2020-2021 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, the Fall Semester 2020 and the Winter Semester 2021.

For your convenience the Undergraduate Calendar is available in PDF format.

If you wish to link to the Undergraduate Calendar please refer to the Linking Guidelines.

The University is a full member of:

- Universities Canada

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February 4, 2020	Initial Publication
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Disclaimer

University of Guelph 2020

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, the Fall Semester 2020 and the Winter Semester 2021.

The University reserves the right to change without notice any information contained in this calendar, including but not limited to that related to tuition and other fees, standards of admission, course delivery or format, continuation of study, and the offering or requirements for the granting of, degrees or diplomas in any or all of its programs. The publication of this calendar does not bind the University to the provision of courses, programs, schedules of study, or facilities as listed herein.

The University will not be liable for any failure or delay in performance arising out of any cause or causes beyond its reasonable control. Such causes may include but are not limited to fire, strike, lock-out, inability to procure materials or trades, war, mass-casualty event, flood, local, regional or global outbreak of disease or other public health emergency, social distancing or quarantine restriction, legislative or regulatory requirements, unusually severe weather, failure of public utility or common carrier, or attacks or other malicious act, including but not limited to attacks on or through the internet, or any internet service, telecommunications provider or hosting facility.

In March 2020 the World Health Organization declared a global pandemic of the virus leading to COVID-19. The Governments of Canada, the Province of Ontario, and local Governments responded to the pandemic with legislative amendments, controls, orders, by-laws, requests and requirements (collectively, the “Governmental Response”). It is uncertain how long the pandemic, and the related Governmental Response, will continue, and it is unknown whether there may be a resurgence of the virus leading to COVID-19 or any mutation thereof (collectively, the “Virus”) and resulting or supplementary renewed Government Response. Without limiting the foregoing paragraph, the University shall not be liable for costs associated with any failure or delay in performance arising out of:

a. the continued spread of the Virus;

b. the continuation of or renewed Governmental Response to control the spread of the Virus; and

c. a University decision, made on an organization-wide basis and in good faith, to control the spread of the Virus, even if exceeding the then current specific Government Response.

In particular, the COVID-19 pandemic may necessitate a revision of the format of course offerings such that courses are offered in whole or in part on an alternate delivery model to in-person classes. Tuition and mandatory fees have been set regardless of the method of instruction and will not be refunded in the event instruction occurs remotely for any part of the academic year.

Dates or times of performance including the Schedule of Dates may be extended as appropriate and the University will notify students promptly of the existence and nature of such delay and shall, so far as practicable, use reasonable efforts to minimize and mitigate any such delay or non-performance.

In the event of a discrepancy between a print version (downloaded) and the Web version, the Web version will apply,

Published by: Enrolment Services

Introduction

Collection, Use and Disclosure of Personal Information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. Certain personal information is disclosed to external agencies, including the Ontario Universities Application Centre, the Ministry of Training, Colleges and Universities, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registrarial Services Departmental Policy on the Release of Student Information. For details on the use and disclosure of this information call the Office of Registrarial Services at the University at (519) 824-4120 or see http://www.uoguelph.ca/registrar/registrar/index.cfm?index.

Disclosure of Personal Information to the Ontario Ministry of Colleges and Universities

The University of Guelph is required to disclose personal information such as characteristics and educational outcomes to the Minister of Colleges and Universities under s. 15 of the Ministry of Training, Colleges and Universities Act, R.S.O. 1990, Chapter M.19, as amended. The Ministry collects this data for purposes including but not limited to planning, allocating and administering public funding to colleges, universities and other post-secondary educational and training institutions.

Amendments made to the Ministry of Training, Colleges and Universities Act, authorizing the collection and use of personal information from colleges and universities by the Minister which were set out in Schedule 5 of the Childcare Modernization Act, 2014, came into force on March 31, 2015.

The amendments strengthen the ability of the Minister to directly or indirectly collect and use personal information about students as required to conduct research and analysis, including longitudinal studies, and statistical activities conducted by or on behalf of the Ministry for purposes that relate to post-secondary education and training, including,

i. understanding the transition of students from secondary school to post-secondary education and training,
ii. understanding student participation and progress, mobility and learning and employment outcomes,
iii. understanding linkages among universities, colleges, secondary schools and other educational and training institutions prescribed by regulation,
iv. understanding trends in post-secondary education or training program choices made by students,
v. understanding sources and patterns of student financial resources, including financial assistance and supports provided by government and post-secondary educational and training institutions,
vi. planning to enhance the affordability and accessibility of post-secondary education and training and the quality and effectiveness of the post-secondary sector,
vii. identifying conditions or barriers that inhibit student participation, progress, completion and transition to employment or future post-secondary educational or training opportunities, and
viii. developing key performance indicators.

Information that the University is required to provide includes but is not limited to: first, middle and last name, Ontario Educational Number, citizenship, date of birth, gender, first three digits of a student’s postal code, mother tongue, degree program and major(s) in which the student is enrolled, year of study and whether the student has transferred from another institution.

Further information on the collection and use of student-level enrolment-related data can be obtained from the Ministry of Colleges and Universities website: https://www.ontario.ca/page/ministry-colleges-universities (English) or https://www.ontario.ca/fr/page/ministere-des-colleges-et-universites (French) or by writing to the Director, Postsecondary Finance and Information Management Branch, Postsecondary Education Division, 7th Floor, Mowat Block, 900 Bay Street, Toronto, ON M7A 1L2.

An update on Institutional and Ministry of Training, Colleges and Universities Act Notice of Disclosure Activities is posted at https://www.ontario.ca/page/ministry-colleges-universities

Frequently Asked Questions related to the Ministry’s enrolment and OEN data activities are also posted at: http://www.tcu.gov.on.ca/pepg/publications/NoticeOfCollection.pdf

Authority to Disclose Personal Information to Statistics Canada

The Ministry of Colleges and Universities discloses student-level enrolment-related data it collects from the colleges and universities as required by Statistics Canada in accordance with Section 13 of the Federal Statistics Act. This gives the Ministry authority to disclose personal information in accordance with s. 42(1) (e) of FIPPA

Notification of Disclosure of Personal Information to Statistics Canada

For further information, please see the Statistics Canada's website at http://www.statcan.ca and Section XIV Statistics Canada.

Address for University Communication

Depending on the nature and timing of the communication, the University may use one of these addresses to communicate with students. Students are, therefore, responsible for checking all of the following on a regular basis:

Email Address

The University issued email address is considered an official means of communication with the student and will be used for correspondence from the University. Students are responsible for monitoring their University-issued email account regularly. See Section I--Statement of Students' Academic Responsibilities for more information.

Home Address

Students are responsible for maintaining a current mailing address with the University. Address changes can be made, in writing, through Enrolment Services.

Name Changes

The University of Guelph is committed to the integrity of its student records, therefore, each student is required to provide either on application for admission or on personal data forms required for registration, the student's complete, legal name. Any requests to change a name, by means of alteration, deletion, substitution or addition, must be accompanied by appropriate supporting documentation.

Student Confidentiality and Release of Student Information Policy Excerpt

The University undertakes to protect the privacy of each student and the confidentiality of the student's record. To this end the University shall refuse to disclose personal information to any person other than the individual to whom the information relates where disclosure would constitute an unjustified invasion of the personal privacy of that person or of any other individual. All members of the University community must respect the confidential nature of the student information which they acquire in the course of their work.

Complete policy at https://uoguelph.civicweb.net/document/68892/ORSInfoReleasePolicy060610.pdf?handle=FF982F8A9AEA4076BE4F3D88147172B8.

Learning Outcomes

On December 5, 2012, the University of Guelph Senate approved five University-wide Learning Outcomes as the basis from which to guide the development of undergraduate degree programs, specializations and courses:

1. Critical and Creative Thinking
2. Literacy
3. Global Understanding
4. Communicating
5. Professional and Ethical Behaviour

These learning outcomes are also intended to serve as a framework through which our educational expectations are clear to students and the broader public; and to inform the process of outcomes assessment through the quality assurance process (regular reviews) of programs and departments.

An on-line guide to the learning outcomes, links to the associated skills, and detailed rubrics designed to support the development and assessment of additional program and discipline-specific outcomes, are available for reference on the Learning Outcomes website.

1. Critical and Creative Thinking

Critical and creative thinking is a concept in which one applies logical principles, after much inquiry and analysis, to solve problems with a high degree of innovation, divergent thinking and risk taking. Those mastering this outcome show evidence of integrating knowledge and applying this knowledge across disciplinary boundaries. Depth and breadth of understanding of disciplines is essential to this outcome.

In addition, **Critical and Creative Thinking** includes, but is not limited to, the following outcomes: **Inquiry and Analysis; Problem Solving; Creativity; and Depth and Breadth of Understanding.**

2. Literacy

Literacy is the ability to extract information from a variety of resources, assess the quality and validity of the material, and use it to discover new knowledge. The comfort in using quantitative literacy also exists in this definition, as does using technology effectively and developing visual literacy.

In addition, **Literacy** includes, but is not limited to, the following outcomes: **Information Literacy, Quantitative Literacy, Technological Literacy, and Visual Literacy.**

3. Global Understanding:

Global understanding encompasses the knowledge of cultural similarities and differences, the context (historical, geographical, political and environmental) from which these arise, and how they are manifest in modern society. Global understanding is exercised as civic engagement, intercultural competence and the ability to understand an academic discipline outside of the domestic context.

In addition, **Global Understanding** includes, but is not limited to, the following outcomes: **Global Understanding, Sense of Historical Development, Civic Knowledge and Engagement, and Intercultural Competence.**

4. Communicating

Communicating is the ability to interact effectively with a variety of individuals and groups, and convey information successfully in a variety of formats including oral and written communication. Communicating also comprises attentiveness and listening, as well as reading comprehension. It includes the ability to communicate and synthesize information, arguments, and analyses accurately and reliably.

In addition, **Communicating** includes, but is not limited to, the following outcomes: **Oral Communication, Written Communication, Reading Comprehension, and Integrative Communication.**

5. Professional and Ethical Behaviour

Professional and ethical behaviour requires the ability to accomplish the tasks at hand with proficient skills in teamwork and leadership, while remembering ethical reasoning behind all decisions. The ability for organizational and time management skills is essential in bringing together all aspects of managing self and others. Academic integrity is central to mastery in this outcome.

In addition, **Professional and Ethical Behaviour** includes, but is not limited to, the following outcomes: **Teamwork, Ethical Reasoning, Leadership, and Personal Organization and Time Management**

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Bachelor of Engineering [B.Eng.]

Program Information

Objectives of the Program

Students in this program obtain a liberal engineering education, which includes a comprehensive core of science, mathematics and engineering science that provides a strong foundation for engineering design and analysis. This enables students to undertake the solution of engineering problems in the areas of biological, biomedical, computer, engineering systems and computing, environmental, mechanical and water resources. Core subjects, combined with elective opportunities, provide an understanding of the connection between engineering and science, coupled with the interdisciplinary skills needed to address the problems and challenges faced by engineers in society today.

The curriculum includes a strong emphasis on engineering design. Students engage in engineering design throughout the program, and gain experience in computer aided design and modeling, conceptual design and physical construction. Emphasis is on teamwork and communications skills, as well as working on interdisciplinary projects.

Career opportunities are open in many segments of the economy. Examples are: consulting services to municipalities, utilities and industry; resource agencies in advisory, regulatory, planning and utilization; service industries of construction, power and water supply and public health; manufacturing, design of computer and control systems, hardware and software development; mechatronics and emerging energy systems; medical devices, pharmaceutical and food industries and industrial ergonomics; academic research and graduate studies within and without the field of engineering.

Many engineers assume management responsibilities after gaining experience in design, development and operations. The balance provided by liberal arts and engineering education allows graduates to enjoy a great deal of career mobility.

Accreditation

The baccalaureate degree programs in all engineering programs are accredited by the Canadian Engineering Accreditation Board of Engineers Canada. Graduates from accredited engineering programs have the educational requirements to apply for membership in the Professional Engineers Ontario (PEO) and other provinces after a number of years of acceptable engineering experience and successful completion of a PEO examination in engineering law and ethics.

Requirements of the Program

Students combine their required courses in mathematics, physical sciences and engineering with additional credits providing the opportunity for specialization in: one of the programs; complementary studies courses; and elective subjects. Complementary studies, consist of courses in the social sciences, arts, management, engineering economics and communication. They complement the technical content of the curriculum. All credits are selected according to the schedule of studies for the student's chosen program. Restrictions apply to the number of non-core credits which may be at the 1000 level. Further information on approved courses may be obtained from the B.Eng. Program Guide available from the director or program counsellor of the School of Engineering

Programs

Entry into a specific B.Eng. program is done two ways. Students can select their desired program of study (major) at the time of application. If accepted, students will be given an offer to their program of choice. Students also have the option of selecting the Undeclared First Year (Undeclared Stream) entry point due to the similarities of first year. Students in the Undeclared Stream then normally select their specific program of study during course selection for Semester II. Students in the Undeclared stream are strongly encouraged to meet with their Program Counsellor during Semester I. The School's Associate Director - Undergraduate Affairs or designate approve program selection during the semester add periods. There are no enrollment caps on any program, so students are free to select their programs of choice. Students wanting to make a switch in majors after the above dates are free to do so with prior approval, but will be off sequence and may be required to take additional courses.

The available programs are:

Undeclared First Year: Students selecting this entry point are required to select one of the B.Eng. Majors at the time of course selection in Semester II.

Biological Engineering - the application of engineering to the control and management of biological processes, environments, and human factors in engineering design.

Biomedical Engineering - the application of engineering to health and medicine.

Computer Engineering - the application of engineering to the design, fabrication, and testing of computing machines and computer systems.

Engineering Systems and Computing - the application of engineering to the design, operation and management of data sensing, transmission and processing systems, and of control systems.

Environmental Engineering - the application of engineering to protect and restore the environment, through the prevention and treatment of gaseous, liquid and solid wastes.

Mechanical Engineering - The application of engineering to the design, manufacturing and control of mechanical and electro-mechanical equipment, systems and devices.

Water Resources Engineering - the application of engineering to the control and management of water and soil resources to meet human needs while sustaining the natural environment.

The schedule of studies for each program is provided below but guidance in the selection of appropriate courses is available from the program counsellor of the School of Engineering.

Additional Course Requirements

Students lacking specific subject requirements are advised to consult the Recommendations and Notes in Section IV--Admission Information-B.Eng..

Continuation of Study

Students are advised to consult the regulations for continuation of study within the program which are outlined in detail in Section VIII, Undergraduate Degree Regulation & Procedures. Students will be ineligible to continue in the B.Eng. program and will not be readmitted to the degree program if the same course is failed three times.

Normally, students in the B.Eng. program will be permitted only one supplemental privilege during their studies. It will usually be granted for 3000 or 4000 level courses only.

Conditions for Graduation

To qualify for the degree the student must complete the courses required for a B.Eng. program and must achieve an overall minimum cumulative average of at least 60% and a minimum cumulative average of at least 60% in all ENGG courses.

Co-operative Education

Students studying for the B.Eng. degree may participate in a Co-operative Education program following the completion of the first 4 semesters of study. The Co-operative Education program consists of a minimum of 4 semesters of experience in industry with employers who participate in the program. Reports and assignments are graded by a faculty supervisor with assistance from the employer. Evaluations of Co-op semesters are recorded on the student's academic record. The Co-operative Education program provides an excellent opportunity for students to obtain work experience in industry directly related to their field of study. Interested students should consult their program counsellor.

Students wishing to participate in the Co-operative Education program should indicate their intention to do so by applying for admission to the Co-op program on entrance. Following the completion of semester 2, in-course applicants will be considered for admission to the Co-op program if space permits.

Successful applicants will:

1. have a minimum cumulative average of 70% in semesters 1 and 2
2. have successfully completed all of the credits required in the schedule of studies for semesters 1 and 2
3. be employable in Canada or be in possession of an appropriate work-permit for Co-op students)
4. have obtained the approval of their Co-op advisor in the school to participate in the program. The Co-op advisor's approval will signify that the schedule of work semesters in the Co-op program as planned by the student is compatible with the schedule of studies in the program in which the student is enrolled.
5. completion of COOP*1100 is a requirement for entry into the first work term.

Please refer to Co-operative Education Program for Admission requirements into the Co-op Program.

B. Eng. Co-op Work Term Schedule

Semester	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5
Fall	1	3	5	6	work
Winter	2	4	work	7	8
Summer		work	work	work	

All candidates must complete a minimum of 4 of the preceding 5 work terms with at least one work-term in each of a Fall, Winter and Summer semester. Students are eligible to participate in a maximum of two (2) work terms commencing in the summer and must follow the academic work schedule as outlined in the Co-operative Education & Career Services website.

Undeclared First Year Entry - B.Eng. Program

School of Engineering, College of Engineering and Physical Sciences

Semester 1- Fall

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications
One of:		
CIS*1300	[0.50]	Programming
CIS*1500	[0.50]	Introduction to Programming

Note: Students planning to declare one of Computer Engineering or Engineering Systems and Computing should take CIS*1300. This course is required for progression into CIS*2500 in Semester 2

Semester 2 - Winter

(for students planning to declare one of: Biological Engineering, Biomedical Engineering, Environmental Engineering, Water Resources Engineering)

CHEM*1050	[0.50]	General Chemistry II
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 2 - Winter

(for students planning to declare one of: Computer Engineering, Engineering Systems and Computing)

CIS*2500	[0.50]	Intermediate Programming
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 2 - Winter

(for students planning to declare Mechanical Engineering)

ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

0.50 restricted electives

Biological Engineering Program (BIOE)

School of Engineering, College of Engineering and Physical Sciences

Students interested in problems requiring the application of knowledge from both the biological sciences and engineering will find a challenge as a Biological Engineer. This field of engineering is the application of principles, methods and concepts of biology to systems and tools, ranging in scale from molecular to ecosystem level. This field combines engineering principles with life sciences to design creative solutions for biological systems, with applications ranging from pharmaceutical and food manufacturing, bioconversions to reduce waste, and production of sustainable, bio-based materials. For example, a Biological Engineer concentrating on biotechnology might design and manage bioreactors to improve their productivity. A Biological Engineering graduate can pursue a career in a number of exciting fields, including food safety, bio-instrumentation, diagnostics and sensorics in bio-systems, biomechanics and ergonomics.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

BIOL*1080	[0.50]	Biological Concepts of Health
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

BIOL*1070	[0.50]	Discovering Biodiversity
BIOL*1090	[0.50]	Introduction to Molecular and Cellular Biology

Semester 4

BIOC*2580	[0.50]	Introduction to Biochemistry
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2450	[0.50]	Electric Circuits
ENGG*2660	[0.50]	Biological Engineering Systems I
MATH*2130	[0.50]	Numerical Methods

Semester 5

ENGG*3160	[0.50]	Biological Engineering Systems II
ENGG*3260	[0.50]	Thermodynamics
ENGG*3450	[0.50]	Electronic Devices
ENGG*3830	[0.50]	Bio-Process Engineering
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Semester 6

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3170	[0.50]	Biomaterials
ENGG*3430	[0.50]	Heat and Mass Transfer
ENGG*3440	[0.50]	Process Control

1.00 restricted electives

Semester 7

ENGG*3240	[0.50]	Engineering Economics
ENGG*4000	[0.00]	Proposal for Engineering Design IV
ENGG*4380	[0.75]	Bioreactor Design
ENGG*4390	[0.75]	Bio-instrumentation Design

1.00 restricted electives

Semester 8

ENGG*4110	[1.00]	Biological Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Biological Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the BIOE-1 Biological Engineering electives
- 0.75 credits from the BIOE-2 Biological Engineering design electives
- 2.00 credits from Complementary Studies electives
- 0.50 credits in Free Electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Biological Engineering Program Co-op (BIOE:C)

School of Engineering, College of Engineering and Physical Sciences

Students interested in problems requiring the application of knowledge from both the biological sciences and engineering will find a challenge as a Biological Engineer. This field of engineering is the application of principles, methods and concepts of biology to systems and tools, ranging in scale from molecular to ecosystem level. This field combines engineering principles with life sciences to design creative solutions for biological systems, with applications ranging from pharmaceutical and food manufacturing, bioconversions to reduce waste, and production of sustainable, bio-based materials. For example, a Biological Engineer concentrating on biotechnology might design and manage bioreactors to improve their productivity. A Biological Engineering graduate can pursue a career in a number of exciting fields, including food safety, bio-instrumentation, diagnostics and sensorics in bio-systems, biomechanics and ergonomics.

Program Requirements

The Co-op program in Biological Engineering is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Biological Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.50 Total Credits)*

19.25 - Required Core Courses

1.00 – BIOE-1 Biological Engineering Electives

0.75 – BIOE-2 Biological Engineering Design Electives

2.00 – Complementary Studies Electives

0.50 – Free Electives

2.00 Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.00.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3 - Fall

BIOL*1080	[0.50]	Biological Concepts of Health
COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

BIOL*1070	[0.50]	Discovering Biodiversity
BIOL*1090	[0.50]	Introduction to Molecular and Cellular Biology

Semester 4 - Winter

BIOC*2580	[0.50]	Introduction to Biochemistry
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2450	[0.50]	Electric Circuits
ENGG*2660	[0.50]	Biological Engineering Systems I
MATH*2130	[0.50]	Numerical Methods

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

ENGG*3160	[0.50]	Biological Engineering Systems II
ENGG*3260	[0.50]	Thermodynamics
ENGG*3450	[0.50]	Electronic Devices
ENGG*3830	[0.50]	Bio-Process Engineering
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*3240	[0.50]	Engineering Economics
ENGG*4380	[0.75]	Bioreactor Design
ENGG*4390	[0.75]	Bio-instrumentation Design

1.00 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3170	[0.50]	Biomaterials
ENGG*3430	[0.50]	Heat and Mass Transfer
ENGG*3440	[0.50]	Process Control

1.00 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4110	[1.00]	Biological Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Biological Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the BIOE-1 Biological Engineering electives
- 0.75 credits from the BIOE-2 Biological Engineering design electives
- 2.00 credits from Complementary Studies electives
- 0.50 credits in Free Electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Biomedical Engineering Program (BME)

School of Engineering, College of Engineering and Physical Sciences

Biomedical Engineering is a field of engineering that deals with health and medicine. (e.g.: electronic and mechanical devices used on biological materials, animals and humans, medical implants and instruments, ergonomics, bioinstrumentation, imaging and pharmacology). Graduates in Biomedical engineering are able to apply mathematical, scientific and engineering principles to a wide variety of fields and find employment across the private and public sectors of the health care industry. The program provides students with a common base of knowledge essential to engineering, and then allows them to select from a menu of electives to attain a degree of specialization in one of three areas, or to choose electives which broaden their general knowledge base. Elective concentrations are available in the areas of biomechanics; biosignal processing; and pharmaceuticals. The program is built around the concept of interdisciplinary application of engineering principles to health related problems.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

0.50 restricted electives

Note: Students planning to pursue the pharmaceutical series of electives are advised to select BIOL*1080 in place of the 0.50 restricted elective in Semester 3 - Fall and select ENGG*2660 as an elective in Semester 4 for prerequisite sequencing.

Semester 4

BIOL*1080	[0.50]	Biological Concepts of Health
BIOM*2000	[0.50]	Concepts in Human Physiology
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods

Semester 5

BIOM*3010	[0.50]	Biomedical Comparative Anatomy
ENGG*3260	[0.50]	Thermodynamics
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Semester 6

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3170	[0.50]	Biomaterials
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer
PATH*3610	[0.50]	Principles of Disease

0.50 restricted electives

Semester 7

ENGG*3240	[0.50]	Engineering Economics
ENGG*4000	[0.00]	Proposal for Engineering Design IV
ENGG*4390	[0.75]	Bio-instrumentation Design

2.50 restricted electives

Semester 8

ENGG*4180	[1.00]	Biomedical Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Biomedical Engineering students to complete the following combination of elective credits to complete their program:

- 2.50 credits from the BME-1 Biomedical Engineering electives
- 0.75 credits from the BME-2 Biomedical Engineering design electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Biomedical Engineering Program Co-op (BME:C)

School of Engineering, College of Engineering and Physical Sciences

Biomedical Engineering is a field of engineering that deals with health and medicine. (e.g.: electronic and mechanical devices used on biological materials, animals and humans, medical implants and instruments, ergonomics, bioinstrumentation, imaging and pharmacology). Graduates in Biomedical engineering are able to apply mathematical, scientific and engineering principles to a wide variety of fields and find employment across the private and public sectors of the health care industry. The program provides students with a common base of knowledge essential to engineering, and then allows them to select from a menu of electives to attain a degree of specialization in one of three areas, or to choose electives which broaden their general knowledge base. Elective concentrations are available in the areas of biomechanics; biosignal processing; and pharmaceuticals. The program is built around the concept of interdisciplinary application of engineering principles to health related problems.

Program Requirements

The Co-op program in Biomedical Engineering is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Biomedical Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.75 Total Credits)*

18.50 - Required Core Courses

2.50 – BME-1 Biomedical Engineering Electives

0.75 – BME-2 Biomedical Engineering Design Electives

2.00 – Complementary Studies Electives

2.00 Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.25.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3 - Fall

COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations

0.50 restricted electives

Note: Students planning to pursue the pharmaceutical series of electives are advised to select BIOL*1080 in place of the 0.50 restricted elective in Semester 3 - Fall and select ENGG*2660 as an elective in Semester 4 for prerequisite sequencing.

Semester 4 - Winter

BIOL*1080	[0.50]	Biological Concepts of Health
BIOM*2000	[0.50]	Concepts in Human Physiology
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

BIOM*3010	[0.50]	Biomedical Comparative Anatomy
ENGG*3260	[0.50]	Thermodynamics
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*3240	[0.50]	Engineering Economics
ENGG*4390	[0.75]	Bio-instrumentation Design

2.00 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3170	[0.50]	Biomaterials
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer
PATH*3610	[0.50]	Principles of Disease

0.50 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4180	[1.00]	Biomedical Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Biomedical Engineering students to complete the following combination of elective credits to complete their program:

- 2.50 credits from the BME-1 Biomedical Engineering electives
- 0.75 credits from the BME-2 Biomedical Engineering design electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Computer Engineering Program (CENG)

School of Engineering, College of Engineering and Physical Sciences

Computer Engineering is a field of engineering that focuses on the design and organization of computer systems. Graduates in Computer Engineering are able to apply mathematical, scientific and engineering principles to design and integrate computer systems suitable for applications in a wide range of fields. The program provides students with a common base of knowledge essential to computer engineering and then allows them to select from a menu of electives to attain a degree of specialization in one of four areas or to choose electives to broaden their knowledge base. Elective concentrations are available in areas of Electronic Design automation, Software Design, Artificial Intelligence and Robotics, and Microsystems.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
CIS*1300	[0.50]	Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CIS*2500	[0.50]	Intermediate Programming
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

CIS*2430	[0.50]	Object Oriented Programming
CIS*2520	[0.50]	Data Structures
ENGG*2400	[0.50]	Engineering Systems Analysis
ENGG*2410	[0.50]	Digital Systems Design Using Descriptive Languages
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

Semester 4

CIS*2910	[0.50]	Discrete Structures in Computing II
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2450	[0.50]	Electric Circuits
ENGG*3380	[0.50]	Computer Organization and Design
MATH*2130	[0.50]	Numerical Methods

0.50 restricted electives (CIS*2750 recommended for students interested in the software area of interest)

Semester 5

ENGG*2120	[0.50]	Material Science
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
ENGG*3640	[0.50]	Microcomputer Interfacing
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Semester 6

CIS*3110	[0.50]	Operating Systems I
CIS*3490	[0.50]	The Analysis and Design of Computer Algorithms
ENGG*3100	[0.75]	Engineering and Design III
ENGG*3210	[0.50]	Communication Systems
ENGG*3410	[0.50]	Systems and Control Theory

0.50 restricted electives

Semester 7

ENGG*3050	[0.50]	Embedded Reconfigurable Computing Systems
ENGG*3240	[0.50]	Engineering Economics
ENGG*4000	[0.00]	Proposal for Engineering Design IV
ENGG*4420	[0.75]	Real-time Systems Design
ENGG*4450	[0.50]	Large-Scale Software Architecture Engineering

1.00 restricted electives

Semester 8

ENGG*4170	[1.00]	Computer Engineering Design IV
ENGG*4540	[0.50]	Advanced Computer Architecture
ENGG*4550	[0.50]	VLSI Digital Design

1.00 electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Computer Engineering students to complete the following combination of elective credits to complete their program:

- 1.50 credits from the CENG-1 Computer Engineering electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Computer Engineering Program Co-op (CENG:C)

School of Engineering, College of Engineering and Physical Sciences

Computer Engineering is a field of engineering that focuses on the design and organization of computer systems. Graduates in Computer Engineering are able to apply mathematical, scientific and engineering principles to design and integrate computer systems suitable for applications in a wide range of fields. The program provides students with a common base of knowledge essential to computer engineering and then allows them to select from a menu of electives to attain a degree of specialization in one of four areas or to choose electives to broaden their knowledge base. Elective concentrations are available in areas of Electronic Design automation, Software Design, Artificial Intelligence and Robotics, and Microsystems.

Program Requirements

The Co-op program in Computer Engineering is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Computer Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (26.00 Total Credits)*

20.50 - Required Core Courses

1.50 – CENG-1 Computer Engineering Electives

2.00 – Complementary Studies Electives

2.00 Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.50.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
CIS*1300	[0.50]	Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

CIS*2500	[0.50]	Intermediate Programming
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3 - Fall

CIS*2430	[0.50]	Object Oriented Programming
CIS*2520	[0.50]	Data Structures
COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2400	[0.50]	Engineering Systems Analysis
ENGG*2410	[0.50]	Digital Systems Design Using Descriptive Languages
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

Semester 4 - Winter

CIS*2910	[0.50]	Discrete Structures in Computing II
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2450	[0.50]	Electric Circuits

ENGG*3380	[0.50]	Computer Organization and Design
MATH*2130	[0.50]	Numerical Methods

0.50 restricted electives (CIS*2750 recommended for students interested in the software area of interest)

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

ENGG*2120	[0.50]	Material Science
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
ENGG*3640	[0.50]	Microcomputer Interfacing
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*3050	[0.50]	Embedded Reconfigurable Computing Systems
ENGG*3240	[0.50]	Engineering Economics
ENGG*4420	[0.75]	Real-time Systems Design
ENGG*4450	[0.50]	Large-Scale Software Architecture Engineering

1.00 restricted electives

Semester 7 - Winter -

CIS*3110	[0.50]	Operating Systems I
CIS*3490	[0.50]	The Analysis and Design of Computer Algorithms
ENGG*3100	[0.75]	Engineering and Design III
ENGG*3210	[0.50]	Communication Systems
ENGG*3410	[0.50]	Systems and Control Theory

0.50 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4170	[1.00]	Computer Engineering Design IV
ENGG*4540	[0.50]	Advanced Computer Architecture
ENGG*4550	[0.50]	VLSI Digital Design

1.00 electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Computer Engineering students to complete the following combination of elective credits to complete their program:

- 1.50 credits from the CENG-1 Computer Engineering electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Engineering Systems and Computing Program (ESC)

School of Engineering, College of Engineering and Physical Sciences

In the last quarter century, the computer has grown so rapidly in importance that engineering, science, business and industry could not function without it. With this growth, a need has evolved for specialists who can incorporate computers and information into complex industrial processes. The Engineering Systems and Computing program has been conceived to satisfy this need. Graduates from this program will have, in addition to the basic engineering skills, the ability to identify application areas where computer technology represents the optimum solution, specify appropriate software for process control, data reduction and/or expert system implementation and integrate the computer into the overall system application.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
CIS*1300	[0.50]	Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CIS*2500	[0.50]	Intermediate Programming
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

CIS*2430	[0.50]	Object Oriented Programming
CIS*2520	[0.50]	Data Structures
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
ENGG*2410	[0.50]	Digital Systems Design Using Descriptive Languages
MATH*2270	[0.50]	Applied Differential Equations

Semester 4

ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

0.50 restricted electives

Semester 5

ENGG*3260	[0.50]	Thermodynamics
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
ENGG*3640	[0.50]	Microcomputer Interfacing

1.00 restricted electives

Semester 6

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3130	[0.50]	Modelling Complex Systems
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Semester 7

ENGG*3240	[0.50]	Engineering Economics
ENGG*4000	[0.00]	Proposal for Engineering Design IV
ENGG*4420	[0.75]	Real-time Systems Design
ENGG*4450	[0.50]	Large-Scale Software Architecture Engineering

1.00 or 1.25 restricted electives

Semester 8

ENGG*4120	[1.00]	Engineering Systems and Computing Design IV
ENGG*4490	[0.75]	Sampled Data Control Design

1.00 or 1.25 electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Engineering Systems and Computing students to complete the following combination of elective credits to complete their program:

- 1.50 credits from the ESC-1 Engineering Systems and Computing electives
- 0.75 credits from the ESC-2 Engineering Systems and Computing electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Engineering Systems and Computing Program Co-op (ESC:C)

School of Engineering, College of Engineering and Physical Sciences

In the last quarter century, the computer has grown so rapidly in importance that engineering, science, business and industry could not function without it. With this growth, a need has evolved for specialists who can incorporate computers and information into complex industrial processes. The Engineering Systems and Computing program has been conceived to satisfy this need. Graduates from this program will have, in addition to the basic engineering skills, the ability to identify application areas where computer technology represents the optimum solution, specify appropriate software for process control, data reduction and/or expert system implementation and integrate the computer into the overall system application.

Program Requirements

The Co-op program in Engineering Systems and Computing is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Engineering Systems and Computing Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III

Year	Fall	Winter	Summer
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.50 Total Credits)*

19.25 - Required Core Courses

1.50 – ESC-1 Engineering Systems and Computing Electives

0.75 – ESC-2 Engineering Systems and Computing Electives

2.00 – Complementary Studies Electives

2.00 Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.00.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
CIS*1300	[0.50]	Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

CIS*2500	[0.50]	Intermediate Programming
ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3 - Fall

CIS*2430	[0.50]	Object Oriented Programming
CIS*2520	[0.50]	Data Structures
COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
ENGG*2410	[0.50]	Digital Systems Design Using Descriptive Languages
MATH*2270	[0.50]	Applied Differential Equations

Semester 4 - Winter

ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

0.50 restricted electives

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

ENGG*3260	[0.50]	Thermodynamics
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electronic Devices
ENGG*3640	[0.50]	Microcomputer Interfacing

1.00 restricted electives

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*3240	[0.50]	Engineering Economics
ENGG*4420	[0.75]	Real-time Systems Design
ENGG*4450	[0.50]	Large-Scale Software Architecture Engineering

1.00 or 1.25 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3130	[0.50]	Modelling Complex Systems
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4120	[1.00]	Engineering Systems and Computing Design IV
ENGG*4490	[0.75]	Sampled Data Control Design

1.00 or 1.25 electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Engineering Systems and Computing students to complete the following combination of elective credits to complete their program:

- 1.50 credits from the ESC-1 Engineering Systems and Computing electives
- 0.75 credits from the ESC-2 Engineering Systems and Computing electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Environmental Engineering Program (ENVE)

School of Engineering, College of Engineering and Physical Sciences

The degradation of the environment is a concern shared by citizens, government agencies, non-governmental agencies and businesses. The Environmental Engineering program offered by the School of Engineering provides graduates with design and engineering skills to minimize and prevent the impact of human activities on water, soil and air systems. Both simple and innovative solutions are part of the tool box. Graduates will also creatively integrate humanistic and social perspectives in their solutions.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2130	[0.50]	Introduction to Environmental Engineering
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations

One of:

BIOL*1090	[0.50]	Introduction to Molecular and Cellular Biology
MICR*2420	[0.50]	Introduction to Microbiology

Semester 4

ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2560	[0.50]	Environmental Engineering Systems
HIST*1250	[0.50]	Science and Technology in a Global Context
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

0.50 restricted electives

Semester 5

ENGG*3180	[0.50]	Air Quality
ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3590	[0.50]	Water Quality
ENGG*3650	[0.50]	Hydrology
ENGG*3670	[0.50]	Soil Mechanics

Semester 6

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3220	[0.50]	Groundwater Engineering

ENGG*3430	[0.50]	Heat and Mass Transfer
ENGG*3440	[0.50]	Process Control
ENGG*3470	[0.50]	Mass Transfer Operations

0.50 restricted electives

Semester 7

ENGG*4000	[0.00]	Proposal for Engineering Design IV
ENGG*4340	[0.50]	Solid and Hazardous Waste Management
ENGG*4370	[0.75]	Urban Water Systems Design

1.50 restricted electives

Semester 8

ENGG*4130	[1.00]	Environmental Engineering Design IV

2.00 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Environmental Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the ENVE-1 Environmental Engineering electives
- 2.00 credits from the ENVE-2 Environmental Engineering electives
- 1.50 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Minor (Honours Program)

Students must be registered in a B.Eng degree program specialization other than Environmental Engineering to apply for a Minor in Environmental Engineering. A Minor in Environmental Engineering consists of at least 5.00 course credits. A maximum of 2.50 course credits taken as part of the Environmental Engineering Minor may also be applied toward the requirements of the B.Eng. Major specialization.

The following courses (2.00 credits) are required:

CHEM*1050	[0.50]	General Chemistry II
ENGG*2560	[0.50]	Environmental Engineering Systems
ENGG*3180	[0.50]	Air Quality
ENGG*3590	[0.50]	Water Quality

At least 2.00 credits must be selected from the following courses:

BIOC*2580	[0.50]	Introduction to Biochemistry
CHEM*2700	[0.50]	Organic Chemistry I
CHEM*3360	[0.50]	Environmental Chemistry and Toxicology
ENGG*3080	[0.50]	Energy Resources & Technologies
ENGG*3250	[0.50]	Energy Management & Utilization
ENGG*3470	[0.50]	Mass Transfer Operations
ENGG*4070	[0.50]	Life Cycle Assessment for Sustainable Design
ENGG*4240	[0.50]	Site Remediation
ENGG*4340	[0.50]	Solid and Hazardous Waste Management
ENGG*4510	[0.50]	Assessment & Management of Risk
ENGG*4760	[0.50]	Biological Wastewater Treatment Design
ENGG*4770	[0.50]	Physical & Chemical Water and Wastewater Treatment Design
ENGG*4810	[0.50]	Control of Atmospheric Particulates
ENGG*4820	[0.50]	Atmospheric Emission Control: Combustion Systems
ENVS*2030	[0.50]	Meteorology and Climatology

At least 1.00 credit must be selected from the following courses:

ECON*2100	[0.50]	Economic Growth and Environmental Quality
EDRD*2650	[0.50]	Introduction to Planning and Environmental Law
ENVS*2270	[0.50]	Impacts of Climate Change
GEOG*1220	[0.50]	Human Impact on the Environment
GEOG*2210	[0.50]	Environment and Resources
GEOG*3020	[0.50]	Global Environmental Change
GEOG*3210	[0.50]	Management of the Biophysical Environment
PHIL*2070	[0.50]	Philosophy of the Environment
POLS*3370	[0.50]	Environmental Politics and Governance
SOC*2280	[0.50]	Society and Environment

Environmental Engineering Program Co-op (ENVE:C)

School of Engineering, College of Engineering and Physical Sciences

The degradation of the environment is a concern shared by citizens, government agencies, non-governmental agencies and businesses. The Environmental Engineering program offered by the School of Engineering provides graduates with design and engineering skills to minimize and prevent the impact of human activities on water, soil and air systems. Both simple and innovative solutions are part of the tool box. Graduates will also creatively integrate humanistic and social perspectives in their solutions.

Program Requirements

The Co-op program in Environmental Engineering is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Environmental Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.50 Total Credits)*

19.00 - Required Core Courses

1.00 – ENVE-1 Environmental Engineering Electives

2.00 – ENVE-2 Environmental Engineering Electives

1.50 – Complementary Studies Electives

2.00 - Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.00

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3 - Fall

COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2130	[0.50]	Introduction to Environmental Engineering
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

BIOL*1090	[0.50]	Introduction to Molecular and Cellular Biology
MICR*2420	[0.50]	Introduction to Microbiology

Semester 4 - Winter

ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2560	[0.50]	Environmental Engineering Systems
HIST*1250	[0.50]	Science and Technology in a Global Context
MATH*2130	[0.50]	Numerical Methods

0.50 restricted electives

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

ENGG*3180	[0.50]	Air Quality

ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3590	[0.50]	Water Quality
ENGG*3650	[0.50]	Hydrology
ENGG*3670	[0.50]	Soil Mechanics

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*4340	[0.50]	Solid and Hazardous Waste Management
ENGG*4370	[0.75]	Urban Water Systems Design

1.50 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3220	[0.50]	Groundwater Engineering
ENGG*3430	[0.50]	Heat and Mass Transfer
ENGG*3440	[0.50]	Process Control
ENGG*3470	[0.50]	Mass Transfer Operations

0.50 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4130	[1.00]	Environmental Engineering Design IV

2.00 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Environmental Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the ENVE-1 Environmental Engineering electives
- 2.00 credits from the ENVE-2 Environmental Engineering electives
- 1.50 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Food Engineering (FENG)

School of Engineering, College of Engineering and Physical Sciences

Minor (Honours Program)

Students must be registered in the B.Eng. degree program to apply for a Minor in Food Engineering.

The minor can be satisfied by taking the following additional courses:

ACCT*1220	[0.50]	Introductory Financial Accounting
BIOC*2580	[0.50]	Introduction to Biochemistry
ENGG*2660	[0.50]	Biological Engineering Systems I
ENGG*3830	[0.50]	Bio-Process Engineering
FOOD*2150	[0.50]	Introduction to Nutritional and Food Science

One of:

ENGG*4300	[0.75]	Food Processing Engineering Design
ENGG*4380	[0.75]	Bioreactor Design

Two of:

FOOD*4070	[0.50]	Food Packaging
FOOD*4110	[0.50]	Meat and Poultry Processing
MCS*3010	[0.50]	Quality Management

One of:

FOOD*3160	[0.75]	Food Processing I
FOOD*4520	[0.50]	Utilization of Cereal Grains for Human Food

One of:

FOOD*2400	[0.50]	Introduction to Food Chemistry
FOOD*3010	[0.50]	Food Chemistry
FOOD*3230	[0.75]	Food Microbiology
FOOD*3260	[0.50]	Industrial Microbiology

**Students must incorporate a food engineering application as part of their capstone design course worth 1.0 credits in the final semester of their B.Eng. major program.*

NOTE: Courses taken for the minors are credited to appropriate elective areas.

Mechanical Engineering Program (MECH)

School of Engineering, College of Engineering and Physical Sciences

Mechanical Engineering at Guelph is built around concepts of sustainability and sustainable design to equip graduates to tackle issues associated with emerging technologies. Graduates in mechanical engineering are able to apply mathematical, scientific and engineering principles to a wide variety of fields and find employment across the private and public sectors. The program provides students with a common base of knowledge essential to mechanical engineering, and then allows them to select from a menu of electives to attain a degree of specialization in one of five areas, or to choose electives which broaden their general knowledge base. Elective concentrations are available in the areas of wind and solar energy, food and beverage engineering, mechatronics, manufacturing system design and biomechanics.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
CIS*1500	[0.50]	Introduction to Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

0.50 restricted electives

Semester 3

ENGG*1070	[0.25]	Occupational Health and Safety
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations

Semester 4

ENGG*2180	[0.50]	Introduction to Manufacturing Processes
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2340	[0.50]	Kinematics and Dynamics
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

Semester 5

ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3280	[0.75]	Machine Design
ENGG*3510	[0.50]	Electromechanical Devices
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Semester 6

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3370	[0.50]	Applied Fluids and Thermodynamics
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer

1.00 restricted electives

Semester 7

ENGG*3140	[0.50]	Mechanical Vibration
ENGG*4000	[0.00]	Proposal for Engineering Design IV

2.50 restricted electives

Semester 8

ENGG*4160	[1.00]	Mechanical Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Mechanical Engineering students to complete the following combination of elective credits to complete their program:

- 3.50 credits from the MECH-1 Mechanical Engineering electives
- 0.75 credits from the MECH-2 Mechanical Engineering design electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Mechanical Engineering Program Co-op (MECH:C)

School of Engineering, College of Engineering and Physical Sciences

Mechanical Engineering at Guelph is built around concepts of sustainability and sustainable design to equip graduates to tackle issues associated with emerging technologies. Graduates in mechanical engineering are able to apply mathematical, scientific and engineering principles to a wide variety of fields and find employment across the private and public sectors. The program provides students with a common base of knowledge essential to mechanical engineering, and then allows them to select from a menu of electives to attain a degree of specialization in one of five areas, or to choose electives which broaden their general knowledge base. Elective concentrations are available in the areas of wind and solar energy, food and beverage engineering, mechatronics, manufacturing system design and biomechanics.

Program Requirements

The Co-op program in Mechanical Engineering s a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Mechanical Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.50 Total Credits)*

17.25 - Required Core Courses

3.50 – MECH-1 Mechanical Engineering Electives

0.75 – MECH-2 Mechanical Engineering Design Electives

2.00 – Complementary Studies Electives

2.00 - Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.00.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040	[0.50]	General Chemistry I
CIS*1500	[0.50]	Introduction to Programming
ENGG*1100	[0.75]	Engineering and Design I
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2 - Winter

ENGG*1210	[0.50]	Engineering Mechanics I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

0.50 restricted electives

Semester 3 - Fall

COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*1070	[0.25]	Occupational Health and Safety
ENGG*2100	[0.75]	Engineering and Design II
ENGG*2120	[0.50]	Material Science
ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations

Semester 4 - Winter

ENGG*2180	[0.50]	Introduction to Manufacturing Processes
ENGG*2230	[0.50]	Fluid Mechanics
ENGG*2340	[0.50]	Kinematics and Dynamics
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
STAT*2120	[0.50]	Probability and Statistics for Engineers

Summer Semester

COOP*1000	[0.50]	Co-op Work Term I

Semester 5 - Fall

ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3280	[0.75]	Machine Design
ENGG*3510	[0.50]	Electromechanical Devices
HIST*1250	[0.50]	Science and Technology in a Global Context

0.50 restricted electives

Winter Semester

COOP*2000	[0.50]	Co-op Work Term II

Summer Semester

COOP*3000	[0.50]	Co-op Work Term III

Semester 6 - Fall

ENGG*3140	[0.50]	Mechanical Vibration

2.50 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3370	[0.50]	Applied Fluids and Thermodynamics
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer

1.00 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4160	[1.00]	Mechanical Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Mechanical Engineering students to complete the following combination of elective credits to complete their program:

- 3.50 credits from the MECH-1 Mechanical Engineering electives
- 0.75 credits from the MECH-2 Mechanical Engineering design electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Water Resources Engineering Program (WRE)

School of Engineering, College of Engineering and Physical Sciences

Water resources engineering focuses on the use and management of land and water resources in rural and urban watersheds. The hydrologic and hydraulic behaviour of watershed flow systems is combined with engineering science and ecological principles in the design of water management systems and strategies. Water management includes flood prevention, warning and control; drainage; design of natural channels; irrigation; and erosion prevention and control. The supply of water for municipal, industrial and agricultural purposes is considered in the context of resource conservation. Identification of potential point and diffused sources of pollutants is used to develop efficient, environmentally sustainable and economical methods to preserve high-quality water to sustain human life and water-dependent ecosystems.

Major (Honours Program)

Semester 1

CHEM*1040	[0.50]	General Chemistry I
ENGG*1100	[0.75]	Engineering and Design I
ENGG*1500	[0.50]	Engineering Analysis
MATH*1200	[0.50]	Calculus I
PHYS*1130	[0.50]	Physics with Applications

Semester 2

CHEM*1050	[0.50]	General Chemistry II
CIS*1500	[0.50]	Introduction to Programming
ENGG*1210	[0.50]	Engineering Mechanics I
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism

Semester 3

ENGG*2230	[0.50]	Fluid Mechanics

ENGG*2400 [0.50] Engineering Systems Analysis
GEOG*2000 [0.50] Geomorphology
MATH*2270 [0.50] Applied Differential Equations
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
MICR*2420 [0.50] Introduction to Microbiology

Semester 4

ENGG*2100 [0.75] Engineering and Design II
ENGG*2120 [0.50] Material Science
ENGG*2550 [0.50] Water Management
ENGG*2560 [0.50] Environmental Engineering Systems
MATH*2130 [0.50] Numerical Methods
0.50 restricted electives

Semester 5

ENGG*3240 [0.50] Engineering Economics
ENGG*3260 [0.50] Thermodynamics
ENGG*3590 [0.50] Water Quality
ENGG*3650 [0.50] Hydrology
ENGG*3670 [0.50] Soil Mechanics
0.50 restricted electives

Semester 6

ENGG*3100 [0.75] Engineering and Design III
ENGG*3220 [0.50] Groundwater Engineering
ENGG*3430 [0.50] Heat and Mass Transfer
HIST*1250 [0.50] Science and Technology in a Global Context
1.00 restricted electives

Semester 7

ENGG*3340 [0.50] Geographic Information Systems in Environmental Engineering
ENGG*4000 [0.00] Proposal for Engineering Design IV
ENGG*4360 [0.75] Soil-Water Conservation Systems Design
ENGG*4370 [0.75] Urban Water Systems Design
1.00 restricted electives

Semester 8

ENGG*4150 [1.00] Water Resources Engineering Design IV
ENGG*4250 [0.75] Watershed Systems Design
1.00 restricted electives

Note: ENGG*4250 can be taken in Semester 6

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Water Resources Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the WRE-1 Water Resources Engineering electives
- 1.00 credits from the WRE-2 Environmental and Water Resources electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

Water Resources Engineering Program Co-op (WRE:C)

School of Engineering, College of Engineering and Physical Sciences

Water resources engineering focuses on the use and management of land and water resources in rural and urban watersheds. The hydrologic and hydraulic behaviour of watershed flow systems is combined with engineering science and ecological principles in the design of water management systems and strategies. Water management includes flood prevention, warning and control; drainage; design of natural channels; irrigation; and erosion prevention and control. The supply of water for municipal, industrial and agricultural purposes is considered in the context of resource conservation. Identification of potential point and diffused sources of pollutants is used to develop efficient, environmentally sustainable and economical methods to preserve high-quality water to sustain human life and water-dependent ecosystems.

Program Requirements

The Co-op program in Water Resources Engineering is a five year program, including five work terms. Students must complete a Fall, Winter and Summer work term and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Water Resources Engineering Academic and Co-op Work Term Schedule

Year	Fall	Winter	Summer
1	Academic Semester 1	Academic Semester 2	Off
2	Academic Semester 3 COOP*1100	Academic Semester 4	COOP*1000 Work Term I
3	Academic Semester 5	COOP*2000 Work Term II	COOP*3000 Work Term III
4	Academic Semester 6	Academic Semester 7	COOP*4000 Work Term IV
5	COOP*5000 Work Term V	Academic Semester 8	N/A

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (25.50 Total Credits)*

19.50 - Required Core Courses

1.00 – WRE-1 Water Resources Engineering Electives

1.00 – WRE-2 Environmental and Water Resources Electives

2.00 – Complementary Studies Electives

2.00 - Co-op Work Terms

Note: A minimum of four Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *A fifth Co-op work term is optional and if completed, the total number of credits will equal 26.00.

See Program Guide for more information on restricted electives and their prerequisite requirements. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.

The recommended program sequence is outlined below.

Major (Honours Program)

Semester 1 - Fall

CHEM*1040 [0.50] General Chemistry I
ENGG*1100 [0.75] Engineering and Design I
ENGG*1500 [0.50] Engineering Analysis
MATH*1200 [0.50] Calculus I
PHYS*1130 [0.50] Physics with Applications

Semester 2 - Winter

CHEM*1050 [0.50] General Chemistry II
CIS*1500 [0.50] Introduction to Programming
ENGG*1210 [0.50] Engineering Mechanics I
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism

Semester 3 - Fall

COOP*1100 [0.00] Introduction to Co-operative Education
ENGG*2230 [0.50] Fluid Mechanics
ENGG*2400 [0.50] Engineering Systems Analysis
GEOG*2000 [0.50] Geomorphology
MATH*2270 [0.50] Applied Differential Equations
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
MICR*2420 [0.50] Introduction to Microbiology

Semester 4 - Winter

ENGG*2100 [0.75] Engineering and Design II
ENGG*2120 [0.50] Material Science
ENGG*2550 [0.50] Water Management
ENGG*2560 [0.50] Environmental Engineering Systems
MATH*2130 [0.50] Numerical Methods
0.50 restricted electives

Summer Semester

COOP*1000 [0.50] Co-op Work Term I

Semester 5 - Fall

ENGG*3240 [0.50] Engineering Economics
ENGG*3260 [0.50] Thermodynamics
ENGG*3590 [0.50] Water Quality
ENGG*3650 [0.50] Hydrology
ENGG*3670 [0.50] Soil Mechanics
0.50 restricted electives

Winter Semester

COOP*2000 [0.50] Co-op Work Term II

Summer Semester

COOP*3000 [0.50] Co-op Work Term III

Semester 6 - Fall

ENGG*3340	[0.50]	Geographic Information Systems in Environmental Engineering
ENGG*4360	[0.75]	Soil-Water Conservation Systems Design
ENGG*4370	[0.75]	Urban Water Systems Design

1.00 restricted electives

Semester 7 - Winter

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3220	[0.50]	Groundwater Engineering
ENGG*3430	[0.50]	Heat and Mass Transfer
HIST*1250	[0.50]	Science and Technology in a Global Context

1.00 restricted electives

Summer Semester

COOP*4000	[0.50]	Co-op Work Term IV

Fall Semester

COOP*5000	[0.50]	Co-op Work Term V
ENGG*4000	[0.00]	Proposal for Engineering Design IV

Semester 8 - Winter

ENGG*4150	[1.00]	Water Resources Engineering Design IV
ENGG*4250	[0.75]	Watershed Systems Design

1.00 restricted electives

Note: ENGG*4250 can be taken in Semester 7

Restricted Electives (see Program Guide for more information)

The Engineering Program requires Water Resources Engineering students to complete the following combination of elective credits to complete their program:

- 1.00 credits from the WRE-1 Water Resources Engineering electives
- 1.00 credits from the WRE-2 Environmental and Water Resources electives
- 2.00 credits from Complementary Studies electives

Consult the Program Guide for further information on the prerequisite requirements specific to each elective. Students can take a maximum of 1.50 credits at the 1000 level from the above list of electives.