2015-2016 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2015-2016 academic year, including the Summer Semester 2015, the Fall Semester 2015 and the Winter Semester 2016.

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:

- The Association of Universities and Colleges of Canada

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Disclaimer

University of Guelph 2015

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2015-2016 academic year, including the Summer Semester 2015, the Fall Semester 2015 and the Winter Semester 2016.

The University reserves the right to change without notice any information contained in this calendar, including fees, any rule or regulation pertaining to the standards for admission to, the requirements for the continuation of study in, and the requirements for the granting of degrees or diplomas in any or all of its programs. The publication of information in this calendar does not bind the University to the provision of courses, programs, schedules of studies, or facilities as listed herein.

The University will not be liable for any interruption in, or cancellation of, any academic activities as set forth in this calendar and related information where such interruption is caused by fire, strike, lock-out, inability to procure materials or trades, restrictive laws or governmental regulations, actions taken by faculty, staff or students of the University or by others, civil unrest or disobedience, public health emergencies, or any other cause of any kind beyond the reasonable control of the University.

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.

Statistics Canada - Notification of Disclosure

For further information, please see Statistics Canada's web site 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, his/her 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 his or her 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 in 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**

Table of Contents

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. A minimum of 23.50 credits must be obtained for the following programs: Biological Engineering, Engineering Systems and Computing, Environmental Engineering, Mechanical Engineering, and Water Resources Engineering. A minimum of 23.25 credits must be obtained for Biomedical Engineering. A minimum of 24.00 credits must be obtained for Computer Engineering. At least 3.00 credits must be complementary studies, which 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, obtaining a minimum of 23.50 credits for one of: Biological Engineering, Environmental Engineering, Mechanical Engineering, Engineering Systems and Computing Engineering; or 23.25 credits for Biomedical Engineering; or 24.00 credits for Computer Engineering, 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 Regular and Co-op

School of Engineering, College of Physical and Engineering Science

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
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 Regular or Co-op (Biological Engineering, Biomedical Engineering, Environmental Engineering, Water Resources Engineering)

CHEM*1050	[0.50]	General Chemistry II
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 2 Regular or Co-op (Computer Engineering, Engineering Systems and Computing)

CIS*2500	[0.50]	Intermediate Programming
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 2 Regular or Co-op (Mechanical Engineering)

ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Biomedical Engineering Program Regular and Co-op (BME/BME:C)

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CHEM*1050	[0.50]	General Chemistry II
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 3 - Regular or Co-op

BIOL*1070	[0.50]	Discovering Biodiversity
COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
One of:		
ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers
One of:		
ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

BIOL*1080	[0.50]	Biological Concepts of Health
BIOM*2000	[0.50]	Concepts in Human Physiology
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods
One of:		
ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers
One of:		
ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Note: Students pursuing the pharmaceutical series of electives may select ENGG*2660 in Semester 4. If ENGG*2660 is selected, students must select BIOM*2000 in semester 6 in place of a 0.50 restricted elective.

Semester 5 - Regular or Co-op

BIOM*3010	[0.50]	Biomedical Comparative Anatomy
ENGG*3170	[0.50]	Biomaterials
ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3390	[0.50]	Signal Processing
ENGG*3450	[0.50]	Electrical Devices

Semester 6 Regular / Semester 7 Co-op

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

1.00 restricted electives

Semester 7 Regular / Semester 6 Co-op

ENGG*4390	[0.75]	Bio-instrumentation Design

2.00 restricted electives

Semester 8 (Winter) - Regular or Co-op

ENGG*4180	[1.00]	Biomedical Engineering Design IV

1.75 restricted electives

Restricted Electives (see Program Guide for more information)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 0.75 credits in Biomedical Engineering design electives
- 2.00 credits in Biomedical Engineering electives

Biological Engineering Program Regular and Co-op (BIOE/BIOE:C)

School of Engineering, College of Physical and Engineering Science

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 relates to the control of technological processes with the aim of enhancing human, animal and plant life. The program encompasses the technologies of biotechnology, waste management, food engineering, and ergonomics. For example, a Biological Engineer concentrating on biotechnology might design and manage bioreactors to improve their productivity. A career in Biomedical Engineering, which requires graduate work beyond the Bachelor's degree, involves designing instruments and diagnostic techniques to be used in the practice of medicine, developing prosthetic devices, and applying engineering techniques to the study of physiological systems.

Major (Honours Program)

Semester 1 - Regular or Co-op

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
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CHEM*1050	[0.50]	General Chemistry II
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 3 - Regular or Co-op

COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2160	[0.50]	Engineering Mechanics II
ENGG*2400	[0.50]	Engineering Systems Analysis
MATH*2270	[0.50]	Applied Differential Equations
One of:		
BIOL*1070	[0.50]	Discovering Biodiversity
BIOL*1090	[0.50]	Introduction to Molecular and Cellular Biology
One of:		
ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers
One of:		
ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

BIOC*2580	[0.50]	Introduction to Biochemistry
ENGG*2450	[0.50]	Electric Circuits
ENGG*2660	[0.50]	Biological Engineering Systems I
MATH*2130	[0.50]	Numerical Methods
One of:		
ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers
One of:		
ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Semester 5 - Regular or Co-op

BIOL*1080	[0.50]	Biological Concepts of Health
ENGG*3160	[0.50]	Biological Engineering Systems II
ENGG*3170	[0.50]	Biomaterials
ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3450	[0.50]	Electrical Devices

Semester 6 Regular / Semester 7 Co-op

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

1.00 restricted electives

Semester 7 Regular / Semester 6 Co-op

ENGG*4390	[0.75]	Bio-instrumentation Design

2.75 restricted electives

Semester 8 (Winter) - Regular or Co-op

ENGG*4110	[1.00]	Biological Engineering Design IV
ENGG*4280	[0.75]	Digital Process Control Design

1.00 restricted electives

Restricted Electives (see Program Guide for more information)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements.

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 0.75 credits in required Design electives
- 1.00 credits in Biological Engineering electives
- 1.00 credits in Free electives

Computer Engineering Program Regular and Co-op (CENG/CENG:C)

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CIS*2500	[0.50]	Intermediate Programming
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism
PHYS*1130	[0.50]	Physics with Applications
One of:		
ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 3 - Regular or Co-op

CIS*2430	[0.50]	Object Oriented Programming
CIS*2520	[0.50]	Data Structures
CIS*2910	[0.50]	Discrete Structures in Computing II
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

Semester 4 - Regular or Co-op

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
STAT*2120	[0.50]	Probability and Statistics for Engineers

0.50 restricted electives (CIS*2750 for the software engineering stream

Semester 5 - Regular or Co-op

ENGG*2120	[0.50]	Material Science
ENGG*3240	[0.50]	Engineering Economics
ENGG*3450	[0.50]	Electrical Devices
ENGG*3640	[0.50]	Microcomputer Interfacing

1.00 restricted electives

Semester 6 - Regular / Semester 7 - Co-op

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 - Regular / Semester 6 - Co-op

ENGG*4080	[0.50]	Micro and Nano-Scale Electronics
ENGG*4420	[0.75]	Real-time Systems Design
ENGG*4450	[0.50]	Large-Scale Software Architecture Engineering

1.00 restricted electives

Semester 8 - Regular or Co-op

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)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements

- 2.00 credits in Complimentary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list)
- 2.00 credits in Computer engineering electives.

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

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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
One of:
ENGG*1210 [0.50] Engineering Mechanics I
HIST*1250 [0.50] Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CIS*2500 [0.50] Intermediate Programming
ENGG*1500 [0.50] Engineering Analysis
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
PHYS*1130 [0.50] Physics with Applications
One of:
ENGG*1210 [0.50] Engineering Mechanics I
HIST*1250 [0.50] Science and Technology in a Global Context

Semester 3 - Regular or Co-op

CIS*2430 [0.50] Object Oriented Programming
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
One of:
ENGG*2100 [0.75] Engineering and Design II
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
ENGG*2120 [0.50] Material Science
ENGG*2230 [0.50] Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

CIS*3110 [0.50] Operating Systems I
ENGG*2450 [0.50] Electric Circuits
MATH*2130 [0.50] Numerical Methods
0.50 restricted electives
One of:
ENGG*2100 [0.75] Engineering and Design II
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
ENGG*2120 [0.50] Material Science
ENGG*2230 [0.50] Fluid Mechanics

Semester 5 - Regular or Co-op

CIS*2520 [0.50] Data Structures
ENGG*3260 [0.50] Thermodynamics
ENGG*3390 [0.50] Signal Processing
ENGG*3450 [0.50] Electrical Devices
ENGG*3640 [0.50] Microcomputer Interfacing
0.50 restricted electives

Semester 6 - Regular / Semester 7 - Co-op

ENGG*3100 [0.75] Engineering and Design III
ENGG*3410 [0.50] Systems and Control Theory
ENGG*3430 [0.50] Heat and Mass Transfer
1.00 or 1.25 restricted electives

Semester 7 - Regular / Semester 6 - Co-op

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 8 - Regular or Co-op

ENGG*4120 [1.00] Engineering Systems and Computing Design IV
ENGG*4280 [0.75] Digital Process Control Design
1.00 electives

Restricted Electives (see Program Guide for more information)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements.

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 1.50 credits in ES&C Engineering electives
- 0.75 credits in ES&C Engineering Design electives

Environmental Engineering Program Regular and Co-op (ENVE/ENVE:C)

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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
One of:
ENGG*1210 [0.50] Engineering Mechanics I
HIST*1250 [0.50] Science and Technology in a Global Context

Note: ENGG*1210 or HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CHEM*1050 [0.50] General Chemistry II
ENGG*1500 [0.50] Engineering Analysis
MATH*1210 [0.50] Calculus II
PHYS*1130 [0.50] Physics with Applications
One of:
ENGG*1210 [0.50] Engineering Mechanics I
HIST*1250 [0.50] Science and Technology in a Global Context

Semester 3 - Regular or Co-op

COOP*1100 [0.00] Introduction to Co-operative Education
ENGG*2400 [0.50] Engineering Systems Analysis
MATH*2270 [0.50] Applied Differential Equations
0.50 restricted electives
One of:
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
MICR*2420 [0.50] Introduction to Microbiology
One of:
ENGG*2100 [0.75] Engineering and Design II
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
ENGG*2120 [0.50] Material Science
ENGG*2230 [0.50] Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

ENGG*2450 [0.50] Electric Circuits
ENGG*2560 [0.50] Environmental Engineering Systems
MATH*2130 [0.50] Numerical Methods
One of:
ENGG*2100 [0.75] Engineering and Design II
STAT*2120 [0.50] Probability and Statistics for Engineers
One of:
ENGG*2120 [0.50] Material Science
ENGG*2230 [0.50] Fluid Mechanics
0.50 restricted electives

Semester 5 - Regular or Co-op

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

0.50 restricted electives

Semester 6 Regular / Semester 7 Co-op

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3220	[0.50]	Groundwater Engineering
ENGG*3410	[0.50]	Systems and Control Theory
ENGG*3430	[0.50]	Heat and Mass Transfer
ENGG*3470	[0.50]	Mass Transfer Operations

0.50 restricted electives

Semester 7 Regular / Semester 6 Co-op

ENGG*3670	[0.50]	Soil Mechanics
ENGG*4330	[0.75]	Air Pollution Control
ENGG*4340	[0.50]	Solid and Hazardous Waste Management
ENGG*4370	[0.75]	Urban Water Systems Design

0.50 restricted electives

Semester 8 - Regular or Co-op

ENGG*4130	[1.00]	Environmental Engineering Design IV
ENGG*4260	[0.75]	Water and Wastewater Treatment Design

1.00 restricted electives

Restricted Electives (see Program Guide for more information)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements.

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 1.50 credits in Environmental Engineering electives

Minor (Honours Program)

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

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

BIOC*2580	[0.50]	Introduction to Biochemistry
CHEM*3360	[0.50]	Environmental Chemistry and Toxicology
ENGG*3180	[0.50]	Air Quality
ENGG*3590	[0.50]	Water Quality
ENGG*4260	[0.75]	Water and Wastewater Treatment Design
GEOG*1300	[0.50]	Introduction to the Biophysical Environment
MICR*1020	[0.50]	Fundamentals of Applied Microbiology
MICR*4180	[0.50]	Microbial Processes in Environmental Management

One of:

ENGG*2560	[0.50]	Environmental Engineering Systems
ENGG*2660	[0.50]	Biological Engineering Systems I

One of:

ENGG*3470	[0.50]	Mass Transfer Operations
ENGG*4330	[0.75]	Air Pollution Control
ENGG*4340	[0.50]	Solid and Hazardous Waste Management

Students must incorporate an environmental application as part of their capstone design course worth 1.00 credits in the final semester of their B.Eng major program.

Food Engineering (FENG)

School of Engineering, College of Physical and Engineering Science

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*2220	[0.50]	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
MICR*1020	[0.50]	Fundamentals of Applied Microbiology

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 Regular and Co-op (MECH/MECH:C)

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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

One of:

ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: One of ENGG*1210 and HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1010	[0.50]	Introductory Electricity and Magnetism
PHYS*1130	[0.50]	Physics with Applications

One of:

ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 3 - Regular or Co-op

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

One of:

ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

ENGG*2180	[0.50]	Introduction to Manufacturing Processes
ENGG*2340	[0.50]	Kinematics and Dynamics
ENGG*2450	[0.50]	Electric Circuits
MATH*2130	[0.50]	Numerical Methods

One of:

ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Semester 5 - Regular or Co-op

ENGG*3140	[0.50]	Mechanical Vibration
ENGG*3240	[0.50]	Engineering Economics
ENGG*3260	[0.50]	Thermodynamics
ENGG*3280	[0.75]	Machine Design
ENGG*3510	[0.50]	Electromechanical Devices

0.50 restricted electives

Semester 6 - Regular / Semester 7 - Co-op

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 - Regular / Semester 6 - Co-op

2.50 restricted electives

Semester 8 - Regular or Co-op

ENGG*4160	[1.00]	Mechanical Engineering Design IV

2.25 restricted electives

Restricted Electives (see Program Guide for more information)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements.

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 0.75 credits in Mechanical Engineering Design electives.
- A minimum of 3.50 credits in Mechanical Engineering electives. Specific credit requirements vary by the mechanical engineering design elective chosen. Please consult the Program Guide for further information on the prerequisite requirements specific to each mechanical engineering design elective.

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

School of Engineering, College of Physical and Engineering Science

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 - Regular or Co-op

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

One of:

ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Note: One of ENGG*1210 and HIST*1250 must be taken in semester 1; the remaining course must be taken in semester 2.

Semester 2 - Regular or Co-op

CHEM*1050	[0.50]	General Chemistry II
ENGG*1500	[0.50]	Engineering Analysis
MATH*1210	[0.50]	Calculus II
PHYS*1130	[0.50]	Physics with Applications

One of:

ENGG*1210	[0.50]	Engineering Mechanics I
HIST*1250	[0.50]	Science and Technology in a Global Context

Semester 3 - Regular or Co-op

COOP*1100	[0.00]	Introduction to Co-operative Education
ENGG*2400	[0.50]	Engineering Systems Analysis
GEOG*2000	[0.50]	Geomorphology
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

One of:

ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Note: ENGG*2100 or STAT*2120 must be taken in semester 3; the remaining course must be taken in semester 4.

Note: ENGG*2120 or ENGG*2230 must be taken in semester 3; the remaining course must be taken in semester 4.

Semester 4 - Regular or Co-op

ENGG*2450	[0.50]	Electric Circuits
ENGG*2550	[0.50]	Water Management
ENGG*2560	[0.50]	Environmental Engineering Systems
MATH*2130	[0.50]	Numerical Methods

One of:

ENGG*2100	[0.75]	Engineering and Design II
STAT*2120	[0.50]	Probability and Statistics for Engineers

One of:

ENGG*2120	[0.50]	Material Science
ENGG*2230	[0.50]	Fluid Mechanics

Semester 5 - Regular or Co-op

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 - Regular / Semester 7 - Co-op

ENGG*3100	[0.75]	Engineering and Design III
ENGG*3220	[0.50]	Groundwater Engineering
ENGG*3430	[0.50]	Heat and Mass Transfer

1.50 restricted electives

Semester 7 - Regular / Semester 6 - Co-op

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 8 (Winter) Regular or Co-op

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)

A maximum of 1.50 credits at the 1000 level is allowed for elective requirements.

- 2.00 credits in Complementary Studies (Students need to take 0.50 credits from each of the three sub-lists noted in the Program Guide. The remaining 0.50 credits can be taken from any Complementary Studies sub-list.)
- 1.00 credits in Water Resources Engineering electives
- 0.50 credits in Environmental Resources electives
- 0.50 credits in Water Resources electives