education program website. To view application deadlines, visit carleton.ca/co-op.

Admission to the co-op option is based on the completion of 5.0 or more credits at Carleton University, the CGPA requirement for the students' academic program as well as any course prerequisites. The articulated CGPA for each program is the normal standard for assessment. Please see the specific degree program sections for the unique admission and continuation requirements for each academic program.

Participation Requirements

COOP 1000

Once a student has been given admission or continuation confirmation to the co-op option s/he must complete and pass COOP 1000 (a mandatory online 0.0 credit course). Students will have access to this course a minimum of two terms prior to their first work term and will be notified when to register.

Communication with the Co-op Office

Students must maintain contact with the co-op office during their job search and while on a work term. All email communication will be conducted via the students' Carleton email account.

Employment

Although every effort is made to ensure a sufficient number of job postings for all students enrolled in the co-op option of their degree program, no guarantee of employment can be made. Carleton's co-op program operates a competitive job search process and is dependent upon current market conditions. Academic performance, skills, motivation, maturity, attitude and potential will determine whether a student is offered a job. It is the student's responsibility to actively conduct a job search in addition to participation in the job search process operated by the co-op office. Once a student accepts a co-op job offer (verbally or written), his/her job search will end and access to co-op jobs will be removed for that term. Students that do not successfully obtain a co-op work term are expected to continue with their academic studies. The summer term is the exception to this rule. Students should also note that hiring priority is given to Canadian citizens for co-op positions in the Federal Government of Canada.

Registering in Co-op Courses

Students will be registered in a Co-op Work Term course while at work. The number of Co-op Work Term courses that a student is registered in is dependent upon the number of four-month work terms that a student accepts.

While on a co-op work term students may take a maximum of 0.5 credit throughout each four-month co-op work term. Courses must be scheduled outside of regular working hours.

Students must be registered as full-time before they begin their co-op job search (2.0 credits). All co-op work terms must be completed before the beginning of the final academic term. Students may not finish their degree on a co-op work term.

Work Term Assessment and Evaluation

To obtain a Satisfactory grade for the co-op work term students must have:

1. A satisfactory work term evaluation by the co-op employer;
2. A satisfactory grade on the work term report.

Students must submit a work term report at the completion of each four-month work term. Reports are due on the 16th of April, August, and December and students are notified of due dates through their Carleton email account.

Workplace performance will be assessed by the workplace supervisor. Should a student receive an unsatisfactory rating from their co-op employer, an investigation by the co-op program manager will be undertaken. An unsatisfactory employer evaluation does not preclude a student from achieving an overall satisfactory rating for the work term.

Graduation with the Co-op Designation

In order to graduate with the co-op designation, students must satisfy all requirements for their degree program in addition to the requirements according to each co-op program (i.e. successful completion of three or four work terms).

Note: Participation in the co-op option will add up to one additional year for a student to complete their degree program.

Voluntary Withdrawal from the Co-op Option

Students may withdraw from the co-op option of their degree program during a study term ONLY. Students at work may not withdraw from the work term or the co-op option until s/he has completed the requirements of the work term.

Students are eligible to continue in their regular academic program provided that they meet the academic standards required for continuation.

Involuntary or Required Withdrawal from the Co-op Option

Students may be required to withdraw from the co-op option of their degree program for one or any of the following reasons:

1. Failure to achieve a grade of SAT in COOP 1000
2. Failure to pay all co-op related fees
3. Failure to actively participate in the job search process
4. Failure to attend all interviews for positions to which the student has applied
5. Declining more than one job offer during the job search process
6. Continuing a job search after accepting a co-op position
7. Dismissal from a work term by the co-op employer
8. Leaving a work term without approval by the Co-op manager
9. Receipt of an unsatisfactory work term evaluation
10. Submission of an unsatisfactory work term report

Standing and Appeals

The Co-op and Career Services office administers the regulations and procedures that are applicable to all co-op program options. All instances of a student's failure during a work term or other issues directly related to their participation in the co-op option will be reported to the academic department.

Any decision made by the Co-op and Career Services office can be appealed via the normal appeal process within the University.

International Students

All International Students are required to possess a Co-op Work Permit issued by Immigration, Refugees and Citizenship Canada before they can begin working. It is illegal to work in Canada without the proper authorization. Students will be provided with a letter of support to accompany their application. Students must submit their application for their permit before being permitted to view and apply for jobs on the Co-op Services database. Confirmation of a position will not be approved until a student can confirm they have received their permit. Students are advised to discuss the application process and requirements with the International Student Services Office.

B.A. Honours, B.Sc. Honours Geomatics: Co-op Admission and Continuation Requirements

- Maintain full-time status in each study term (2.0 credits);
- Be eligible to work in Canada (for off-campus work)
- Have successfully completed COOP 1000 [0.0]

In addition to the following:

1. Registered in the Bachelor of Arts Honours or Bachelor of Science Honours in Geomatics;
2. Obtained and maintained an overall minimum CGPA of 9.5 and a major CGPA of 9.5;
3. Have obtained third-year standing;
4. Successfully completed, by the start-date of the first work term:
 - a. the required second-year methods courses in their program (GEOG 2005/ENST 2005, GEOG 2006/ENST 2006)
 - b. the required field course in their program (ENST 3900/GEOG 3000/GEOG 3010/GEOG 3030)
5. Be registered as a full-time student.

B.A. and B.Sc. Honours Geomatics students must successfully complete three (3) work terms to obtain the co-op designation.

Work Term Course: GEOM 3999

Work/Study Pattern:

Year 1		Year 2		Year 3		Year 4		Year 5	
Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern
Fall	S	Fall	S	Fall	S	Fall	S/W	Fall	O
Winter	S	Winter	S	Winter	S	Winter	S/W	Winter	S
Summer		Summer		Summer	W	Summer	S/W		

Legend

S: Study

W: Work

O: Optional

* indicates recommended work study pattern

** student finds own employer for this work-term.

Admissions Information

Admission Requirements are for the 2021-22 year only, and are based on the Ontario High School System. Holding the minimum admission requirements only establishes eligibility for consideration. The cut-off averages for admission may be considerably higher than the minimum. See also the **General Admission and Procedures** section of this Calendar. An overall average of at least 70% is normally required to be considered for admission. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. The overall average required for admission is determined each year on a program by program basis. Consult admissions.carleton.ca for further details.

Note: Courses listed as *recommended* are not mandatory for admission. Students who do not follow

the recommendations will not be disadvantaged in the admission process.

Admission Requirements

Degrees

- Bachelor of Arts (B.A.)(Honours)
- Bachelor of Arts (B.A.)

First Year

For B.A. and B.A. (Honours)

The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. The six 4U or M courses must include a 4U course in English (or *anglais*). For applicants whose first language is not English, the requirement of English can also be met under the conditions outlined in the section “English Language Requirements” in the Admissions Requirements and Procedures section of this Calendar.

The cut-off average for admission will be set annually and will normally be above the minimum requirement. Applicants falling slightly below the cut-off average will be considered on an individual basis to determine whether there are special circumstances that would permit their admission. Students who feel that their high school grade average does not reflect their potential may apply to the Enriched Support Program (see the Enriched Support Program section of this Calendar).

Advanced Standing

B.A. and B.A. (Honours) Program

Applications for admission to the second or subsequent years will be assessed on their merits. Advanced standing will be granted only for those courses that are determined to be appropriate.

Admissions Information

Admission Requirements are for the 2021-22 year only, and are based on the Ontario High School System. Holding the minimum admission requirements only establishes eligibility for consideration. The cut-off averages for admission may be considerably higher than the minimum. See also the **General Admission and Procedures** section of this Calendar. An overall average of at least 70% is normally required to be considered for admission. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. The overall average required for admission is determined each year on a program by program basis. Consult admissions.carleton.ca for further details.

Note: Courses listed as *recommended* are not mandatory for admission. Students who do not follow the recommendations will not be disadvantaged in the admission process.

Degrees

- B.Sc. (Honours)
- B.Sc. (Major)
- B.Sc.

Admission Requirements

B. Sc. Honours Program

First Year

The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. For most programs including Biochemistry, Bioinformatics, Biotechnology, Chemistry, Combined Honours in Biology and Physics, Chemistry and Physics, Computational Biochemistry, Food Science, Nanoscience, Neuroscience, Neuroscience and Mental Health, and Psychology, the six 4U or M courses must include Advanced Functions and two of Biology, Chemistry, Earth and Space Sciences or Physics. (Calculus and Vectors is strongly recommended).

Specific Honours Admission Requirements

For the Honours programs in Earth Sciences, Environmental Science, Geomatics, Interdisciplinary Science and Practice, and Physical Geography, Calculus and Vectors may be substituted for Advanced Functions.

For the Honours programs in Physics and Applied Physics and for double Honours in Mathematics and Physics, Calculus and Vectors is required in addition to Advanced Functions and one of 4U Physics Chemistry, Biology, or Earth and Space Sciences. For all programs in Physics, 4U Physics is strongly recommended.

For the Combined Honours program in Chemistry and Computer Science, 4U Chemistry and Calculus and Vectors are strongly recommended.

For Honours in Psychology, a 4U course in English is recommended.

For Honours in Environmental Science, a 4U course in Biology and Chemistry is recommended.

Advanced Standing

For entry to an Honours program after the completion of 5.0 included credits, a student must have a major CGPA of 5.50 or higher, an overall CGPA of 4.50 or higher and the recommendation of the Honours department or committee. A student beginning the final 10.0 credits towards an Honours degree must present a major CGPA of 6.00 or higher, an overall CGPA of 5.00 or higher and the recommendation of the Honours department or committee. A student beginning the final 5.0 credits towards an Honours degree must present a major CGPA of 6.50 or higher and an overall CGPA of 5.00 or higher, as calculated for graduation. Advanced standing will be granted for studies undertaken elsewhere when these are recognized as the equivalent of subjects offered at Carleton University.

B.Sc. Major Program

B.Sc. Program

First Year

The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. The six 4U or M courses must include Advanced Functions and two of Calculus and Vectors, Biology, Chemistry, Earth and Space Science or Physics (Calculus and Vectors is strongly recommended). For the B.Sc. Major in Physics, 4U Physics is strongly recommended. Equivalent courses may be substituted between the old and new Ontario mathematics curriculum.

Advanced Standing

For entry to a B.Sc. or B.Sc. Major program after the completion of 5.0 included credits, a student must have a major and core CGPA of 3.50 or higher and an overall CGPA of 3.50 or higher. A student beginning the final 5.0 credits towards a B.Sc. or B.Sc. Major degree must present a major and core CGPA of 4.00 or higher and an overall CGPA of 4.00 or higher, as calculated for graduation. Advanced standing will be granted for studies undertaken elsewhere when these are recognized as the equivalent of subjects offered at Carleton University.

Co-op Option

Direct Admission to the First Year of the Co-op Option

Applicants must:

1. meet the required overall admission cut-off average and prerequisite course average. These averages may be higher than the stated minimum requirements;
2. be registered as a full-time student in the Bachelor of Science Honours program;
3. be eligible to work in Canada (for off-campus work placements).

Note that meeting the above requirements only establishes eligibility for admission to the program. The prevailing job market may limit enrolment in the co-op option.

Note: continuation requirements for students previously admitted to the co-op option and admission requirements for the co-op option after beginning the program are described in the Co-operative Education Regulations section of this Calendar.

Geomatics (GEOM) Courses

GEOM 1004 [0.5 credit]

Maps, Satellites and the Geospatial Revolution

Introduction to the creation and use of maps using a variety of geospatial tools to better understand and resolve physical, social and environmental problems. Overview of geomatics (cartography and map design, geographic information systems, GPS, remote sensing).

Includes: Experiential Learning Activity

Also listed as EARTH 2004.

Precludes additional credit for GEOM 2004 (no longer offered).

Lectures and laboratory, four hours a week.

GEOM 2005 [0.5 credit]**Introduction to Geospatial Programming**

Computer programming for geomatics students focusing on storage, manipulation, management, visualization and analysis of geospatial data; Essential coding concepts and best practices including variables, loops, and conditional statements; programmatic handling of raster and vector data structures; batch geoprocessing and map production; GIS tool customization.

Includes: Experiential Learning Activity

Lectures and laboratory, four hours per week.

GEOM 2007 [0.5 credit]**Points, Lines and Polygons**

Storage, visualization, manipulation and analysis of vector geospatial data. Vector geoprocessing including buffering, overlays and topological analysis; feature classification and cartographic representation; managing coordinate reference systems for vector layers; selected applications of vector GIS such as urban planning, environmental and resource management and socio-economic mapping.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 1004 or permission of the Department.

Lectures and laboratory, four hours a week.

GEOM 2008 [0.5 credit]**Pixels and Grids**

Storage, visualization, manipulation, and analysis of gridded geospatial data; 3D raster visualization; digital terrain analysis; interpolation and filtering; raster geoprocessing and projections; selected topics in raster GIS such as least-cost path analysis, natural hazard assessment, pollution mapping, hotspot analysis for crime and disease mapping.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 1004 or permission of the Department.

Lectures and laboratory, four hours per week.

GEOM 3002 [0.5 credit]**Introduction to Remote Sensing**

Principles and methods of remote sensing; visual interpretation of air photos and satellite imagery; digital image processing, analysis and classification for thematic mapping; introduction to various active and passive remote sensing imagery types such as optical, hyperspectral, RADAR and LiDAR.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 2008 and third-year standing, or permission of the Department.

Lectures two hours a week, laboratory two hours a week.

GEOM 3005 [0.5 credit]**Geospatial Analysis**

An advanced course in geospatial analysis theory and practice; geoprocessing; geo-visualization; geostatistics; spatial modelling; working with spatio-temporal data structures; advanced site-suitability and network analysis; intermediate GIS tool customization.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 2007 and GEOM 2008.

Lecture and laboratories five hours a week.

GEOM 3007 [0.5 credit]**Cartographic Theory and Design**

Principles of and issues in cartography, cartographic communication and map design; practical aspects of cartographic representation using multimedia and online/interactive mapping.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 2007 or GEOM 2008 or permission of the Department.

Lectures and laboratory four hours a week.

GEOM 3999 [0.0 credit]**Co-operative Work Term**

Includes: Experiential Learning Activity

GEOM 4001 [0.5 credit]**Special Topics in Geomatics**

A seminar focusing on selected topics in geomatics including advanced theory and/or application.

Includes: Experiential Learning Activity

Prerequisite(s): fourth-year Honours standing in Geomatics or permission of the department.

Laboratory or seminar three hours a week.

GEOM 4003 [0.5 credit]**Remote Sensing of the Environment**

Advanced image enhancement; land cover classification for thematic mapping; biophysical modeling; applications in resources, environment, and urban mapping.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 3002 and Honours standing, or permission of the Department.

Lectures two hours a week, laboratory two hours a week.

GEOM 4005 [0.5 credit]**Directed Studies in Geomatics**

Students pursue their interest in a selected theme in Geomatics on a tutorial basis with a member of the Department.

Prerequisite(s): permission of the Department.

GEOM 4008 [0.5 credit]**Advanced Topics in Geographic Information Systems**

Advanced methods and techniques in GIS applications including: positional and attribute error analysis, multiple criteria decision making, interpolation, elevation modeling and ortho-imaging, and spatial pattern measurement.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 3005 and Honours standing.

Lectures two hours a week, laboratory two hours a week.

GEOM 4009 [0.5 credit]**Applications in Geographic Information Systems**

Project design and customization, application development within a GIS, digital atlas compilation and geomatics education.

Includes: Experiential Learning Activity

Prerequisite(s): GEOM 3005 and (COMP 1006 or GEOG 3003), or permission of the department.

Workshop three hours a week.

GEOM 4406 [0.5 credit]**Practicum I**

Experience in an employment environment through field placement. Observation and involvement in issues and research methods used by professional geographers. May be taken for credit in addition to GEOG/GEOM 4408.

Includes: Experiential Learning Activity

Also listed as GEOG 4406.

Prerequisite(s): fourth-year Honours standing in Geomatics or Geography and permission of the Department.

Field placement one day a week.

GEOM 4408 [0.5 credit]**Practicum II**

Experience in an employment environment through field placement. Observation and involvement in issues and research methods used by professional geographers. May be taken for credit in addition to GEOG/GEOM 4406.

Includes: Experiential Learning Activity

Also listed as GEOG 4408.

Prerequisite(s): fourth-year Honours standing in Geomatics or Geography and permission of the Department.

Field placement one day a week.

GEOM 4906 [1.0 credit]**Honours Research Project**

Candidates for B.Sc. with Concentration in Geomatics undertake a research project within their area of specialization. The project is supervised by a member of the department and a written report must be submitted. The candidate may be examined orally on the report.

Includes: Experiential Learning Activity

Precludes additional credit for GEOG 4904/GEOM 4904 (no longer offered), GEOG 4906, GEOG 4909, GEOM 4909, ENST 4906, and ENST 4907.

Prerequisite(s): fourth-year Honours standing in BSc Geomatics, and an approved research topic and adviser.

Hours to be arranged with faculty adviser.

GEOM 4909 [1.0 credit]**Honours Research Thesis**

Independent design and implementation of a research project leading to the submission of a research thesis. Students work with an individual faculty adviser. The subject for research is decided upon in consultation with the supervisor.

Includes: Experiential Learning Activity

Precludes additional credit for GEOG 4904 / GEOM 4904 (no longer offered), GEOG 4906, GEOM 4906, GEOG 4909, ENST 4906 and ENST 4907.

Prerequisite(s): fourth-year Honours standing in B.A. Geomatics, a minimum CGPA of 9.00 in the major or permission of the Department, and an approved research topic and adviser.

Hours to be arranged with faculty adviser.