

2009-2010 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2009-2010 academic year, including the Summer Semester 2009, the Fall Semester 2009 and the Winter Semester 2010.

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.

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Disclaimer

University of Guelph 2009

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2009-2010 academic year, including the Summer Semester 2009, the Fall Semester 2009 and the Winter Semester 2010.

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.

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Published by: Undergraduate Program 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 Undergraduate Program 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 <http://www.uoguelph.ca/policies/pdf/ORSInfoReleasePolicy060610.pdf>.

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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 systems and computing, biological, mechanical, 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 with the exception of Mechanical Engineering 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.

According to CEAB regulations, the Mechanical Engineering Program is not eligible for accreditation until the first class graduates in June 2013. However, due to the common core in all B.Eng. programs and the School's experience with the CEAB process, the School expects to achieve accreditation for the first class.

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. 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 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 associate 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 Semester II. However, if students in the Undeclared Stream are interested in the Engineering Systems and Computing Major, they need to decide 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.

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 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.

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 (i.e. be a Canadian citizen or a permanent resident in Canada)
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.

| Co-op Work Schedule | | | | | |
|---------------------|-------|-------|-------|-------|-------|
| | Yr. 1 | Yr. 2 | Yr. 3 | Yr. 4 | Yr. 5 |
| Fall | 1 | 3 | 5 | 6 | work |
| Winter | 2 | 4 | work | 7 | 8 |
| Spring | | work | work | work | |

All candidates must complete a minimum of 4 of the preceding 5 work terms.

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 |
| HIST*1250 | [0.50] | Science and Society Since 1500 |
| MATH*1200 | [0.50] | Calculus I |

Semester 2 Regular or Co-op (All Programs except Engineering Systems and Computing)

| | | |
|-----------|--------|-------------------------|
| 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*1130 [0.50] Physics with Applications
Semester 2 Regular or Co-op (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 |
| PHYS*1130 | [0.50] | Physics with Applications |

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 |
| HIST*1250 | [0.50] | Science and Society Since 1500 |
| MATH*1200 | [0.50] | Calculus I |

Semester 2 - Regular or Co-op

| | | |
|-----------|--------|---------------------------|
| 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*1130 | [0.50] | Physics with Applications |

Semester 3 - Regular or Co-op

| | | |
|-----------|--------|--|
| 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 |

One of:

| | | |
|-----------|--------|--------------------------------------|
| BIOL*1030 | [0.50] | Biology I |
| MICR*1020 | [0.50] | Fundamentals of Applied Microbiology |

Semester 4 - Regular or Co-op

| | | |
|-----------|--------|--|
| BIOC*2580 | [0.50] | Introductory Biochemistry |
| ENGG*2230 | [0.50] | Fluid Mechanics |
| ENGG*2450 | [0.50] | Electric Circuits |
| ENGG*2660 | [0.50] | Biological Engineering Systems I |
| MATH*2130 | [0.50] | Numerical Methods |
| STAT*2120 | [0.50] | Probability and Statistics for Engineers |

Semester 5 - Regular or Co-op

| | | |
|-----------|--------|-----------------------------------|
| 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 |

One of:

| | | |
|-----------|--------|------------|
| BIOL*1040 | [0.50] | Biology II |
|-----------|--------|------------|

0.50 restricted electives

Note: Students select 0.50 restricted electives in Semester 5 if MICR*1020 was selected in Semester 3. If BIOL*1030 was selected in Semester 3, then students must select BIOL*1040 in Semester 5 in place of the 0.50 restricted elective.

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
- 1.50 credits in Free electives

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:

| | | |
|-----------|--------|--|
| BIOC*2580 | [0.50] | Introductory Biochemistry |
| BUS*2220 | [0.50] | Financial Accounting |
| 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.

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 |
| HIST*1250 | [0.50] | Science and Society Since 1500 |
| MATH*1200 | [0.50] | Calculus I |

Semester 2 - Regular or Co-op

| | | |
|-----------|--------|--|
| 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 |
| PHYS*1130 | [0.50] | Physics with Applications |

Semester 3 - Regular or Co-op

| | | |
|-----------|--------|--|
| CIS*2430 | [0.50] | Object Oriented Programming |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| ENGG*2100 | [0.75] | Engineering and Design II |
| ENGG*2120 | [0.50] | Material Science |
| 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

CIS*3110 [0.50] Operating Systems

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

0.50 restricted electives

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

HIST*1250 [0.50] Science and Society Since 1500

MATH*1200 [0.50] Calculus I

Semester 2 - Regular or Co-op

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*1130 [0.50] Physics with Applications

Semester 3 - Regular or Co-op

COOP*1100 [0.00] Introduction to Co-operative Education

ENGG*2100 [0.75] Engineering and Design II

ENGG*2120 [0.50] Material Science

ENGG*2400 [0.50] Engineering Systems Analysis

MATH*2270 [0.50] Applied Differential Equations

0.50 restricted electives

One of:

BIOL*1030 [0.50] Biology I

MICR*1020 [0.50] Fundamentals of Applied Microbiology

Semester 4 - Regular or Co-op

ENGG*2230 [0.50] Fluid Mechanics

ENGG*2450 [0.50] Electric Circuits

ENGG*2560 [0.50] Environmental Engineering Systems

MATH*2130 [0.50] Numerical Methods

STAT*2120 [0.50] Probability and Statistics for Engineers

One of:

BIOL*1040 [0.50] Biology II

0.50 restricted electives

Note: Students select 0.50 restricted electives in Semester 4 if MICR*1020 was selected in Semester 3. If BIOL*1030 was selected in Semester 3, then students must select BIOL*1040 in Semester 4 in place of the 0.50 restricted elective.

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*3410 [0.50] Systems and Control Theory

ENGG*3430 [0.50] Heat and Mass Transfer

ENGG*3470 [0.50] Mass Transfer Operations

1.00 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

GEOL*3060 [0.50] Groundwater

0.50 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 (if BIOL*1030 is selected in Semester 3, then BIOL*1040 must be selected from the list in the Program Guide).

Minor (Honours Program)

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

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

| | | |
|-----------|--------|---|
| BIOC*2580 | [0.50] | Introductory 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.

Mechanical Engineering Program Regular and Co-op (MECH/MECH:C)**School of Engineering, College of Physical and Engineering Science**

Mechanical Engineering is the most general of all engineering disciplines. 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. The program is built around concepts of sustainability and sustainable design to equip graduates to tackle these issues in the workplace.

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 Society Since 1500 |

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 Society Since 1500 |

Semester 3 - Regular or Co-op

| | | |
|-----------|--------|--|
| 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 |
| ENGG*3240 | [0.50] | Engineering Economics |
| MATH*2270 | [0.50] | Applied Differential Equations |

Semester 4 - Regular or Co-op

| | | |
|-----------|--------|--|
| 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 |

0.50 restricted electives

Semester 5 - Regular or Co-op

| | | |
|-----------|--------|--|
| ENGG*2410 | [0.50] | Digital Systems Design Using Descriptive Languages |
| ENGG*3260 | [0.50] | Thermodynamics |
| ENGG*3280 | [0.75] | Machine Design |
| ENGG*3450 | [0.50] | Electrical Devices |
| ENGG*3510 | [0.50] | Electromechanical Devices |

0.50 restricted electives

Semester 6 - Regular / Semester 7 - Co-op

| | | |
|-----------|--------|-----------------------------------|
| ENGG*1070 | [0.25] | Occupational Health and Safety |
| 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 |

0.50 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 |
| HIST*1250 | [0.50] | Science and Society Since 1500 |
| MATH*1200 | [0.50] | Calculus I |

Semester 2 - Regular or Co-op

| | | |
|-----------|--------|---------------------------|
| 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*1130 | [0.50] | Physics with Applications |

Semester 3 - Regular or Co-op

| | | |
|-----------|--------|--|
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| ENGG*2100 | [0.75] | Engineering and Design II |
| ENGG*2120 | [0.50] | Material Science |
| ENGG*2400 | [0.50] | Engineering Systems Analysis |
| GEOG*2000 | [0.50] | Geomorphology |
| MATH*2270 | [0.50] | Applied Differential Equations |
| MICR*1020 | [0.50] | Fundamentals of Applied Microbiology |

Semester 4 - Regular or Co-op

| | | |
|-----------|--------|--|
| ENGG*2230 | [0.50] | Fluid Mechanics |
| 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 |
| STAT*2120 | [0.50] | Probability and Statistics for Engineers |

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*3430 | [0.50] | Heat and Mass Transfer |
| GEOL*3060 | [0.50] | Groundwater |

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